MUMBAI METRO RAIL CORPORATION LIMITED
(A JV company of Govt. of India and Govt. of Maharashtra)
5th Floor, A - Wing, Old MMRDA Building, Bandra-Kurla Complex, Bandra (E), Mumbai- 400 051.
MMRC e-Tendering portal: www.tenderwizard.com/MMRC
Website: www.mmrcl.com

Invitation of Bid For, "Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

Date: [15th December 2017]
Contract No: [MM3-CBS-DEM]

Sr. No	Reference Clause no. and Description	Existing content to be deleted	To be replaced as
1	Volume1,Section 1, NIT Clause 1.1.2 KEY DETAILS, Page 1 of 10	1**.1.2 KEY DETAILS:** Approximate Cost of work = INR 69,67,05,672/	1**.1.2 KEY DETAILS:** Approximate Cost of work = **INR 61,99,92,389/-**

2	Volume1,Section 1, **NIT** Clause 1.1.2 **KEY DETAILS**, Page 1 & 2 of 10 Refer, Addendum-4, Sr. No-1	**Tender Security amount**	INR 70,00,000/-	**Tender Security amount**	INR62,00,000/-
		Revenue operation date	September 2020	**Revenue operation date**	30 June 2021
		Tender documents on sale	From 24-07-2017 to 18-12-2017 (up to 18:00Hrs) on e-tendering website www.tenderwizard.com/MMRC Tender Documents can be downloaded for reference purpose from the e-Tendering Portal www.tenderwizard.com/MMRC. Interested Bidders have to make online payment of Tender Fee using online payment gateway during bid preparation through Debit Card/ Credit Card/ Net-Banking. Tender Fee receipt can be system generated during bid preparation by the Bidder. For further information on this regard bidders are advised to contact on +91-7666563870, +91-7980042472, +9180-49352000 & on E-mail ID – twhelpdesk358@gmail.com	Tender documents on sale	From 24-07-2017 to 16-01-2018 (up to 18:00Hrs) on e-tendering website www.tenderwizard.com/MMRC Tender Documents can be downloaded for reference purpose from the e-Tendering Portal www.tenderwizard.com/MMRC. Interested Bidders have to make online payment of Tender Fee using online payment gateway during bid preparation through Debit Card/ Credit Card/ Net-Banking. Tender Fee receipt can be system generated during bid preparation by the Bidder. For further information on this regard bidders are advised to contact on +91-7666563870, +91-7980042472, +9180-49352000 & on E-mail ID – twhelpdesk358@gmail.com
		Cost of Tender documents	INR 21,000/- (inclusive of all taxes)	Cost of Tender documents	INR 17796.61+18% GST (INR 21,000/-)
		Date & time of Submission of Tender	19-12-2017 up to 1800 Hrs.	Date & time of Submission of Tender	17-01-2018 up to 1800 Hrs.
		Date & time of opening of Tender (Tender Security + Technical	20-12-2017 from 1100 Hrs.	Date & time of opening of Tender (Tender Security + Technical	18-01-2018 from 1100 Hrs.

3	Volume 1,Section 1 – Notice Inviting Tender (NIT) 1.1.3.2 Minimum Eligibility Criteria : General Experience Page 4 of 10	A. General Experience: (i) At least one "similar work" ** of value of INR 56.0 Crores or more. OR (ii) Two "similar works" ** each of value of INR 35.0 Crores or more. OR (iii) Three "similar works" ** each of value of INR 28.0 Crores or more.	A. General Experience: (i) At least one "similar work" ** of value of INR 49.6 Crores or more. OR (ii) Two "similar works" ** each of value of INR 31.0 Crores or more. OR (iii) Three "similar works" ** each of value of INR 24.8 Crores or more.
4	Volume 1,Section 1 – Notice Inviting Tender (NIT) 1.1.3.2 Minimum Eligibility Criteria : Similar works: , Page 4 of 10 Sr. No 2 of Addendum -1	** "Similar works" for this contract shall be the work of "Design, Supply, Installation, Testing and Commissioning of E&M works of Metro Station / Metro Depot / Mass Rapid Transit System (MRTS) / Commercial Buildings / Official Buildings/ Railway Stations/ Airport/ Hospital buildings/ Industrial establishment. Such E&M work can as well be part of a larger contract. E&M works shall be defined as work containing HT&LT electrical Fire suppression & Detection and VAC components, out of which electrical component shall be not less than 60% of the stipulated value of required similar E&M work/s (i.e. 33.6 crores in case of one similar work or 21 crores in case of two similar works or 17.4 crores in case of three similar works).	** "Similar works" for this contract shall be the work of "Design, Supply, Installation, Testing and Commissioning of E&M works of Metro Station / Metro Depot / Mass Rapid Transit System (MRTS) / Commercial Buildings / Official Buildings/ Railway Stations/ Airport/ Hospital buildings/ Industrial establishment. Such E&M work can as well be part of a larger contract. E&M works shall be defined as work containing HT&LT electrical Fire suppression & Detection and VAC components, out of which electrical component shall be not less than 60% of the stipulated value of required similar E&M work/s (i.e**. 29.8 crores in case of one similar work or 18.6 crores in case of two similar works or 14.9 crores in case of three similar works).**
5	Volume 1,Section 1 – Notice Inviting Tender (NIT) 1.1.3.2 Minimum Eligibility Criteria : Similar works: , Page 4 & 5 of 10 Sr. No 3 of Addendum -1	In case the work(s) listed under A (i), (ii) or (iii) do not include at least one work with VAC component of minimum value of Rs. 9.8 crores or more in case of single work or 6.1 crores or more , each in case of two works or 4.9 crores or more , each in case of 3 works respectively , then the tenderer should have executed any other work(s) containing Design, Supply, Installation, Testing and Commissioning of VAC work component of Large Complex/ Metro Station/ Mass Rapid Transit System/	In case the work(s) listed under A (i), (ii) or (iii) do not include at least one work with VAC component of minimum value of **Rs. 6.8 crores or more in case of single work or 4.3 crores or more , each in case of two works or 3.4 crores** or more , each in case of 3 works respectively , then the tenderer should have executed any other work(s) containing Design, Supply, Installation, Testing and Commissioning of VAC work component of Large Complex/ Metro Station/ Mass Rapid Transit

		Commercial Buildings/ Official Buildings/ Railway Stations/ Airport/ hospital buildings/ Industrial establishment of value Rs. 9.8 crores or more in case of single work or 6.1 crores or more, each in case of two works or 4.9 crores or more, each in case of 3 works respectively, **And** In case the work(s) listed under A (i),(ii) or (iii) do not include at least one work with Fire and Hydraulics System component of minimum value Rs. 7.2 crores or more in case of single work or 4.5 crores or more , each in case of two works or 3.6 crores or more, each in case of 3 works respectively, then the tenderer should have executed any other work containing Design, Supply, Installation, Testing and Commissioning of Fire and Hydraulics System of Large Complex/Metro Station/Mass Rapid Transit System/ Commercial Buildings/ Official Buildings/ Railway Stations/Airport/hospital buildings/ industrial establishment of value Rs. 7.2 crores or more in case of single work or 4.5 crores or more, each in case of two works or 3.6 crores or more, each in case of 3 works respectively **And** In case the work(s) listed under A (i),(ii) or (iii) do not include at least one Work with HT Sub-Station / Distribution Works With Transformer, 33KV GIS and 33KV Cables installation system component of minimum value Rs. 4.5 crores or more in case of single work or 2.8 Crores or more each in case of two works or 2.2 crores or more each in case of 3 works respectively, then the tenderer should have executed any other Work containing Design, Supply , Installation, Testing and Commissioning of HT Sub-Station / Distribution Works With Transformer, 33KV GIS and 33KV Cables Installation	System/ Commercial Buildings/ Official Buildings/ Railway Stations/ Airport/ hospital buildings / Industrial establishment of value **Rs.6.8 crores or more in case of single work or 4.3 crores or more, each in case of two works or 3.4 crore**s or more, each in case of 3 works respectively,, **And** In case the work(s) listed under A(i),(ii) or (iii) do not include at least one work with Fire and Hydraulics System component of minimum value **Rs. 7.6 crores or more in case of single work or 4.7 crores or more , each in case of two works or 3.8 crores** or more, each in case of 3 works respectively , then the tenderer should have executed any other work containing Design, Supply , Installation, Testing and Commissioning of Fire and Hydraulics System of Large Complex/Metro Station/Mass Rapid Transit System/ Commercial Buildings/ Official Buildings/ Railway Stations/Airport/hospital buildings/ industrial establishment of value **Rs. 7.6 crores or more in case of single work or 4.7 crores or more, each in case of two works or 3.8 crores** or more, each in case of 3 works respectively **And** In case the work(s) listed under A (i),(ii) or (iii) do not include at least one Work with HT Sub-Station / Distribution Works With Transformer, 33KV GIS and 33KV Cables installation system component of minimum value **Rs. 4.6 crores or more in case of single work or 2.8 crores or more each in case of two works or 2.3 crores or more each in case of 3 works respectively, then the tenderer/ Specialised subcontractor** should have executed any other Work containing Design, Supply , Installation, Testing and Commissioning of HT Sub-Station / Distribution Works With Transformer, 33KV

		System of Large Complex/Metro Station/Mass Rapid Transit System/ Commercial Buildings/ Official Buildings/ Railway Stations/Airport/ hospital buildings/ industrial establishment/ Power Distribution Utilities or Company of value Rs. 4.5 crores or more in case of single work or 2.8 crores or more , each in case of two works or 2.2 crores or more, each in case of 3 works respectively. Note: - The tenderer shall submit details of works executed by them in the Performa of Appendix 11 & 12 of FOT for the works to be considered for qualification of work experience criteria. Documentary proof such as completion certificates from client clearly indicating the nature/scope of work, actual completion cost and actual date of completion for such work should be submitted. Experience certificate of any person/official below the rank of Executive engineer will not be accepted as proof for Eligibility. The work, executed for private client will not be considered for eligibility evaluation For completed works, value of work done shall be updated to 31.03.2017 assuming 5% inflation for Indian Rupees every year and 2% for foreign currency portions per year. The exchange rate of foreign currency shall be applicable 28 days before the submission date of tender.	GIS and 33KV Cables Installation System of Large Complex/Metro Station/Mass Rapid Transit System/ Commercial Buildings/ Official Buildings/ Railway Stations/Airport/ hospital buildings/ industrial establishment/ Power Distribution Utilities or Company of value **Rs. 4.6 crores or more in case of single work or 2.8 crores or more each in case of two works or 2.3 crores or more each in case of 3 works respectively, then the tenderer/ Specialised subcontractor**. Note: - The tenderer shall submit details of works executed by them in the Performa of Appendix 11, **11-A (In case of Specialist Subcontractor work experience for HT GIS works)** & 12 of FOT for the works to be considered for qualification of work experience criteria. Documentary proof such as completion certificates from client clearly indicating the nature/scope of work, actual completion cost and actual date of completion for such work should be submitted. Experience certificate of any person/official below the rank of Executive engineer will not be accepted as proof for Eligibility. The work, executed for private client will not be considered for eligibility evaluation For completed works, value of work done **shall be as on date of tender submission** assuming 5% inflation for Indian Rupees every year and 2% for foreign currency portions per year. The exchange rate of foreign currency shall be applicable 28 days before the submission date of tender.

6	Volume-1, Section -1 NIT, Clause 1.1.3.2- B Financial Standing page 6 of 10 **T4: Annual turnover**	**(iv) T4: Annual Turnover:** The average annual turnover of last five financial years should be > 38 Crores.	**(iv) T4: Annual Turnover:** The average annual turnover of last five financial years should be > 34 **Crores.**
7	Volume1,Section 1:NIT 1.1.3.3 Bid Capacity Criteria: Page 7 of 10	B = Value of existing commitments (as on 31.07.2017) for on-going works during period of 22 months w.e.f. 31.07.2017. Appendix 15 of FOT. & Notes 1st paragraph Value of existing commitments for on-going construction works during period of 22 months w.e.f. 31.03.2017 has to be submitted by the tenderer in APPENDIX 15 OF FOT. These data shall be certified by the Chartered Accountant with his stamp and signature.	B = Value of existing commitments **(as on 31.12.2017)** for on-going works during period of 22 months w.e.f. **31.12.2017**. Appendix 15 of FOT. Notes 1st paragraph Value of existing commitments for on-going construction works during period of 22 months w.e.f**. 31.12.2017** has to be submitted by the tenderer in APPENDIX 15 OF FOT. These data shall be certified by the Chartered Accountant with his stamp and signature.
8	Volume1,Section 1:NIT 1.1.8 B) e-Envelope 'B' (Financial Bid) Payment Procedure for Tender Fee and Tender security .ii Tender Security amount Page 9 of 10	Tender Security amount for this work will be INR 70, 00,000/- (Rupees Seventy Lakhs only). The Tenderer shall submit with his Tender a Tender Security for the sum mentioned in NIT in the following forms	Tender Security amount for this work will be INR **62,00,000/- (Rupees Sixty Two Lakhs only).** The Tenderer shall submit with his Tender a Tender Security for the sum mentioned in NIT in the following forms
9	Volume-1, Section -II ITT, Clause C 2.2 (l) Page 13 of 70		Add (l)-1 Appendix 11A to the Form of Tender-specialised Subcontractor Experience for HT GIS works

9	Volume-1, Section -II ITT, Clause C 2.2 (y) Page 13 of 70	(First Paragraph only) Annexure 3 to ITT – The tenderer may submit minor deviations in this annexure and a confirmation that price of every such minor deviation has been given in the financial package. Minor deviation may be in the employer's requirements or in any other tender requirement which do not alter the basic functionality of the work or part thereof. If there is no such minor deviation, then the tender must write "NIL" in this annexure. Tenderer to note that such minor deviations may or may not be accepted by the employer and the tenderer shall not have any right to any claim on this account. The offer in pricing document shall be given without considering any deviation in tender conditions.	(First Paragraph only) Annexure 3 to ITT – The tenderer may submit minor deviations in this annexure and a confirmation that price of every such minor deviation has been given in the financial package. Minor deviation may be in the employer's requirements or in any other tender requirement which do not alter the basic functionality of the work or part thereof. If there is no such minor deviation, then the tender must write "NIL" in this annexure. Tenderer to note that such minor deviations may or may not be accepted by the employer and the tenderer shall not have any right to any claim on this account. The offer in pricing document shall be given **while** considering any deviation in tender conditions **and shall mention cost of withdrawal of deviation in Appendix-A to Annexure-4 of ITT**
10	Volume1,Section II ITT :Clause C-2.3 (ii-b)	Value of the commitments and on-going works, on a yearly basis, to be completed during the period of 22 months w.e.f 31.07.2017.	Value of the commitments and on-going works, on a yearly basis, to be completed during the period of 22 months w.e.f **31.12.2017.**
11	Volume1,Section II ITT :Clause C-18 Tender Security sub clause C 18.1 page 21 of 70	Tender Security amount for this work will be Rs. 70,00,000/- (Rupees Seventy Lakhs only). The Tenderer shall submit with his Tender a Tender Security for the sum mentioned in NIT in the following forms	Tender Security amount for this work will be Rs. **62,00,000/- (Rupees Sixty Two Lakhs only).** The Tenderer shall submit with his Tender a Tender Security for the sum mentioned in NIT in the following forms:
12	Volume-1, Section – III FOT, Appendix-1 &11	APPENDIX 1 – REQUIREMENTS UNDER GENERAL CONDITIONS OF CONTRACT (GCC)	APPENDIX 1 – REQUIREMENTS UNDER GENERAL CONDITIONS OF CONTRACT (GCC) Revised Refer Attachment-13 to Addendum-5
13	Volume-1, Section – III FOT, Appendix-11A	APPENDIX- 11 WORK EXPERIENCE	APPENDIX- 11 WORK EXPERIENCE Revised Refer Attachment-1a to Addendum-5 & **Add** Appendix-11A Specialist Sub-Contractor Work

			Experience for HT-GIS works only. Refer Attachment-1b to Addendum-5
14	Volume-1, Section – III FOT, Appendix-11A	APPENDIX 13 - FINANCIAL DATA (FINANCIAL STANDING) APPENDIX 14 - FINANCIAL DATA (WORKDONE) APPENDIX 15 – WORKS IN HAND	APPENDIX 13 - FINANCIAL DATA (FINANCIAL STANDING) Revised APPENDIX 14 - FINANCIAL DATA (WORKDONE) Revised APPENDIX 15 – WORKS IN HAND Revised Refer Attachment-14 to Addendum-5
15	Volume-1I, Section – IV GCC Clause-17.9 (a) Arbitration page 69 of 71	Clause 17.9 (a)-Arbitration (a) Matters to be arbitrated upon shall be referred to a sole Arbitrator if the total value of the claim is up to Rs.5 million and to a panel of three Arbitrators if total value of claims is more than **Rs.5 million.** The Employer shall provide a panel of three arbitrators **which may also include MMRC officers** for the claims up to **Rs.5 million** and a panel of five Arbitrators **which may also include MMRC officers** for claims of more than **Rs.5 million**. The Contractor shall have to choose the sole Arbitrator from the panel of three and/or one Arbitrator from the panel of five in case three Arbitrators are to be appointed. The Employer shall also choose one Arbitrator from this panel of five and the two so chosen will choose the third arbitrator from the panel only. . The Arbitrator(s) shall be appointed within a period of 30 days from the date of receipt of written notice/ demand of appointment of Arbitrator from either party. Neither party shall be limited in the proceedings before such arbitrator(s) to the evidence nor did arguments put before the Engineer for the purpose of obtaining his decision. No decision given by the Engineer in accordance with the foregoing provisions shall	Clause 17.9 (a)-Arbitration (a) Matters to be arbitrated upon shall be referred to a sole Arbitrator if the total value of the claim is up to Rs.50Lakhs and to a panel of three Arbitrators if total value of claims is more than **Rs.50 Lakhs**. The Employer shall provide a panel of three arbitrators for the claims up to **Rs.50 Lakhs** and a panel of five Arbitrators for claims of more than **Rs.50 Lakhs.** The Contractor shall have to choose the sole Arbitrator from the panel of three and/or one Arbitrator from the panel of five in case three Arbitrators are to be appointed. The Employer shall also choose one Arbitrator from this panel of five and the two so chosen will choose the third arbitrator from the panel only. The Arbitrator(s) shall be appointed within a period of 30 days from the date of receipt of written notice/ demand of appointment of Arbitrator from either party. Neither party shall be limited in the proceedings before such arbitrator(s) to the evidence nor did arguments put before the Engineer for the purpose of obtaining his decision. No decision given by the Engineer in accordance with the foregoing provisions shall disqualify him from being called as a witness and giving evidence before the

		disqualify him from being called as a witness and giving evidence before the arbitrator(s) on any matter, whatsoever, relevant to dispute or difference referred to arbitrator/s. The arbitration proceedings shall be held in Mumbai only. The language of proceedings that of documents and communication shall be English.	arbitrator(s) on any matter, whatsoever, relevant to dispute or difference referred to arbitrator/s. The arbitration proceedings shall be held in Mumbai only. The language of proceedings that of documents and communication shall be English.
16	Volume 3 Employers Requirement General Specification MANAGEMENT PLANS AND SUBMISSIONS Page 25 of 166		**Add** **3.1.4 Project Management Information System (PMIS)** The Contractor shall devise and utilise a PMIS provided by the Employer such that all documents generated by the Contractor can be transmitted to the PM by electronic means (and vice versa) and that all documents generated by either party are electronically captured at the point of origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the PM's office at site and the Employer's Office by the Contractor. The number of copies and format of the required document submissions are detailed in Annex A1, **Refer Attachment-2 to Addendum-5.** The Transmittal Form and the Document Submission Report (DSR) forms are located in Appendix-7. (Revised).

17	Volume 3 Employers Requirement General Specification -18 HEALTH AND SAFETY page 142 of 166	18. HEALTH AND SAFETY 18.1 Health and Safety Philosophy 18.1.1 The health, safety and welfare of all personnel working on the Project, the general public and the avoidance of damage to property are of paramount importance to the Employer. Prime consideration shall be paid to construction activities to ensure that all operations shall be conducted in such a manner as to eliminate the risks to persons and property. The Contractor shall treat safety measures as the first priority in all his activities with respect to executing the Works. 18.1.2 The Contractor will be issued with the following MMRC documents: Corporate Safety Standards, Safety Policy, Safety Plan, Safety Procedure Rule Book and Joint Operating Procedure as they become available. These documents set out the minimum standards to be achieved by the Contractor but do not relieve the Contractor of his liabilities and obligations under the Enactment. Where there is a discrepancy in the documents, the higher or stricter standards shall be applied. For contents, refer to Appendix-17 of this specification.	18 – OCCUPATION, HEALTH, SAFETY AND ENVIRONMENT (OHS&E). (Revised) Refer Attachment No-3 to Addendum-5
18	Volume-3-Employer's Requirement General Specification-Appendix -7 QUALITY ASSURANCE FORM	Appendix – 7 QUALITY ASSURANCE FORM	Appendix – 7 QUALITY ASSURANCE FORM. (Revised) Refer:-Attachment No-4 to Addendum 5

19	Volume 3 of 6 , General Specification APPENDIX-17 OHS&E MANUAL – SAFETY AND HEALTH 7,	APPENDIX-17 OHS&E MANUAL – SAFETY AND HEALTH clause 3.1.3 last sentence “The level of fines to be levied will set out in the Conditions of Contract.”	APPENDIX-17 OHS&E MANUAL – SAFETY AND HEALTH clause 3.1.3 last sentence “The level of fines to be levied is attached in Annex A of this document”.
20	Volume 3 of 6 , General Specification APPENDIX-17 OHS&E MANUAL – SAFETY AND HEALTH,		Add Annexure-A – To Appendix-17 OSH&E Penalties Refer:- Attachment No-5 to Addendum-5
21	Volume 3 Employers Requirement General Specification APPENDIX 28 - LIST OF APPROVED MANUFACTURERS / SUPPLIERS or MAKES AND MATERIAL FOR E&M WORK Sr. No 30 addendum -1	APPENDIX 28 - LIST OF APPROVED MANUFACTURERS / SUPPLIERS or MAKES AND MATERIAL FOR E&M WORK. (Revised) Ref.- Attachment No.10)	APPENDIX 28 - LIST OF APPROVED MANUFACTURERS / SUPPLIERS or MAKES AND MATERIAL FOR E&M WORK. (Revised) R2 Refer:- Attachment-6 to Addendum-5
22	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no 3.1, para-3, The scope of work includes SITC of all equipment, cables, ancillary equipment, Auxiliary Substation contained within each ASS premises. Laying and termination of 33kv cables from Aarey Substation GIS (provided by power supply contractor) to **ASS2 & ASS1** GISs respectively. Identify the Trenches and duct requirements to Depot Civil Contractor.	Clause no 3.1, para-3, The scope of work includes SITC of all equipment, cables, ancillary equipment, Auxiliary Substation contained within each ASS premises. Laying and termination of 33kv cables from Aarey Substation GIS (provided by power supply contractor) to **ASS-1 & ASS-2** GISs respectively. Identify the Trenches and duct requirements to Depot Civil Contractor.

23	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no 3.2.1.1 (d) Interfacing with **Substation Automation System** (provided by Power Supply System Contractor) for all the ASSs under DEM contract.	Clause no 3.2.1.1 (d) Interfacing with **Power Supply SCADA** (provided by Power Supply System Contractor) for all the ASSs under DEM contract.
24	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no 3.2.1.1 (f) 2nos battery chargers each rated for 100% capacity and one battery bank rated for 100% capacity of batteries.	Clause no 3.2.1.1 (f) 2 nos battery chargers each rated for 100% capacity and one battery bank rated for 100% capacity of batteries located in ASS-1 & ASS-2 respectively.
25	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 3.2.1.3 Internal & External cabling of 33kV cables including termination from Aarey Station to ASS-2 & ASS-1 at Depot respectively.	Clause no.3.2.1.3 Internal & External cabling of 33kV cables including termination from Aarey Station to **ASS-1 & ASS-2** at Depot respectively.
26	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 3.2.1.3 (a). Supply and installation of 33KV cables from Aarey Station (ASS) 33kV GIS to auxiliary transformers in the ASS-2 then the loop extended to ASS-1 respectively along with associated cable trays and cable supports with associated minor civil works.	Clause no. 3.2.1.3 (a). Supply and installation of 33KV cables from Aarey Station (ASS) 33kV GIS to 33kV GIS in ASS-1 then the loop shall be extended to ASS-2 along with associated cable trays and cable supports with associated minor civil works.

27	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 3.2.2.1 (a) Two RTUs and associated communications equipment for each RTUs for Depot ASSs will be provided by the PSS / OCS contractor.	Clause no. 3.2.2.1 (a) **One** RTUs and associated communications equipment for each **ASS in Depot** will be provided by the PSS / OCS contractor.
28	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 3.5.3 As preparatory work prior to installation, the location and position of supporting fittings, rigid conductor rail and anchoring shall be verified and marked at site. Height of the tunnel from top of rail at various locations shall be confirmed. The submission will include, but not limited to, following:-	Clause no. 3.5.3 As preparatory work prior to installation, their locations, position of supporting fittings, anchoring, etc. shall be verified and marked at site. The submission will include, but not limited to, following:-
29	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 4.2.3. Auxiliary network will consist of double circuit 33 kV cables (3 single core cables per circuit) from Aarey Station ASS 33 kV GIS Switchgear to respective depot ASS. The 33 kV Auxiliary Power Distribution Network will be formed with Loop in-Loop out arrangement through 33 kV circuit breakers provided in each Auxiliary Substation. The size of the cable shall be determined as per the 33 kV load flow study conducted by the Power Supply Contractor while taking into consideration the method of installation and voltage drop under worst case operating condition.	Clause no. 4.2.3. Auxiliary network will consist of double circuit 33 kV cables (3 single core cables per circuit) from Aarey Station ASS 33 kV GIS Switchgear to respective depot ASS. The 33 kV Auxiliary Power Distribution Network will be formed with Loop in-Loop out arrangement through 33 kV circuit breakers provided in each Auxiliary Substation. The size of the cable shall be determined as per the 33 kV **load flow study while** taking into consideration the method of installation and voltage drop under worst case operating condition.
30	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 4.3.8.1 The Contractor shall be responsible for providing a System design, maintenance procedures, and defining the recommended spares holdings to ensure that the Availability requirements of the Power Supply system and Overhead Equipment shall be achieved.	Clause no. 4.3.8.1 The Contractor shall be responsible for providing a System design, maintenance procedures, and defining the recommended spares holdings to ensure that the Availability requirements of the **Power Supply system shall** be achieved.

31	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 5.2.1 Transformer Protection	Clause no. 5.2.1 Transformer protection The transformer is protected against fault, but not limited to, by the followings - F 50: Instantaneous over current protection - F 51: Time delayed over current protection - F50 N: Instantaneous earth fault protection (zero sequence) - F51 N: Time delayed earth fault protection (zero sequence) - 51G Standby earth fault protection - 64: REF Protection The protection scheme to be done in coordination with the PSS Contractor.
32	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT		ADD 5.2 Auxiliary Sub Station Protection Clause no. 5.2.2 These protections are mainly concerned with the monitoring of the state and operation of: a. SF6 gas pressures of 33 kV circuit breakers, b. transformer temperature , c. non availability of auxiliary supply (d.c.). Two stages are involved: a. the first one is an alarm, b. the second one causes tripping (except for the SF6 gas pressure which entails blocking) of the equipment concerned.

33	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no 5.1	ADD a para at end of clause no 5.1: Interlocking arrangement is to be provided for the separation of cables of 400sqmm and 120sqmm separately.
34	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 6.1 Locations of Receiving power from Aarey Station Sub Station are shown in the schematic power supply substation location drawing. Refer volume-5 Tentative power supply arrangement is shown in the Power Supply System Single Line Diagram. Refer volume-5	Clause no. 6.1 Tentative power supply arrangement is shown in the Typical 33kV Distribution Scheme. Refer volume-5.
35	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 6.2.1 (c) Abnormal operating conditions associated with complete loss of one ASS.	Clause no. 6.2.1 (c) Abnormal operating conditions associated with loss of one transformer in each ASS.
36	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 6.3.1 The ASS room equipment arrangement shall be detailed and designed to accommodate the following equipment and facilities:	Clause no. 6.3.1 The ASS room equipment arrangement shall be detailed and designed to accommodate the following equipment and facilities as mentioned below but not limited to:
37	Volume-4 Employers Requirement - Technical Specification	Clause no. 7.1.1 In Depot, there will be two Auxiliary Substations (ASS-1 and ASS-2). Each ASS will have a 33 kV GIS Switchgear, Auxiliary Transformer power rating of 2000 kVA. In Aarey station, there will be one ASS room at the	Clause no. 7.1.1 In Depot, there will be two Auxiliary Substations (ASS-1 and ASS-2). Each ASS will have 2 sets of 33 kV GIS Switchgear, 2nos of Auxiliary Transformer each having power rating of 2000 kVA. In Aarey station, there will be

	Section-VI-A-Electrical-HT	Concourse level. The capacity of transformers given is tentative and is subject to verification. Scope of work includes, but not limited to, 33 kV GIS Switchgear, 33 kV cables, 33 kV/ 433 V Dry type transformers along with the necessary protection arrangement and ancillary equipment to deliver fully functional Auxiliary Substations. All equipment on the LT Panels, i.e. 433V Circuit Breakers (Incoming and Coupler). Connection between the 33kV/433 V Transformer secondary and the LT Board bus duct is also covered under this contract. The DEM contractor shall maintain necessary interface with the Power Supply Contractor to ensure proper installation of LT bus duct. The Contractor shall provide and ensure suitable interlocking arrangement between the 433 V LT Breaker, the HT beaker and Auxiliary Transformer enclosure.	one ASS room at the Concourse level. The capacity of transformers given is tentative and is subject to verification. Scope of work includes, but not limited to, 33 kV GIS Switchgear, 33 kV cables, 33 kV/ 433 V Dry type transformers along with the necessary protection arrangement and ancillary equipment to deliver fully functional Auxiliary Substations, all equipment on the LT distribution, etc. Connection between the 33kV/433 V Transformer secondary and the LT Board bus duct is also covered under this contract. The DEM contractor shall maintain necessary interface with the Power Supply Contractor to ensure proper installation of LT cables / bus duct. The Contractor shall provide and ensure suitable interlocking arrangement between the 433 V LT Breaker, the HT beaker and Auxiliary Transformer enclosure.
38	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 7.1.2.1 The transformer shall be dry (cast resin) type, complete in all respects with all parts and accessories necessary for efficient operation in sub-stations. All such parts & accessories shall be deemed to be within the scope of this Specification, whether specifically mentioned or not. Transformer shall satisfy the requirements of relevant IEC and other International Standards, particularly IEC 60076, BS 171; and I E Rules and BEE Guidelines, as amended or supplemented by this specification, wherever applicable.	Clause no. 7.1.2.1 The transformer shall be dry (cast resin) type, complete in all respects with all parts and accessories necessary for efficient operation in sub-stations. All such parts & accessories shall be deemed to be within the scope of this Specification, whether specifically mentioned or not. Transformer shall satisfy the requirements of **latest relevant IEC and other International Standards, particularly IEC: 60076, BS: 171; IS: 2026, IS: 11171, I E Rules and BEE Guidelines,** as amended or supplemented by this specification, wherever applicable.
39	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 7.1.2.2 (k) Impedance voltage : 4%	Clause no. 7.1.2.2 (k) Impedance voltage: as per latest applicable IS Standard.

40	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 7.6.2 Earth mat for each substation has to be designed individually. The earth mat has to be designed for the site conditions and shall ensure a low overall impedance not more than 0.5 ohms and a current carrying capacity consistent with the fault current magnitude.	Clause no. 7.6.2 Earth mat for each substation has to be designed individually. The earth mat has to be designed for the site conditions and shall ensure a low overall impedance not more than **1.0 ohms** and a current carrying capacity consistent with the fault current magnitude.
41	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 7.6.3 The maximum short circuit current to be taken into consideration for the design of the Earth mat shall be obtained at each Receiving Substation at the point of common coupling with the Power Supply Authority	Clause no. 7.6.3 The maximum short circuit current to be taken into consideration for the design of the Earth mat **shall be based on the value derived from the transformer rating**
42	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 7.7.1.1 33 kV, 3 phase, duplicate feeder from the outgoing 33 kV GIS Switchgear at Aarey Station ASS to designated Depot ASS, one feeder for each 33 kV GIS Switchgear Unit at each ASS in Loop in Loop Out arrangement. Cable route for installation of 33 kV cables inside the RSS premises will be finalised by the PSS Contractor. The cable route from boundary of the RSS to ASS shall be finalised by the Contractor.	Clause no. 7.7.1.1 33 kV, 3 phase, duplicate feeder from the outgoing 33 kV GIS Switchgear at Aarey Station ASS to designated Depot ASS, one feeder for each 33 kV GIS Switchgear Unit at each ASS in Loop in Loop Out arrangement. Cable route for installation of 33 kV cables inside the Depot premises will be in line with the tender drawings.
43	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 7.7.1.2 33 kV, 3 phase, duplicate Network, one circuit in each tunnel; on ramp and at-grade; as applicable. Ring Main system will be made with Loop in–Loop out arrangement through 33kV GIS Switchgear.	Clause no. 7.7.1.2 Ring Main system will be made with Loop in–loop out arrangement through 33kV GIS Switchgear.

44	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 7.7.4.1 Single core 400 sq.mm stranded copper: Connection between Aarey Station 33kV Switchgear to ASS-2 and ASS-1 33kV GIS Switchgear's respectively	Clause no. 7.7.4.1 Single core 120 sq.mm stranded copper: Connection between Aarey Station 33kV Switchgear to ASS-1 and ASS-2 33kV GIS Switchgear's respectively
45	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 7.7.4.2 Single Core 95 sq. mm stranded copper conductor, for connections from transformer Circuit Breaker to the 33kV/433V Auxiliary transformer in the ASS.	Clause no. 7.7.4.2 Single Core 120 sq. mm stranded copper conductor, for connections from transformer Circuit Breaker to the 33kV/433V Auxiliary transformer in the ASS.
46	Volume-4 Employers Requirement - Technical Specification Section-VI-A-Electrical-HT	Clause no. 8.1.3 Works area The Contractor shall comply with the requirements specified in Part 2, Section 6A, General Specifications with regards to the use of allocated worksites.	Clause no. 8.1.3 Works area The Contractor shall comply with the requirements specified in Volume 3, Employers Requirement – General Specification, with regards to the use of allocated worksites.
47	Volume-4 Employers Requirement - Technical Specification Section VI-B-Electrical –LT Page 7 of 154 Clause 1.26 MAINTENANCE DURING DEFECTS LIABILITY PERIOD	a) During the defect liability period the contractor shall maintain all the assets on the lines of a Comprehensive Maintenance Contract which will include replacement/ rectification of defective equipment/component. The Contractor shall supply adequate quantity of consumable and contingent spare parts in order to minimize the shut down time due to repairs and maintenance. The contractor is also required to carry out all the preventive maintenance schedules, specified by the manufacturer. The consumables required for undertaking preventive maintenance schedules shall be supplied by the contractor. The contractor shall be responsible for preventive as well as corrective maintenance. The infrastructure including T&Ps, M&P, Testing Instruments, Material Handling	a) During the defect liability period the contractor shall maintain all the assets on the lines of a Comprehensive Maintenance Contract which will include replacement/ rectification of defective equipment/component. The Contractor shall supply adequate quantity of consumable and contingent spare parts in order to minimize the shut down time due to repairs and maintenance. The contractor is also required to carry out all the preventive maintenance schedules, specified by the manufacturer. The consumables required for undertaking preventive maintenance schedules shall be supplied by the contractor. The contractor shall be responsible for preventive as well as corrective maintenance. The infrastructure including T&Ps, M&P, Testing Instruments, Material Handling

		Equipments, Jigs & Fixtures and ladder etc. are to be arranged by the contractor for Maintenance during Defect Liability Period. Contractor shall furnish a list of M&Ps, T&Ps, Testing Instruments, Material Handling Equipments, Jigs & Fixtures, Unit Exchange Spares, Rotational Spares, and Components and Consumables along with quantities to be kept by him in MMRC's premises during Defects Liability Period. They shall be maintained by contractor at contractor's own store at a location approved by employer during DLP Period. The balance DLP spares (balance after actual consumption, the contractor has to take written permission for using DLP spares from employer otherwise it will be assumed that the contractor has not used DLP spare and shall be liable to return these spares after completion of DLP) shall be the property of the employer and if any additional spares are required the contractor shall arrange the same without any extra payment. Mandatory spares provided to the Employer under the Contract will not normally be released to the Contractor for DLP purpose	Equipments, Jigs & Fixtures and ladder etc. are to be arranged by the contractor for Maintenance during Defect Liability Period. Contractor shall furnish a list of M&Ps, T&Ps, Testing Instruments, Material Handling Equipments, Jigs & Fixtures, Unit Exchange Spares, Rotational Spares, and Components and Consumables along with quantities to be kept by him in MMRC's premises during Defects Liability Period. **However, contractor has to maintain items as mentioned in Annexure -4 as minimum mandatory spares for DLP (Refer:- Attachment-7 to Addendum-5) in contractor's own store at a location approved by the employer during DLP period. If any additional spares are required during the DLP period for routine, preventive or corrective maintenance/ for the rectification of defective equipment / component, same shall be arranged by the contractor without any extra payment / claim**. The balance DLP spares (balance after actual consumption, the contractor has to take written permission for using DLP spares from employer otherwise it will be assumed that the contractor has not used DLP spare and shall be liable to return these spares after completion of DLP) shall be the property of the employer and if any additional spares are required the contractor shall arrange the same without any extra payment. Mandatory spares provided to the Employer under the Contract will not normally be released to the Contractor for DLP purpose.

48	Volume-4 Employers Requirement - Technical Specification Section VI-B- Electrical –LT Page-9 of 154 Clause 1.28 MAINTENANCE DURING DEFECTS LIABILITY PERIOD	Second Paragraph: A list of Mandatory/ contract spare are to be provided three months prior to the commissioning of the respective system. The mandatory tools should be supplied three months prior to the final testing and commissioning of the entire system. The cost of items shall be deemed to have been included in the price quoted by the contractor. Any additional Spares/tools required for maintaining the system for a period of two years after the DLP in case of EOT Crane, Air Compressor sand high mast lighting tower, may also be added by the tenderer in spare list provided as part of technical submission. However, the same shall be reviewed during DLP and any additional spares required for maintenance for these systems for a period of two years after DLP shall have to be provided by the contractor without any extra cost.	Mandatory/ contract spare are to be provided three months prior to the commissioning of the respective system. The mandatory tools should be supplied three months prior to the final testing and commissioning of the entire system. The cost of items shall be deemed included in the price quoted by the contractor. Any additional Spares/tools required for maintaining the system for a period of two years after the DLP, may also be added by the tenderer in spare list provided as part of technical submission. However, the same shall be reviewed during DLP.
49	Volume-4 Employer Requirement Technical Specification Section VI-B- Electrical –LT 2. LOW VOLTAGE POWER DISTRIBUTION SYSTEM Clause 2.1.2 Air Circuit Breaker	Clause 2.1.2 Air Circuit Breaker h) Mechanical & Electrical life. The Circuit Breaker shall have minimum Mechanical life of 20000 operations and electrical life of 8000 operations **for ratings up to 2000A.**	Clause 2.1.2 Air Circuit Breaker h) Mechanical & Electrical life. The Circuit Breaker shall have minimum Mechanical life of 20000 operations and electrical life of 8000 operations.

50	Volume-4 Employer Requirement Technical Specification Section VI-B- Electrical –LT Clause 2.1.3 MCCBs.	**b)** MCCBs shall be current limiting type with trip time of less than 10 millisecond suitable for 3 phase, 415 Volts, AC, 50 HZ supply with neutral 4P/3P/2P as required and rated for insulation voltage 750 V, Rated Impulse-8 KV and Rated operating voltage of 415V for 3 Phase, **Service short circuit breaking capacity (Ics) i.e Ics =35 kA up to 250A above and Ics= 50 kA for 400 Amp and above and marked with suitability for isolation as specified and required.** All Breakers/MCCBs shall incorporate front adjustable trip units with adjustable overload and adjustable short circuit faults. All the MCCBs shall have microprocessor based releases. All MCCB's offered shall have double insulation feature as standard. MCCB's offered shall be from the same series to have a commonality of appearance and spares management. No mixing of series is allowed within a manufacturer's range of MCCBs. Four pole MCCBs shall have flexibility of setting neutral current N or N/2. The mechanical operations MCCBs shall be minimum 15000 operations.	**b)** MCCBs shall be current limiting type with trip time of less than 10 millisecond suitable for 3 phase, 415 Volts, AC, 50 HZ supply with neutral 4P/3P/2P as required and rated for insulation voltage 750 V, Rated Impulse-8 KV and Rated operating voltage of 415V for 3 Phase, **Service short circuit breaking capacity (Ics) shall be 50kA at MDB and marked with suitability for isolation as required.** All Breakers/MCCBs shall incorporate front adjustable trip units with adjustable overload and adjustable short circuit faults. All the MCCBs shall have microprocessor based releases. All MCCB's offered shall have double insulation feature as standard. MCCB's offered shall be from the same series to have a commonality of appearance and spares management. No mixing of series is allowed within a manufacturer's range of MCCBs. Four pole MCCBs shall have flexibility of setting neutral current N or N/2. The mechanical operations MCCBs shall be minimum 15000 operations.
51	Volume-4 Employer Requirement Technical Specification Section VI-B- Electrical – LT, Clause 2.2.7 Addendum-1 Sr. No-32	**2.2.7 Switchboard Bus bars** a) Bus bars shall be made of high conductivity, high strength Copper, complying with requirements of grade E 91E of IS 5082 -1981. Design of bus bar system shall comply to IS 5578 and IS 11353. **Bus bars shall be of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar or as stipulated in schedule of quantities.** Bus bar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities. **And ADD:** g) The bus bar shall be air insulated, solid rectangular bars of electro-tin plated, hard drawn, high conductivity, 99%copper bars and shall be mechanically braced to withstand the maximum symmetrical short-circuit current	**2.2.7 Switchboard Bus bars** a) Bus bars shall be made of high conductivity, high strength Copper, complying with requirements of grade E 91E of IS 5082 -1981. Design of bus bar system shall comply to IS 5578 and IS 11353. **Bus bars shall be of rectangular cross sections suitable for full load current for phase bus bars and neutral bus bar or as stipulated in schedule of quantities.** Bus bar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities. **And ADD:** g) The bus bar shall be air insulated, solid rectangular bars of electro-tin plated, hard drawn, high conductivity, 99%,copper bars and shall be mechanically braced to withstand the maximum symmetrical short-circuit current

<table>
<tr><td></td><td></td><td>rating of the main breaker in each assembly
h) The bus bar shall have sufficient cross sectional area to continuously conduct rated full load current for operation in 500C ambient temperature and for limit temperature rise within the requirements of IEC-61439- 1. The current carrying capacity of the bus bar shall be of the bare bus bar rating confirming to IEC-61439-1
i) Ground bus shall be of 50% size of phase bus and shall be furnished to the entire length of the switchboard.</td><td>rating of the main breaker in each assembly
h) The bus bar shall have sufficient cross sectional area to continuously conduct rated full load current for operation in 500 degree centigrade ambient temperature and for limit temperature rise within the requirements of IEC-61439- 1. The current carrying capacity of the bus bar shall be of the bare bus bar rating confirming to IEC-61439-1
i) Ground bus shall be of 50% size of phase bus and shall be furnished to the entire length of the switchboard.</td></tr>
<tr><td>52</td><td>Volume-4 Employer Requirement Technical Specification Section VI-B- Electrical –LT

2.2. LT PANELS – PCC/ MCC/ SUB DISTRIBUTION PANEL</td><td>2.2.19 GENERAL REQUIREMENTS
The designated panels will be interfaced with BMS/ Fire Detection/ Fire fighting systems. All necessary provision to be made in the panels for these interfaces. Designated panels will be provided with CO2 fire trace system, which has to be taken care by the panel manufacturer at is works or for making the necessary provisions for accommodating the same inside the panels and conduct necessary tests at factory.</td><td>2.2.19 GENERAL REQUIREMENTS
The designated panels will be interfaced with BMS/ Fire Detection/ Fire fighting systems. All necessary provision to be made in the panels for these interfaces. Designated panels will be provided with clean agent gas system, which has to be taken care by the panel manufacturer at their works or for making the necessary provisions for accommodating the same inside the panels and conduct necessary tests at factory.</td></tr>
<tr><td>53</td><td>Volume-4 Employer Requirement Technical Specification Section VI-B- Electrical –LT Sandwich Bus Duct

Refer- Addendum-1 Sr. No.31</td><td>2.6.4 SYSTEM PARAMETERS OF BUS DUCTS

Bus Ducts shall be suitable for following system parameters.<table><tr><td>Short circuit ratings</td><td>Minimum short circuit ratings 65 KA for 1 sec.</td></tr></table></td><td>2.6.4 SYSTEM PARAMETERS OF BUS DUCTS

Bus Ducts shall be suitable for following system parameters.<table><tr><td>Short circuit ratings</td><td>Minimum short circuit ratings 50 KA for 1 sec.</td></tr></table></td></tr>
</table>

54	Volume-4 Employers Requirement - Technical Specification Section-VI-B-Electrical-LT	Lighting Specification Clause no 2.14	Revised Lighting Specification Clause no 2.14 Attachment No-8 to Addendum-5
55	Volume-4 Employers Requirement - Technical Specification Section-VI-C-VAC	Volume-4 -Technical Specification-Section-VI-C-VAC	Revised Technical Specification-Section-VI-C-VAC Attachment No-9 to Addendum-5
56	Volume-4 Employers Requirement - Technical Specification Section-VI-F-BMS	Volume-4 -Technical Specification-Section-VI-F-BMS	Revised Technical Specification-Section-VI-F-BMS Attachment No-10 to Addendum-5
57	Volume-4 Employers Requirement - Technical Specification Section VI-G EOT Cranes. Page 25 of 45	Section VI-G EOT Cranes Appendix-1 Technical Parameters	Section VI-G EOT Cranes Revised Appendix-1 Technical Parameters Attachment No-15 to Addendum-5
58	Volume-5 Tender Drawings	Volume-5 Tender Drawings & Addendum-1 Serial No 28 & 29	Volume-5 Revised Drawing Attachment No-12 to Addendum-5

59	Volume 6 BILL OF QUANTITIES Sr. No 23 of Addendum -1	Vol-6 Bill of Quantities (Revised) (Ref.-Attachment No.6)	Vol-6 Bill of Quantities **Revised BOQ - (R2)** Attachment No-11 to Addendum-5
60	Attachment No-2 to Addendum No-1 Volume-1- Bidding Procedure Section 2 – ITT	a) The DDC scope generally includes, but not limited to: • Proof checking of design and drawings of tender documents for Station, Depot with OCC; • Perform cost effective detailed design of Electrical, Building Electrical & Mechanical services including illumination, power supply, fire detection and suppression, Air conditioning, BMS and pumps for plumbing systems. This shall be done for complete Station and Depot including OCC. Station air-conditioning is excluded; • Co-ordinate and integrate design and details with contractors and consultants of other discipline working on the Station and Depot including OCC and contracts works adjacent to the site of work of this contract;	a) The DDC scope mainly includes, but not limited to: • Verification of tender design and drawings/ documents for complete scope of work under DEM Tender; • Perform cost effective Detailed Design of all Electrical (HT & LT both) & Mechanical Services for complete scope of work under DEM Tender. Station Air-Conditioning is excluded; • Co-ordinate, integrate and incorporate the design details requirements of / with other system wide contractors, sub-contractors, consultants of all other disciplines, working at Depot;
61	Volume-4 Employers Requirement - Technical Specification Section-VI-B-Electrical-LT	Clause no 2.10.5 (e) (last sentence) The requirements of chemical earth or maintenance free earth is mentioned in clause 2.9.7 for necessary compliance.	Clause no 2.10.5 (e) (last sentence) The requirements of chemical earth or maintenance free earth is mentioned in clause **2.10.7** for necessary compliance.
62	Volume-4 Employers Requirement - Technical Specification Section-VI-B-Electrical-LT	**Clause no 2.15.13** **Three Phase Inverter**	Deleted

63	Volume-4 Employers Requirement - Technical Specification Section-VI-B-Electrical-LT		Add 2.16.1.2 Scope of work under this tender will include:- l. Wherever it is mentioned that the Contractor shall perform certain work or provide certain facilities, it implies that the Contractor shall do so at his cost. m. Wherever the Technical Specifications stipulate requirements in addition to those contained in the applicable Indian Standard specifications/ Codes these additional requirements shall also be satisfied the Contractor shall do so at his cost. n. Then DEM contractor will coordinate Civil plumbing works contractor to ensure that a water outlet (controlled by suitable Valve) shall be provided near the Acoustic Enclosure for meeting the water requirement of DG set radiators. o. DG sets are expected to run at light load/No load. The DG set offered, shall be suitable for operation under light load/No load, without any adverse impact on the service performance or life of the equipment. The tenderer should clearly explain that the DG set proposal meets the above requirements. p. Depot & Station are provided with independent reliable sources for power supplies and DG sets would be required to operate for a very small duration and after large period of idling. DG set should be designed to work satisfactorily even after prolonged idling period. q. Approximately 60 percent of the load shall be non − linear, DG set should be designed to operate under non

			− linear load environment. DG set should be so designed that the ripples are not created in the energy generated and EMI and RFI are within acceptable limit, specified by standards. (Requirements of EMI/ EMC due to Single − phase A.C. traction should be taken care) During the Integrated, Testing and Commissioning of the DG set, the set will be tested for the actual linear and non − linear loads at site and the test report furnished. r. Equipment offered shall comply with latest pollution norms as notified by the Government and other statutory bodies at the time of delivery of the DG sets at the site.
64	Volume-4 Employers Requirement - Technical Specification Section-VI-B-Electrical-LT	Clause no 2.16.1.3 Tender Conditions, Specification and Schedule	Deleted
65	Volume-4 Employers Requirement - Technical Specification Section-VI-B-Electrical-LT	Clause no 2.16.1.4 Tender Conditions, Specification and Schedule	Deleted
66	Volume-4 Employers Requirement - Technical Specification	2.16.2.6 ALTERNATOR (b) Excitation system (iii) The excitation system and engine governor should be such that the alternator is capable of starting up induction	2.16.2.6 ALTERNATOR (b)(iii) (b) Excitation system (iii) The excitation system and engine governor should be such that the alternator is capable of starting up induction

	Section-VI-B-Electrical-LT	motors having a starting kVA of not less than 1.8 times the alternator rated kVA. Manufacturer should indicate the voltage dip and duration under such conditions as required under equipment data. The highest capacity of induction motor to be started for underground stations will be 75HP with the base load of 45 kVA. c. Automatic Mains Failure (AMF) operation (iv) (a) 4 Pole MCCBs & 3 pole breakers / contactor and One Neutral Isolating contactor of adequate rating, electrically and mechanically interlocked. (iv) (d) For DG sets, 3 outgoing breakers shall be provided − one for Panel of Fire fighting system & one to extend power supply to Main distribution panel.	motors having a starting kVA of not less than 1.8 times the alternator rated kVA. Manufacturer should indicate the voltage dip and duration under such conditions as required under equipment data. c. Automatic Mains Failure (AMF) operation (iv) (a) 4 Pole ACB's / MCCBs & 3 pole breakers / contactor and One Neutral Isolating contactor of adequate rating, electrically and mechanically interlocked. (iv) (d) For DG sets, 2 outgoing breakers shall be provided − one for Panel of Fire fighting system & one to extend power supply to Main distribution panel.
67	Volume-4 Employers Requirement - Technical Specification Section-VI-B-Electrical-LT	Clause no. 2.16.2.15 FIRE SAFETY MEASURES FOR THE DIESEL ENGINE AMF PANEL. Delete point (a) to (l)	Deleted
68	Volume-4 Employers Requirement - Technical Specification Section-VI-E-Fire Suppression	8. TOTAL ROOM FLOODING SYSTEM 8.1 OBJECT This document defines technical characteristics required in order to design and satisfactory install approved FM200/ NOVAC 1230 or equivalent fire suppression systems. It includes all engineering, materials, equipment, design, commissioning and maintenance necessary to complete and run FM200 / NOVAC 1230 or equivalent at </=50 BAR system.	8. TOTAL ROOM FLOODING SYSTEM 8.1 OBJECT This document defines technical characteristics required in order to design and satisfactory install approved **clean gas agent** fire suppression systems. It includes all engineering, materials, equipment, design, testing, commissioning and maintenance.

69	Volume-4 Employers Requirement - Technical Specification Section-VI-E-Fire Suppression	8.2 CODES/STANDARDSCOMPLIANCE The design, installation, testing and maintenance of FM200 / NOVAC 1230 or equivalent Fire suppression systems shall be in accordance to the following codes, standards and regulatory bodies:	8.2 CODES/STANDARDSCOMPLIANCE The design, installation, testing and maintenance of **clean gas agent** Fire suppression systems shall be in accordance to the following codes, standards and regulatory bodies:
70	Volume-4 Employers Requirement - Technical Specification Section-VI-E-Fire Suppression	8.12 PIPING, FITTING AND DISCHARGE NOZZLES 3. SUMMARY FOR TENDERS (III) Gas System should be FM200 / NOVAC 1230 or equivalent at 25 to 50 BAR system. Manufacturer have to supply name of filling station in the country	8.12 PIPING, FITTING AND DISCHARGE NOZZLES 3. SUMMARY FOR TENDERS (III) Gas System should be of **clean gas agent** system. Manufacturer have to supply name of filling station in the country
71	Volume-4 Employers Requirement - Technical Specification Section-VI-E-Fire Suppression	9.8 MAIN COMPONENTS OF THE SYSTEM b) Automatic flooding of CO2	9.8 MAIN COMPONENTS OF THE SYSTEM b) Automatic flooding of clean **agent gas.**
72	Volume-4 Employer Requirement Technical Specification Section VI-I-Plumbing Pump	1.15 Pumps for Borewell	**1.15 Installation, Commissioning and Guarantees** **Installation** a) The pumps and accessories shall be installed in a true workman like manner true to level and grade in accordance with the best current practice. b) Vendor shall employ sufficient and proper equipments for lifting and placing of pumping equipment, in a manner which shall not strain or cause damage to the existing structures. If any damage is done, the sample shall be made good to the satisfaction of the Engineer's Representative without any additional cost. c) The vendor shall submit detailed shop drawing showing

			sizes of all piping, valves, etc. for approval. The work shall be started only after approval of shop drawings. **Commissioning** a) On completion of the work in all aspects, the vendor shall start up the pumps in a manner normally done for the continuous operation for a period of not less than 48 hours and shall rectify and adjust the pumps and equipments for leakages and balancing the system. b) After satisfactory commissioning of the pumps, the vendor shall conduct performance tests to satisfy the Engineer's Representative that all pumps and equipments are performing to the rated outputs of any or all pumps and equipment shall be rectified or replaced if the same is not performing in accordance with the specifications. **Guarantees** a) On award of the work the vendor shall submit a guarantee covering the quality and performance of all materials and installations under the contract. This guarantee shall cover each and every material whether manufactured by the contractor or not. b) Vendor shall specify a suitable procedure to test the rated performance of the equipment and the system and shall provide all necessary equipments, gauges, etc. for conducting such tests.
73	Volume-4 Employer Requirement Technical Specification Section VI-I-Plumbing Pump	2. Technical Detail	The pump sets shall be submersible centrifugal type and shall be selected based on the following minimum requirements as stated below: i) Head loss ii) Discharge based on continuous operation for water supply iii) Pump efficiency to be not less than 85% of the maximum possible for the particular type of pump chosen iv) Pump shall be selected considering maximum life span based on corrosion analysis of the water or content of solid to be pumped

			v) The pump should be maintenance free with liquid level controlled automatic operation and capable of remote interface & monitoring vi) The pump shall be noise and vibration free vii) The duty and standby pumps shall be identical viii) The NPSH of the pump shall always be lower than the atmospheric NPSH to avoid cavitation due to evaporization ix) 100% standby shall be provided for each installation x) Pump shall be provided with in-built protection against dry running, reverse rotation pump failure xi) Pressure gauges shall be complying with IS: 3624. Glycerine filled dial shall be provided where the gauge is subjected to pressure pulsation and / or vibrations. The internal parts of pressure gauge shall be stainless steel. The accuracy of the pressure gauges shall be ± 1 % of full scale, accessories such as snobbery, isolation valve & drain valve shall be provided. Impulse tubing and fittings as required shall be provided. The submersible pumps provided to supply potable water from sump as per specifications detailed below: Casing : Ci-Ni Impeller CF 8M Shaft : SS 304 Guide pipe : GI Lifting Chain : MSEP/ST-ZN Solid handling : max 5 mm Pump rpm : 2900 rpm Motor rpm : 2900 rpm Each pump shall have a complete set of discharge arrangement with sluice/butterfly valves, non-return valves and accessories. The under given velocities shall be followed while designing the suction and delivery of pumps; Pump Suction : 1-1.5 m/sec Pump Delivery : 2-2.5 m/sec

			Header : 1.8-2 m/sec **Motor shall be Squirrel Cage- Submersible Motor (Energy Efficient), 3 Phase, 415 V/50 Hz, 2900 rpm, IP 68 with F class insulation and shall have VFD.** The pump shall be provided with control panel. The motors shall be rated a minimum of 25% more than its rated KW or as per the applicable standards. The power to the control panel shall be taken from the MCC of the Effluent Treatment Plant. The cost of cable from the ETP MCC to the pump control panel shall be in the scope of the Contractor under the present contract. The contractor is advised to visit the site to take all consideration for the same. Running hour meters shall be provided for Main Pump Motors of the above pumps. Building connection Potable Water Connection to the building shall be through a Stainless Steel (SS) strip saddle and no direct connection shall be made on the HDPE pipe directly. This is necessary to prevent leakages and any contamination in the potable water network.

MUMBAI METRO RAIL CORPORATION LIMITED Mumbai Metro Line-3 Project Response to Bidder's Queries on Volumes 1 to Volume-6 for Contract No. MM3-CBS-DEM Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"							MMRC'S RESPONSE / CLARIFICATION dated 14th December 2017.
Sr. No.	**Volume**	**Section**	**CLAUSE No. / Sub Head / BOQ Sr.No. / Addendum-1**	**PAGE No.**	**Relevant Abstract from Tender & Addendum-1**	**Bidder's Queries**	**MMRC'S RESPONSE**
1					Sub: Contract Number: MM3-CBS-DEM "Contract MM3-CBS-DEM) Design, Manufacture, Supply, Installation, Testing and Commissioning of Electrical Sub Station with HT and LT Works, Ventilation and Air Conditioning System (VAC), Fire Detection System, Fire Suppression (Fire Fighting) System, Building Management System (BMS), EOT Cranes, Air-Compressors Including Compressed air piping works and Plumbing Pumps for the Depot Building Including OCC and at grade Aarey Station for Mumbai Metro Line-3. With reference to the subject project we are in receipt of addendum-1, wherein you have now added requirement that the tenderer should have executed "atleast one work with HT Sub-Station/ Distribution works with Transformer, 33kV GIS and 33kV cables installation system component of minimum value Rs.4.5 crores or more in case of single work or 2.8 Crores or more each in case of two works or 2.2 crores or more each in case of 3 works respectively....."	In this regards, we wish to state that none of Depots executed or under execution include HT substation (GIS) works as part of Depot scope. Hence, we request you to kindly modify the requirement as under: 1. Option I: Request to include 33kV AIS / 33kV GIS and 33kV cables or higher rating. 2. Option II: As per the estimate in the tender for GIS substation work, accounts for only 8% of contract value, whereas minimum 26% participation is required by the member for JV / consortium, hence we kindly request you to amend the clause and permit us to consider specialised subsontractor for the same, meeting the substation experience criteria.	Refer Addendum-5 Serial No - 5, 9 & 13 (of Form 11A Special Sub Concractor for GIS) in conjunction with tender terms and conditions.
2			"Contract MM3-CBS-DEM) Design, Manufacture, Supply, Installation, Testing and Commissioning of E & M works for Comprising of Electrical Sub Station with HT and LT Works, Ventilation and Air Conditioning System (VAC), Fire Detection System, Fire Suppression (Fire Fighting System, Building Management System (BMS), EOT Cranes, Air-Compressors Including Compressed air piping works and plumbing Pumps for the Depot Building Including OCC and at grade Aarey Station for Mumbai Metro Line-3. Eligibility Criteria Confirmation for above Project.			Wish to inform you that while scrutinizing the NIT, we come to know that the experience of various items is required to execute this E&M works i. e 33KV-GIS , Fire Fighting System. As the Quantum of various item is less, So big company are not interesting for JV above too small less scope of work. So we are requesting to allow us for our associate Sub-Contractor (Agencies) for 33KV-GIS, Fire Fighting e.tc. Works for the qualifying of criteria. So that we can bid in above E&M work with our experience Sub-Contractors for above works. Hence you are request to allow us for the same working criteria.	Refer Addendum-5 Serial No - 5, 9 & 13 (of Form 11A Special Sub Concractor for GIS) in conjunction with tender terms and conditions.
3					As per qualification criteria, tenderer should have executed any other works containing Design, Supply, Installation, Testing and Commissioning of HT Sub-Station/ Distribution Works with Transformer, 33kV GIS and 33kV Cables Installation System:	We request you to please accept Supply, Installation, Testing and Commissioning of HT Sub-Station/ Distribution Works with Transformer, 33kV and above Installation System. Alternatively We request you to accept general experience for E&M works for the bidder along with Willingness / Support letter from GIS OEM to associate with us for this project.	Refer Addendum-5 Serial No - 5, 9 & 13 (of Form 11A Special Sub Concractor for GIS) in conjunction with tender terms and conditions.
4					As per qualification criteria "Note", it is mentioned as the work, executed for private client will not be considered for eligibility evaluation whereas as per addendum,**"Similar works" for this contract shall be works of Metro Station/ Metro Depot/ Mass Rapid Transit System (MRTS)/ Commercial Buildings/ Official Buildings/ RAilway Stations/ Airport/ Hospital Buildings/ Industrial establishment.	Since work executed for all above mentioned establishment is acceptable, we request you to accept work executed for government as well as private client for HT substation/ Distribution works with Transformer, 33kV and above Installation System.	Tender Conditions Prevail
5	6	(Attachment No-6 to Addendum No-1) PART-A - Depot Substation & HT works	2.1 & 3.1	9	Foundation for GIS panel & Transformer	Kindly confirm that super-elevated base for the GIS panel and civil work for transformer shall be made by civil agency and E&M contractor has to provide necessary drawings / details.	Please refer to Attachment-7 to Addendum-1. Volume-3, Employers requirements - General Specification, Appendix-19.
6	6	Depot, OCC & Station	E.01 M V SWITCHGEAR - 10.1 a, 6.1a & 2.1a	39, 134 & 203	High electro mat high voltage (11kV grade) mat of 6 MM thick and 1000 mm wide and length on per LT panel requirement as per IS 15652-2006.	As per IS 15652-2006 mat thickness shall be 2.5 mm for 11 kV . Kindly confirm.	Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
7	6	(Attachment No-6 to Addendum No-1) PART-B DEP-LT	E.04 CONDUIT WIRING - 1.2.2	55	Secondary light points for high/medium bay light fixtures with 3 x 4.0 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 32mm dia MS recessed and/or surface conduiting system including cost of providing saddles/hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications and as required.	All point wiring items are with GI conduits. Kindly confirm whether MS or GI conduit is to be considered for BOQ Sr. No. 1.2.2.	Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)

MUMBAI METRO RAIL CORPORATION LIMITED
Mumbai Metro Line-3 Project

Response to Bidder's Queries on Volumes 1 to Volume-6 for Contract No. MM3-CBS-DEM

Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

MMRC'S RESPONSE / CLARIFICATION dated 14th December 2017.

Sr. No.	Volume	Section	CLAUSE No. / Sub Head / BOQ Sr.No. / Addendum-1	PAGE No.	Relevant Abstract from Tender & Addendum-1	Bidder's Queries	MMRC'S RESPONSE
8	6	(Attachment No-6 to Addendum No-1) PART-B DEP-LT	E.04 CONDUIT WIRING - 2.4 to 2.6	58	……..GI enclosure with IP 56 protection rating with all mounting & fixing accessories, terminations & Cable glands for cable entry with separately lockable facility complete as required.	GI enclosure with locking arrangement is a tailor / custom made item which none of the approved makes provide. Kindly confirm whether CRCA (with locking arrangement) / Polycarbonate (without locking arrangement) enclosure can be considered instead of GI for Depot, OCC & Station.	Tender Conditions Prevail
9	6	(Attachment No-6 to Addendum No-1) PART-C - 'SCHEDULE OF QUANTITIES -STATION - LT	E.05 INDOOR LIGHTING AND FANS - 1.7	147	Supply, Installation, Testing & commissioning of 430W LED Decorative chandellar LED Light fixture with accessories	Chandelier light fixture rate vary substatially with MOC, design & aesthetic appeal. Kindly provide Cat. No. of approved make or per unit rate of fixture to be capped at 60% - 70% of the rate provided in the BOQ.	Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
10	6	(Attachment No-6 to Addendum No-1) PART-D - 'SCHEDULE OF QUANTITIES -STATION - LT	E.04 CONDUIT WIRING - 1.3 & 1.3 a	209	1.3 Supply & laying of wiring for the following light point with 3 core x 2.5 sq. mm, 1100 Volt grade PVC insulated FR copper condutor flexible cabe in existing raceway or existing heavy gauge GI conduit surface run with GI saddles, or concealed or in MS raceway including chases and complete with GI junction boxes, pull boxes, inspection boxes,bends & other accessories etc. including insulated Protective Earth (PE) Conductor and earthing excluding the cost of MCB as specified and as under: - **QTY - 1000 Nos.** 1.3a One point controlled by 10A MCB. - QTY - 114 Nos.	We understand BOQ Sr. No. 1.3 is details / description for 1.3a. (in line with item No. 1.1) and there is no difference in 1.3 & 1.3a (but there is unit rate difference as per BOQ); hence quantity put against 1.3 may be by error. Kindly confirm.	Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
11	6	(Attachment No-6 to Addendum No-1) PART-D - 'SCHEDULE OF QUANTITIES -STATION - LT	E.06 PROTECTIVE EARTHING - 3.5	214	8 SWG WIRE	Kindly confirm Material of construction whether GI / Cu.	Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
12	6	(Attachment No-6 to Addendum No-1) PART-D - 'SCHEDULE OF QUANTITIES -STATION - LT	E.06 PROTECTIVE EARTHING - 5	214	Extra for GI / Electrolytic Copper test links/ termination With building pier continuity Conductor including termination plate, nut& bolts,fixing/welding etc as per specifications and as required.	Kindly provide details such as size and Material of construction whether GI / Cu.	Tender Conditions Prevail
13	4	Comprehensive maintainance during DLP	1.26	Page 7 of 154	Mandatory list of spares	To bring all the bidders to be at par, we request you to provide list of unit exchange spares, mandatory spares & consumables. As spares for EOT & Compressors are given, we request you to provide list of spare for other items as well.	Please refer Addendum-5, Sr.No. - 47. Attachment no-7
14	Addendum 1	Addendum 1 C	LIST OF APPROVED MANUFACTURERS / SUPPLIERS	Page 7 of 10	Approved makes given for Lighting Bus Trunking : Legrand & MK	Lighting Bus Trunking is not in the product range of M/s. MK. We request to accept C&S make.	Please refer Addendum-5, Sr.No. - 21 (Volume-3, Appendix-28-R2) Attachment no-6
15	Volume 6		OCC - VAC H.01	57 of 270	Air Cooled Chiller	This being BOQ based tender, kindly provide the Chiller selection parameters of Ambient Temp. and Chilled Water Inlet & outlet temp. with fouling factor	Please refer Addendum-5, Sr.No-55, Revised VAC Technical Specification (Attachment no-9) & Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
16	Volume 6		OCC - VAC & DEPOT - VAC H.01		Air Handling Units, Fan Coil Units, Wall Mounted VRV Indoor Units and Split Units	Kindly advise whether heat pipe needs to be provided, as the same cannot be provided on FCUs, VRV Indoor Units and Split Units	Please refer Addendum-5, Sr.No-55, Revised VAC Technical Specification (Attachment no-9) & Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)

MUMBAI METRO RAIL CORPORATION LIMITED Mumbai Metro Line-3 Project Response to Bidder's Queries on Volumes 1 to Volume-6 for Contract No. MM3-CBS-DEM Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"							MMRC'S RESPONSE / CLARIFICATION dated 14th December 2017.
Sr. No.	**Volume**	**Section**	**CLAUSE No. / Sub Head / BOQ Sr.No. / Addendum-1**	**PAGE No.**	**Relevant Abstract from Tender & Addendum-1**	**Bidder's Queries**	**MMRC'S RESPONSE**
17	Volume 6		BMS System		BMS System	This being BOQ based tender, kindly provide IO Summary to understand the scope of BMS.	Tender Conditions Prevail. IO summary works is covered under detailed design scope and shall be based on similar Metro Depot & Station Application.
18	Addendum 1	Addendum 1 A	Sr. No. 1	Page 1 & 2 of 19	Date & time of Submission of Tender is on 05.10.2017 upto 1800Hrs	Kindly extend bid submission date to 05.11.2017 upto 1800Hrs	Refer Addendum-5
19	Final Addendum 1 S.No-2,3		Minimum Eligibility Criteria: A.General Experience	Page 1,2,3 of 18	As per Final Adeendum1 S.No-1,2,3 of 18,tenderer should have executed any other Work containing Design, Supply , Installation, Testing and Commissioning of HT Sub-Station / Distribution Works With Transformer, 33KV GIS and 33KV Cables Installation System of Large Complex/Metro Station/Mass Rapid Transit System/ Commercial Buildings/ Official Buildings/ Railway Stations/Airport/ hospital buildings/ industrial establishment/ Power Distribution Utilities or Company of value Rs. 4.5 crores or more in case of single work or 2.8 crores or more , each in case of two works or 2.2 crores or more, each in case of 3 works respectively.	1.We request you to please accept Supply, Installation, Testing and Commissioning of HT Sub-Station / Distribution Works with Transformer, 33KV and above Installation System. **Alternatively** We request you to accept general experience for E&M works for the bidder along with Willingness / Support letter from GIS OEM to associate with us for this project.	Refer Addendum-5 Serial No - 5, 9 & 13 (of Form 11A Special Sub Concractor for GIS) in conjunction with tender terms and conditions.
20	Volume 1 of 6, Section-1		Cl No-1.1.3.2 Minimum Eligibility Criteria: A.General Experience	Page 4 of 10	As per qualification criteria "Note", it is mentioned as the work, executed for private client will not be considered for eligibility evaluation whereas as per addendum, ** "Similar works" for this contract shall be works of Metro Station / Metro Depot / Mass Rapid Transit System (MRTS) / Commercial Buildings / Official Buildings/ Railway Stations/ Airport/ Hospital buildings/ Industrial establishment.	Since work executed for all above mentioned establishment is acceptable, we request you to accept work executed for government as well as private client for HT Substation / Distribution Works with Transformer, 33KV and above Installation System.	Tender Conditions Prevail
21	Volume-4- Section VI-B- Electrical LT & Final Addenduum1 BOQ	MV Switchgear	2.1.3	Page No-18 of 154	(q) Earth fault protection shall be inbuilt feature of MCCB. For TP MCCBs external Neutral CT shall be provided to avoid nuisance tripping due to unbalance loads" & (p) All 4-pole ACBs shall have fully rated neutral pole. All 4-pole ACBs & MCCBs shall be provided earth fault protection.	As per BOQ specifications of Volume-6,4P(4 Pole) MCCB's are provided with Earth fault protection along with S/C and O/C. But For TP (3 pole) MCCB's, BOQ has not specified clearly whether Earth fault protection is to be considered or not Please confirm.	Tender Conditions Prevail
22	Final Addendum 1 BOQ	MV Switchgear-Metering		Page No-16 of 260	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.	We presume Digital meter (MFM) with RS-485 is required only for incoming feeder of LV Switch boards. Please confirm.	Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
23	Final Addendum 1 BOQ	Air Handling Units (Double Skin)		(Attachment No-6 to Addendum No-1) PART-C - OCC BUILDING VAC System Page No-160	Supply, installing, testing and commissioning of Air Handling Unit double skin type (Euro Vent Certified for mechanical & unit Performance), complete with blowers, fan section, cooling coils, coil section,V filter section with 50mm thick panel type filters, fan motor(IE-2), isolator for motor belt drive , with UVC emitter fitted etc. AHU shall be with cooling coil minimum 4/6 Row Deep and fin spacing shall be Max 10 FPI. The complete compartmentation shall be provided in fan and coil section.	AHU Static pressure is not mentioned. Please clarify actual static pressure requirement.	Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
24	Final Addendum 1 BOQ	Chilled Water Piping		(Attachment No-6 to Addendum No-1) PART-C - OCC BUILDING VAC System Page No-161-162	1.1. Design, Supply. Installation, testing and commissioning of MS C class Chilled water piping complete with companion flanges, nuts, bolts, gaskets fittings supports etc. as required and as per specifications and drawings including all necessary civil work Duly Insulated(nitrile rubber) as per specifications 1.2.Thermal insulation pipe section Rock wool Chilled water Pipes Insulation density 100 - 125kg/m3	Nitrile rubber insulation is mentioned in piping description whereas rockwool insulation is separately mentioned for the chilled water piping.Kindly clarify the same. Also, provide us the thickness of insulation required.	Please refer Addendum-5, Sr.No-55, Revised VAC Technical Specification (Attachment no-9) & Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)

MUMBAI METRO RAIL CORPORATION LIMITED Mumbai Metro Line-3 Project Response to Bidder's Queries on Volumes 1 to Volume-6 for Contract No. MM3-CBS-DEM Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"							MMRC'S RESPONSE / CLARIFICATION dated 14th December 2017.
Sr. No.	**Volume**	**Section**	**CLAUSE No. / Sub Head / BOQ Sr.No. / Addendum-1**	**PAGE No.**	**Relevant Abstract from Tender & Addendum-1**	**Bidder's Queries**	**MMRC'S RESPONSE**
25	Final Addendum 1 BOQ	Thermal insulation pipe section Rock wool Chilled water Pipes Insulation density 100 - 125kg/m3		(Attachment No-6 to Addendum No-1) PART-C - OCC BUILDING VAC System Page No-162	1.2 J) Drain Pipe	Kindly provide the diameter of drain pipe,insulation thickness Also there is no separate line item for drain piping in BOQ,Kindly confirm wheather piping material cost to be considered here or not.	Please refer Addendum-5, Sr.No-55, Revised VAC Technical Specification (Attachment no-9) & Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
26	Final Addendum 1 BOQ	Duct Insulation		(Attachment No-6 to Addendum No-1) PART-C - OCC BUILDING VAC System Page No-170	6.Design, Supply. Installation, testing and commissioning of insulation on the surface of the duct per specifications. The rates shall include all materials of the insulation and labour works with adhesive, complete as required and specifications.	Kindlly confirm the insulation material type.	Please refer Addendum-5, Sr.No-55, Revised VAC Technical Specification (Attachment no-9) & Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
27	Final Addendum 1 BOQ	H.05 CHEMICAL DOSING		(Attachment No-6 to Addendum No-1) PART-C - OCC BUILDING VAC System Page No-170	1.Design, Supply. Installation, testing and commissioning of chemical dozing arrangement complete with three sets of tanks with associated items like pump, piping, valves and chemicals for condenser circuit and one pump with associated items for chilled water circuits.	Air cooled chiller is there so there is no requiremenrt of condenser circuit chemical dosing.	Please refer Addendum-5, Sr.No-55, Revised VAC Technical Specification (Attachment no-9) & Please refer Addendum-5, Sr.No. - 59. Revised BOQ - (R2) (Attachment no-11)
28	Final Addendum 1 Addendum No. 1 Sr. No. 1				Date & time of Submission of Tender 05-10-2017 up to 1800 Hrs. Date & time of opening of Tender (Tender Security + Technical) 06-10-2017 from 1100 Hrs.	We request you to extend bid submission date for 6 weeks from date of clarification from you on our queries.	Refer Addendum - 5
29						This is with reference to the above mentioned subject work, we hereby humbly request you to grant us an extension of four weeks from the current submission date (i.e. 05/10/2017) The given time shall definitely help us to submit our best competitive techno-commercial proposal, with an in-depth study of all the tender details.	Refer Addendum - 5
30						As per NIT the due date for submission of the above tender is 04-10-2017. Due to festive season and public holidays in the intervening period, and due to changes to be carried out in the BOQ due to changes in GST rules, we need some more time for preparation of the same. Hence we request you to extend the tender submission date up to 20th October 2017.	Refer Addendum - 5
31						Please be informed that we really interested to participate in above tender. However considering the job involvement there, to collect the quotation of Bought Out Item we require another 15 working days time to submit our best price offer. Under the above circumstances we would request to you to please extend the tender submission date up to 20.11.2017 to enable us to submit our best proposal.	Refer Addendum - 5

APPENDIX – 11 WORK EXPERIENCE (Revised)

Applicant's Legal Name: [insert full name]

Date:

Group Member's legal name: [insert full name]

Page _____ of _____ pages

For similar works as per clause no. 1.1.3.2 (A) or more value of work done shall be updated to the price level as on date of tender submission (considering escalation as per Clause 1.1.3.2 Notes).

Specific Construction Experience		
Similar Contract Number____of_____required	Information	
Contract Identification		
Award date Completion date		
Employer's Name		
Employer's Address: Telephone / Fax number: E Mail		
Role in Contract (Individual/JV/JVA member)	Individual	JV Member.
Completion Cost	Currencies (as stated in Clients Certificate)	In equivalent INR updated to the price level as on date of tender submission.
If JV member, specify percentage participation in contract & amount (Please refer Note-1)	% participation	In equivalent INR and considering escalation as described above.
Quantum of similar work in support of clause no. 1.1.3.2. A & B		In case of JV/JVA, actual works executed by the Applicant (duly substantiated with Client Certificate).

NOTE:

(i) Only the value of contract as executed by the applicant/member in his own name should be indicated. Where a work is undertaken by a group, JV/JVA only that portion of the contract which is undertaken by the concerned applicant/member should be indicated and the remaining done by the other members of the group be excluded. This is to be substantiated with documentary evidence.

(ii) Separate sheet for each work along with Clients Certificate to be submitted.

APPENDIX – 11-A
SPECIALIST SUB-CONTRACTOR WORK EXPERIENCE FOR HT-GIS WORKS ONLY

Applicant's Legal Name: [insert full name]

Date:

Group Member's legal name: [insert full name]

Page _____ of _____ pages

For similar works as per clause no. 1.1.3.2 (A) or more value of work done shall be updated to the price level as on date of tender submission (considering escalation as per Clause 1.1.3.2 Notes).

Specific Construction Experience		
Similar Contract Number____of_____required	Information	
Contract Identification		
Award date Completion date		
Employer's Name		
Employer's Address: Telephone / Fax number: E Mail		
Role in Contract (Individual/JV/JVA member)	Individual	JV Member.
Completion Cost	Currencies (as stated in Clients Certificate)	In equivalent INR updated to the price level as on date of tender submission.
If JV member, specify percentage participation in contract & amount (Please refer Note-1)	% participation	In equivalent INR and considering escalation as described above.
Quantum of similar work in support of clause no. 1.1.3.2. A & B		In case of JV/JVA, actual works executed by the Applicant (duly substantiated with Client Certificate).

NOTE:

(i) Only the value of contract as executed by the applicant/member in his own name should be indicated. Where a work is undertaken by a group, JV/JVA only that portion of the contract which is undertaken by the concerned applicant/member should be indicated and the remaining done by the other members of the group be excluded. This is to be substantiated with documentary evidence.

(ii) Separate sheet for each work along with Clients Certificate to be submitted.

Annex A1

Required Number of Copies of Submittals and Format Requirements

Submittal	No. of paper copies			No. of electronic copies	Ref
	A1	A3	A4		
Initial Programme and Works Programme plus supporting information and narrative		6		2	
Monthly Programme Update		6		2	
3 Month Rolling Programme		6		2	
3 Week Rolling Programme		6		2	
Monthly Progress Report			6	2	
Preliminary and Definitive Designs	3	3		2	
Installation Reference Drawings	3	3		2	
Working Drawings	3	3		2	
Method Statements			6	2	
Interface Management Plan			6	2	
As built drawings	6			2	
Materials Submissions (documentation)			6	2	
Operation and Maintenance Manuals			6	2	
E&M Submissions			6	2	
Quality plan			6	2	
Quality Control Register			4	2	
Reports of Quarterly Quality Audits			4	2	
Materials and Workmanship Test Results/Reports			6	2	
Safety Plan			6	2	
Environmental Plan			6	2	
Traffic Management Submissions			6	2	
Investigation and survey reports.			6	2	
Monitoring, protection and replacement proposal reports			6	2	
All other submittals	6	6	6	2	

Notes:

a) In case of any contradiction between the text and this table then the text shall prevail, unless otherwise instructed by the PM.

ii) Drawings to support A4 text documents shall be of A3 size.

18 - Employer's Requirement for OHS.

1. Scope

1.1 The Employer's Requirements for OHS&E details the Safety, Health and Environmental control measures that all Contractor and any other agency, who work on the Mumbai Metro Rail Corporation construction sites or associated premises shall be required to comply.

1.2 Application of this document

1.2.1 The Employer's Requirements, for OHS&E applies to all aspects of the Contractor's scope of work, including that conducted by their appointed sub- Contractor and other agencies on their behalf. There shall be no activity associated with the Mumbai Metro Line 3 Project, which is exempted from the purview of this document. The Employer's Requirements OHS&E is supplemented with a further 2 OHS&E Appendices for ease of reference (refer Volume 3– GS appendices,). Their individual scope and applicability is as follows;

a) This OHS&E document is the controlling document for all Contracts and is fixed throughout the term of the project. Compliance with this OHS&E document is mandatory.

b) OHS&E Appendix 17 (Refer Volume 3 –GS) provides Safety & Health guidance that the Contractor may choose to use unless stated as mandatory within this document. The contents of OHS&E Appendix 17 remain subject to revision by the Engineer in the event of new Legislation or changing circumstances. The information contained within Appendix 17 shall be used by the Engineer in assessing the sufficiency and suitability of the Contractor's management systems and performance.

c) OHS&E Appendix 18 (Refer Volume 3 –GS) provides Environmental guidance and procedural requirements for the project. Appendix 18 remains subject to periodic revision and updating.

1.3 Purpose of this document

The purpose of this document, the Employer's Requirements for OHS&E is to provide Contractors and other interested parties with the mandatory requirements relating to Health, Safety and the Environment practices and performance expectations on the Mumbai Metro Line 3 Project.

This document:

1.3.2 Describes the OHS&E interfaces between the Employer, Engineer and the Contractor;

1.3.3 Details the processes by which the Contractor shall manage OHS&E issues while carrying out the works under the contract and;

1.3.4 Describes by reference, the practices, procedures and requirements pertaining to the Mumbai Metro Line 3 Project.

1.4 Mumbai Metro Rail Corporation OHS&E Objectives

Mumbai Metro Rail Corporation has identified five principle objectives for attainment during the Mumbai Metro Line 3 project. These long term objectives shall be supported with quarterly, short and medium term objectives to enable structured advancement in overall performance. Our Short and medium term objectives also aims to facilitate effective

monitoring and measurement to identify where a directional change may be necessary. Our Long term objectives are:

1.4.1. To eliminate or minimize the unwanted effects of hazards and risks to personnel, members of the public and other stakeholders who may be exposed to the undertakings associated with the construction of the Mumbai Metro Line 3 project.
1.4.2. Establish an effective and robust OHS&E management system that will enable Contractors to achieve international recognition and registration to the BS EN 18001:2007 Series.
1.4.3. Actively contribute to Contractors development through support, encouragement, determination in control and transfer of knowledge and skills in order to make the move from traditional compliance driven management through to risk managed processes.
1.4.4. To simplify the risk concept, to ensure a sensible approach to risk management and simplify hazard awareness training through adoption of the ALARP (As low as reasonably practicable) principles.
1.4.5. To practice 'Best Practice' within the construction industry - Establishing a work environment that conforms to international health & safety standards and make recommendation to improve effectiveness of regulations both nationally and locally.

2 Reference publications

BS EN ISO 9000:2005,	Quality management systems — Fundamentals and vocabulary
BS EN ISO 9001:2008,	Quality management systems — Requirements
BSENISO 14001:2004,	Environmental management systems — Requirements with guidance
BS EN ISO 19011:2002,	Guidelines for quality and/or environmental management systems auditing
BS OHSAS 18001:2007,	Occupational health and safety management systems Requirements
BS OHSAS 18002,	Occupational health and safety management systems – Guidelines for the implementation of BS OHSAS 18001
PAS 99,	Specification of common management system requirements as a framework for integration
ILO-OSH 2001	International Labour Organization: 2001, Guidelines on occupational health and safety management systems

Health & Safety Guidance (HSG) Health and Safety Executive publications United Kingdom

3 Terms and definitions

3.1 **Acceptable risk.** Risk that has been reduced to a level that can be tolerated by the organization having regard to its legal obligations and its own OHS&E policy
3.2 **Accident.** Incident giving rise to injury, ill health or fatality
3.2 **ALARP** (As low as reasonably practicable) principles.
3.3 **Audit.** Systematic, independent and documented process for obtaining "audit evidence" and evaluating it objectively to determine the extent to which "audit criteria" are

fulfilled

3.4 **BOCWA.** Building and Other Construction Workers (Regular Employment and Conditions of Service) Act, 1996

3.5 **BOCWR.** Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998

3.6 **Chief Safety Expert.** An officer nominated by MMRC who is the overall responsible for monitoring all OHS&E functions prescribed in this document.

3.7 **MMRC**. Mumbai Metro Rail Corporation

3.8 **Competent person.** Person with the appropriate combination of skill, knowledge, qualifications and experience

3.9 **Continual improvement.** Recurring process of enhancing the OHS&E management system in order to achieve improvements in overall OHS&E performance consistent with the organization's OHS&E policy

3.10 **Corrective action.** Action to eliminate the cause of a detected nonconformity or other undesirable situation

3.11 **Design Risk Assessments**. Used to record the actions of designers when reducing risks in construction and for future repairs and maintenance issues.

3.12 **Employer**. Mumbai Metro Rail Corporation (MMRC).

3.13 **Hazard.** Source, situation, or act with a potential for harm in terms of human injury or ill health, or a combination of these

3.14 **Hazard identification.** Process of recognizing that a hazard exists and defining its characteristics

3.15 **Health surveillance.** Monitoring health of employees to detect signs or symptoms of work‑related ill health so that steps can be taken to eliminate, or reduce the probability of, further harm

3.16 **Ill health.** Identifiable, adverse physical or mental condition arising from and/or made worse by a work activity and/or work-related situation

3.17 **Incident.** Work-related event(s) in which an injury or ill health (regardless of severity) or fatality occurred, or could have occurred. An accident is an incident which has given rise to injury, ill health or fatality. An incident where no injury, ill health, or fatality occurs may also be referred to as a "near-miss", or "dangerous occurrence".

3.18 **Interested party.** Person or group, inside or outside the workplace, concerned with or affected by the OHS&E performance of an organization

3.19 **Nonconformity.** Non-fulfilment of a requirement; A nonconformity can be any deviation from: relevant work standards, practices, procedures, legal requirements, etc. or OHS&E management system requirements. Nonconformity can be any deviation from: — relevant work standards, practices, procedures, legal requirements, etc. — OHS&E management system criteria.

3.20 **OHS&E management system.** Part of an organization's management system used to develop and implement its OHS&E policy and manage its OHS&E risks. A management system is a set of interrelated elements used to establish policy and objectives and to achieve those objectives. A management system includes organizational structure, planning activities (including for example, risk assessment and the setting of objectives), responsibilities, practices, procedures, processes and resources.

3.21 **OHS&E objective.** OHS&E goal, in terms of OHS&E performance that an organization sets itself to achieve.

3.22 **OHS&E performance.** Measurable results of an organization's management of its OHS&E risks

3.23 **OHS&E policy.** Overall intentions and direction of an organization related to its OHS&E performance as formally expressed by top management

3.24 **Preventive action.** Action to eliminate the cause of a potential nonconformity (3.19) or other undesirable potential situation

3.25 **Procedure.** Specified way to carry out an activity or a process

3.26 **Record.** Document stating results achieved or providing evidence of activities performed

3.27 **Risk.** Combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure(s)

3.28 **Risk assessment**. process of evaluating the risk(s) arising from a hazard(s) taking into account the adequacy of any existing controls, and deciding whether or not the risk(s) is acceptable.

3.29 **Risk control.** Selection and application of suitable measures to reduce risk

3.30 **Shall**. Indicates a mandatory requirement within this document

3.31 **Stakeholders.** Those with a interest in an organization's achievements that includes, but is not limited to, internal and "outsourced" employees, customers, suppliers, partners, employees, distributors, investors, insurers, shareholders, owners, government and regulators.

3.32 **Status review.** Formal evaluation of the OHS&E management system

3.33 **Top management.** Person or group of people who direct and control an organization at the highest level

3.34 **Worker representative.** Representative of employee occupational health and safety.

4 SHE management system requirements

4.1 General requirement

4.1.1 The Contractor shall define and document the scope of its Occupational Safety Health and Environmental (OHS&E) management system to meet legal requirements and the requirements of Mumbai Metro Rail Corporation as stated within this document.

4.1.2 The Contractor's OHS&E management system shall determine how the organization shall document, implement, maintain and continually improve upon performance in accordance with the requirements of the International OHSAS Standard to which the Employer is committed.

4.2 MMRC OHS&E Policy Statement of Intent

Mumbai Metro Rail Corporation consider that health, safety and environmental is of equal importance in comparison to any other aspect of business management and as such is committed to promoting high standards of safety, health, environment and welfare on all of their sites and premises. To achieve this Mumbai Metro Rail Corporation shall:

- Constantly work towards improving the safety culture at all levels.
- Ensure compliance with all relevant legal duties in respect of health and safety at work legislation.
- Provide adequate resources for planning and controlling working conditions and safe systems of work.
- Work with our Contractors and suppliers to improve their safety performance, by Measuring and monitoring their performance.

Responsibilities and performance requirements for Safety, Health and the Environment are summarised as follows: -

- All Contractors, employees, sub-Contractors, consultants, suppliers and visitors have a duty to play an active role in achieving our objectives through compliance with their legal obligations and this Safety Policy.
- Participation and consultation are vital aspects of this Policy and to the achievement of our objectives. Contractors and Staff are encouraged and expected to:
  - Discuss safety, health and welfare matters with their managers, and company Safety, Health & Environmental Representatives who will offer or obtain further expert advice, where necessary.
  - Co-operate at all times; contribute good ideas and improvements; report defects and short falls.

The correction of any breach of statutory provision or Mumbai Metro Rail Corporation requirements on health and safety shall take priority. Should appropriate action not be taken to meet the required standards, this will be taken seriously and may lead to disciplinary action being taken.

This Policy Statement shall be displayed prominently on all Mumbai Metro Rail Corporation sites and offices and will be kept under review to ensure its relevance.

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Managing Director
Mumbai Metro Rail Corporation

4.3 Planning

4.3.1 Hazard identification, risk assessment and determining controls

a The Contractor shall submit a procedure detailing the process in place for the identification of Hazards and Risks and the determination of control measures including the relevant standards as per clause 4.4.4 on documentation. The Procedure shall incorporate the Employer's Requirements within this and other applicable OHS&E Volumes.

b Management of Change

i All temporary and permanent changes to organisational, personnel, systems, procedures, equipment, products, materials or substances shall be evaluated by the Contractor and managed to ensure that health, safety and environmental risks arising from these changes remain at an acceptable level. Changes made by the Contractor are subject to submittal and notice of no objection by the Engineer prior to adopting change.

c Risk Register & Hazard Log

i The Contractor's Construction Health and safety Plan shall contain a detailed 'Risk Register' and 'Hazard Log' specific to the project. The register and log shall be assessed against the MMRC OHS&E requirements Appendix 17

ii The Hazard Log shall identify future method statement, risk assessment and operational procedures pertaining to specific equipment and operations in relation risk and local environmental constraints. Construction phase OHS&E Plans shall not be accepted without a fully completed Hazard Log and Risk Register.

d Method Statements

i Method statements are to be submitted to the Engineer a minimum of 21 days prior to task commencement to ensure sufficient time is available for review and notice of no objection.

ii Method statements shall contain the information requirements as prescript within the MMRC OHS&E Appendix-17.

iii Method statements shall incorporate the control measures within the process methodology as identified within the risk assessment.

iv A copy of the relevant method statement for the activity being undertaken shall be available on site for reference by all site management and supervisors.

e Risk Assessment production & submittal

i Risk assessments shall contain as a minimum, the information as specified within the MMRC OHS&E Appendix-17. The Contractor may choose to use their own format however the risk tolerances, probability and consequences must be included.

ii Risk assessments shall be produced and submitted to the Employer's a minimum of 21 days prior to task commencement for notice of no objection. Risk assessments may be submitted independently or as part of a Method Statement.

iii Generic risk assessments other than routine activities of low risk shall not be accepted by the Employer.

iv Risk assessments shall be regularly reviewed to ensure they remain suitable and sufficient. Risk assessment reviews shall be undertaken where an incident has

occurred and when a change in location may introduce additional risks from construction activities.

v Substances hazardous to health shall be subject to assessment by the Contractor. Where Hazardous substances are identified for use within a process the assessment and determining controls shall be included within the relative method statement.

f Design Risk Assessment

i Design Risk Assessments shall be submitted to the Engineer for granting of no objection. Design risk assessments shall accompany all drawing submittals for operations involving;

- Temporary works,
- Formwork & false-work
- Heavy lifting equipment.

ii Drawings shall not be accepted by the Engineer without an accompanying design risk assessment.

4.3.2 Legal and other requirements

a Contractor shall comply with all legal obligations and the requirements of Mumbai Metro Rail Corporation as contained herein.

b Indian statutory requirements

The Contractor shall abide by all national, state and local bye-laws. It is the duty of the Contractor to ensure that all Sub-contractors appointed also comply with their legal obligations as listed below but not limited to:

i. Indian Electricity Act 2003 and Rules 1956
ii. National Building Code, 2005
iii. Factories Act, 1948,
iv. Motor Vehicles Act as amended in 1994, The Central Motor Vehicles Rules, 1989.
v. Indian Road Congress Code IRC: SP: 55-2001 ‘Guidelines on Safety In Road Construction Zones.
vi. The Petroleum Act, 1934 and Rules 1976
vii. Gas Cylinder Rules, 2003
viii. Indian Explosives Act. 1884, along with the Explosives substance Act 1908 and The explosives Rules 1983
ix. The (Indian) Boilers Act, 1923
x. The Public Liability Insurance Act 1991 and Rules 1991
xi. Minimum Wages Act, 1948 and Rules 1950
xii. Contract Labour Act, 1970 and Rules 1971
xiii. Child Labour (Prohibitions & Regulations) Act, 1986 and Rules 1950
xiv. Environment Protection Act, 1986 and Rules 1986
xv. Air (Prevention and control of Pollution) Act, 1981
xvi. Water (Prevention and Control of Pollution) Act, 1974
xvii. The Noise Pollution (Regulation & Control) Rules, 2000

xviii. Notification on Control of Noise from Diesel Generator (DG) sets, 2002
xix. Recycled Plastic Usage Rules, 1998
xx. Notification, Central Ground Water Board, Act January 1997
xxi. Manufacture, Storage & Import of Hazardous Chemicals Rules, 1989
xxii. The Hazardous Waste (Management & Handling) Rules, 1989
xxiii. Hazardous Waste Management Rules 1989 (as amended in 1999)
xxiv. Batteries (Management and Handling) Rules
xxv. Fly ash utilization notification, Sept 1999 as amended in August 2003
xxvi. Workman Compensation Act, 1923 along with allied Rules.

c International Standards, Guidelines & ISO Certifications

i If the requirements stated in this document are in conflict or inconsistent with the requirements of applicable laws, the more stringent requirements shall apply.

ii The works shall be undertaken in accordance with the applicable international guidelines, standards and specifications on OHS&E and every Contractor shall actively pursue the achievement of:

- BS EN OHSAS 18001:2007 - OHS Management Systems
- ISO 14001-2004: Environmental Management Systems

iii The process of international certification to BS EN 18001:2007 and ISO 14001-2004 standard shall commence immediately after the award of Contract through appointment of ISO accrediting body for obtaining the certification. Should this not be undertaken by the Contractor within 3 months of the Contract award, the Engineer shall appoint at the Contractor's cost.

iv Should the Contractor already posses such certification, the scope of the CMR project must be included on the Contractor's certification within 1 year of Contract commencement and proof of such attainment demonstrated to Mumbai Metro Rail Corporation.

4.3.3 Objectives and programme(s)

a The Contractor shall maintain procedures to establish detailed OHS&E objectives and performance criteria. Such objectives and performance criteria shall be developed to incorporate the Mumbai Metro Rail Corporation policy and strategic OHS&E objectives. The Contractor's objectives shall be quantified, wherever practicable, and identified with defined timescales. The Contractor is required to submit for notice of no objection their procedure and objectives as per clause 4.4.4.1 of this control document.

4.4 Implementation and operation

4.4.1 Resources, roles, responsibility, accountability and authority

a The Contractor shall detail within the Construction Health, Safety and Environmental Plan the planned roles and resources allocated for the MMRC project. In addition to the staffing arrangements the Contractor shall prescribe the responsibilities specific to role, accountability and the authority under which they operate.

b Safety, health & environmental resources shall be provided by the Contractor as per

the Contract value in table 1.

Table 1 Mandatory Contractor OHS&E management resource requirement

<table>
<tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Contract Value in (Cr.)</td><td>Chief OH S&E Manager</td><td>Senior OHS&E Manager</td><td>Junior OHS&E Manager</td><td>Safety Steward</td><td>Senior Electrical Engineer</td><td>Junior Electrical Engineer</td></tr>
<tr><td>Up to 2</td><td>-</td><td>-</td><td>1</td><td rowspan="5">Refer to note 1</td><td>-</td><td>1</td></tr>
<tr><td>Up to 10</td><td>-</td><td>1</td><td rowspan="5">Refer to note 1</td><td>1</td><td rowspan="5">Refer to note-2</td></tr>
<tr><td>Up to 25</td><td>1</td><td rowspan="4">Refer to note 1</td><td>1</td></tr>
<tr><td>Up to 100</td><td>1</td><td>1</td></tr>
<tr><td>Up to 250</td><td>1</td><td>1</td></tr>
<tr><td>250 or More</td><td>1</td><td></td><td>1</td></tr>
</table>

<table>
<tr><td></td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr>
<tr><td>Contract Value in (Cr.)</td><td>Occupational Health Officer with qualified First Aider (Refer Note 3)</td><td>Environmental Manager</td><td>Fire Officer (Refer Note 4)</td><td>Housekeeping & Barricade Maintenance</td><td>Labour Welfare Officer</td></tr>
<tr><td>Up to 2</td><td>-</td><td>-</td><td>-</td><td rowspan="6">Refer to Note 5</td><td>-</td></tr>
<tr><td>Up to 10</td><td>1 (PT)</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Up to 25</td><td>1 (PT)</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Up to 100</td><td>1 (PT)</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Up to 250</td><td>2 (FT)</td><td>1</td><td>1</td><td>1 with support staff</td></tr>
<tr><td>250 or More</td><td>2 (FT)</td><td>1 with support staff</td><td>1</td><td>1 with support staff</td></tr>
<tr><td>Note 1</td><td colspan="5">Qualified and trained OHS&E Professionals as per Table 2 with required support staff to be deployed at each worksite at each shift. Qualifications of appointed OHS&E personnel shall be in accordance with section 4.4.2 Competence, Awareness and Training within this document.</td></tr>
<tr><td>Note 2</td><td colspan="5">Qualified and trained Electrical Engineers/Supervisors to be deployed at each worksite for each shift.</td></tr>
<tr><td>Note 3</td><td colspan="5">(PT) means Part- Time and (FT) means Full-Time.</td></tr>
<tr><td>Note 4</td><td colspan="5">Senior OHS&E (Traffic) Engineer Post and Barricade Manager posts are applicable to contracts where the work has to be executed either below or over the public right-of way such as Viaduct, Station contracts.</td></tr>
<tr><td>Note 5</td><td colspan="5">One Housekeeping Manager/ Barricade Manager supported by required supervisors and workmen necessary to maintain a clean and tidy site or yard.</td></tr>
</table>

c Responsibility

i The General Manager of the Contractor is responsible and accountable for compliance with the conditions and clauses within this document.

ii The General Manager is responsible to ensure that the necessary resources are allocated and made available to meet the requirements as laid out within this document and other referenced materials to include Legal Requirements (4.3.2).

iii For all works carried out by the Contractor and appointed Sub-contractors, the responsibility for ensuring OHS&E resources remains with the main Contractor. Activities undertaken by the Contractor's Sub-contractors shall be monitored by the Contractor at all times to ensure compliance with agreed safe systems of working.

iv All Contractor's OHS&E personnel shall report to the Chief OHS&E Manager who shall report directly to the General Manager or Corporate Safety Director of the Contractor's organization. This shall be reflected in the Contractor's organization charts within the OHS&E plan and Quality Management Plan.

v The Employer shall monitor adherence to the provisions of Table 1. Where deviation is evident this shall be recorded as a non-conformance.

vi The Contractor shall provide all OHS&E personnel with such facilities, equipment and information that are necessary to enable them to dispatch their duties effectively.

vii The Contractor's Safety Managers, Safety Advisors and Officers are responsible for ensuring that reports on the performance of the OHS&E management system are presented to top management for review and used as a basis for improvement of the OHS&E management system.

viii The Contractor's Safety Managers, Safety Advisors and Officers are responsible for independently monitoring the operations of the Contractor, where deficiencies are identified they are responsible to report their findings immediately to the Site Engineer in charge who then must take action as directed.

d Accountability

i In cases where the Contractor fails to provide the minimum required manpower as

ii illustrated in Table 1**,** or fails to fill vacancies created within 30 days, the same may be provided by the Engineer at the Contractor's cost. Any administrative expenses involved in providing the same for example, vacancy advertisements or recruitment consultant charges, shall also be at the cost of Contractor.

iii No OHS&E personnel shall be permitted to do any work which is unconnected to, inconsistent with or detrimental to the performance of the OHS&E duties.

iv Supervisors must ensure that the employees under their direct supervision are working incompliance with the approved safe systems of working.

e Authority

i The Contractor's Safety Managers, Safety Advisors and Officers authority shall be stated within the Construction Health and Safety Plan and the authority level must be communicated to all Contractor's Staff including Sub-contractors.

ii The Contractor's Safety Managers, Safety Advisors and Officers shall have the

authority as assigned by the General Manager to suspend works where deviation from an approved method of working occurs that presents a risk of injury, equipment or property damage.

iii The Engineer shall have the right to stop the work if in his opinion the work is being carried out in such a way that a risk of injury, property and or equipment damage may exist. The Contractor shall not proceed with the work until remedial works have been complied with under the direction and satisfaction of the Employer. Should the Contractor continue to work without implementing the Engineer's instruction, clause 4.4.2.2 shall be applied to the individual responsible for the decision to proceed.

iv The Contractor shall not be entitled to any damages or compensation for stoppage of work, due to safety reasons. The period of such stoppages of work shall not be taken as an extension of time for completion of the facilities and will not be the ground for waiver of levy of liquidateddamages.

4.4.2 Competence, training and awareness

a The Contractor shall ensure that the recruitment, selection and placement processes shall be in place to ensure that personnel are qualified, competent, and physically fit for assigned tasks. The Contractor shall produce a procedure that shall be made available to the Engineer for notice of no objection as per Clause 4.4.4. of this document. The procedure shall define the processes in place to ensure competence.

b The Contractor's attention is drawn to Volume 2 Section IV General Conditions Clause 6.9 , whereby any person employed thereon, who in the opinion of the Engineer, misconducts himself or is incompetent or negligent or fails to conform with any particular provisions with regard to safety, health or environment which is set out in the Contractor's OHS&E Plan or a requirement of the Contract, or persists in any conduct which is prejudicial to safety or health, shall be removed from site immediately, and such persons shall not be employed again upon the Works. The decision of the Engineer in this regard shall be final.

c Notice of No Objection from the Engineer

  i The name, educational qualifications and work experience for all persons intended for a Contractor's OHS&E role shall be submitted to the Engineer for notice prior to employment. Only upon notice of no objection by the Engineer shall OHS&E personnel be authorized to work on a MMRC site.

  ii The Contractor shall appoint the required OHS&E personnel in accordance with the qualifications and experience as listed in Table 2.

Table 2 OHS&E Personnel Qualifications & Experience

Item	Designation	Qualification	Experience (Yrs)
1	Chief OHS&E Manager	The Chief OHS&E Manager shall be qualified in any of the following degrees/diplomas: Post Graduate Diploma in Industrial Safety & Environmental Management (PGDISEM) M.E. in Industrial Safety from NIT, B.E. in Fire and Safety Engg. B.E/DE. with DIS from CLI/RLI only. B.E / B.Arch., with one year Full Time advanced Safety diploma B.E/B.Tech full time Degree / Diploma in Safety. International qualifications, CSP (Certified Safety Professional), NEBOSH, MIOSH, MSISO, etc.	15
2	Senior OHS&E Manager	As stated in Sl. No:1 and in addition the following categories: i) B.Sc.(Physics/Chemistry/Maths) with one year Full Time advanced Safety diploma ii) B.Sc. / Diploma in Engg. with advanced safety Management Diploma iii) B.Sc. (Physics/Chemistry/Maths) with One year Full Time diploma in Safety Engineering iv) Any Graduate or diploma holder with 7 years of work experience in a OHS&E department upon approval of Engineer.	2 years for category (i) (ii) and (iii)
3	Junior OHS&E Manager	i) Degree in Science / Diploma in Engineering with Govt. recognized safety diplomas ii)Any Graduate or diploma holder with 5 years of work experience in a OHS&E department with prior approval of Engineer (on a case to case basis)	i) 2 Years
4	Safety Steward	Any basic qualification with any OHS&E related certificate courses.	2 Years
5	Senior Electrical Manager	Degree in Electrical Engineering + Govt. Recognized Electrical Licence holder	2 Years
6	Electrical Manager	Diploma in Electrical Engineering + Govt. Recognized Electrical Licence holder	1 Year
7	Occupational Health Officer	MBBS with Govt. recognized degree/diploma in Industrial/ occupational health	1 Year
8	Environmental Manager	Govt. recognized PG Degree / PG Diploma / Degree in Environmental Engineering / Science	2 Years

9	Fire Officer Engineer	Govt. recognized PG Degree / Degree / Diploma in Fire Engineering	1 Year
10	Housekeeping & Barrier Manager	Any Diploma in Engineering	1 Year

iii Where a potential candidate has previously worked in a Metro Rail construction environment and does not possess the qualifications and or the necessary experience as listed in Table 2 for the particular role, the Engineer may upon a successful interview of the candidate grant a waiver subject to successful completion of a probation period of 3 months.

iv In order to effectively interact on labour welfare matters with the Engineer and the statutory authorities enforcing the labour welfare legislations every Contractor shall employ a full time Labour Welfare Officer duly qualified and experienced as per clause

d OHS&E Induction Training

i The Contractor shall ensure that all personnel (Workers/Staff/Employees/Sub- Contractors and their personnel) working at the site receive an induction OHS&E training of at least 2 weeks (96 hrs) explaining the nature of the work, reporting & communication routes the hazards that may be encountered during the site work and the particular hazards attached to their own function within the operation. The training shall cover as a minimum the contents as directed within OHS&E Appendix 17 (refer –Volume 3-GS,).

ii Records of all inductions shall be maintained by the Contractor and be made available for inspection by the Employer upon request.

iii The Contractor shall provide their workforce and management staff with an OHS&E induction Handbook containing the information as per the induction training.

iv A condensed induction shall be given by the Contractor to all visitors. The induction briefing shall include the risk and hazards associated with the particular site and the operations being conducted.

v All personnel shall be issued a temporary ID upon the completion of the Contractor's' induction. The temporary ID shall be signed by the Human Resource Manager or appointed representative and limited to a 2 week validity period at which time the temporary ID shall be replaced with a permanent ID including photograph.

vi Individuals found on site by the Engineer without-dated temporary ID cards shall be removed from site

e OHS&E Training

i The Contractor shall assess the training requirements for all the employees, plan and initiate a training program to fulfil the training needs assessment. The assessment of training needs shall incorporate all levels of staff including Sub-contractor's against an individual's role,

responsibility, ability, language skill and risk.

ii The Contractor shall produce a 'Training Implementation Plan' to incorporate the findings of the needs assessment.

iii The training needs assessment together with Implementation Plan shall be submitted to the Engineer for notice of no objection within 4 weeks of commencement. The Engineer shall evaluate the assessment and plan against the base line training matrix contained within OHS&E Appendix 17 (refer Volume 3-GS).

iv Records of all training conducted shall be maintained and made available for inspection by the Engineer upon request.

v Should the Contractor fail to provide the training identified within the Contractor's assessment, implementation plan and the Engineer's Training matrix within the agreed timescales, this shall be reflected in the potential scores awarded within the monthly audit report.

vi Specific training with regard to the provisions of the Construction Safety Plan, and associated operational and system procedures shall be conducted by the Contractor for all persons with supervision responsibilities. Records of training including duration shall be maintained.

4.4.3 Communication, participation and consultation

a Communication

i The Contractor shall produce a 'High Quality' quarterly newsletter on a rotational basis with other Contractors. Rotation shall be announced within the Engineer's OHS&E Committee meetings.

ii All Contractors including the Engineer shall provide input into the rotational Contractor for the newsletter content such as details of accidents, incidents and near misses together with any lessons learned; specific safety initiatives; internal competitions and workforce awards etc.

iii The Engineer shall be issued the draft newsletter for review prior to the Contractor's publishing.

iv The OHS&E Newsletters shall publicize all Contractors OHS&E performances over the previous 3 months in relation to OHS&E Audits and shall form the basis for the Engineer's Awards program. Results of audits shall be provided by the Engineer for inclusion.

v The quarterly newsletters shall be issued to all interested parties and be promulgated at site level. Where language barriers exists the contents of the newsletters shall be communicated by the Workforce Representative to ensure understanding.

vi At site level the Contractor shall erect pertinent awareness signage and posters. Posters shall be changed on a monthly basis to maintain impact.

vii Poster campaigns shall be discussed and agreed at the Engineer's Committee Meeting to maintain a consistent improvement program across all MMRC Sites.

viii Informational posters, banners etc. shall be provided both in Marathi/Hindi and English.

ix Toolbox talks or team briefings shall be carried out daily by the Contractor and correspond to the works activities being undertaken or to communicate

a specific awareness initiative. Toolbox talks shall not replace professional training.

x Records of all toolbox talks undertaken together with the date, topic, participant's names and signatures shall be maintained and made available for inspection by the Engineer.

xi Method statement and risk assessment briefings shall be carried out prior to the commencement of a new task and or when a change to the method of working arises. Records of all such briefings shall be maintained by the Contractor.

xii Visitor information signage shall be posted at site entrances detailing where to report and contact information. Note: visitors shall be accompanied at all times by site security where office locations require walking through operational areas.

xiii Public Liaison

xiv Public informational signage and Contractor contact information shall be posted externally to the site.

xv The Contractor shall appoint an individual as a Public liaison Officer to communicate directly with members of the public regarding forthcoming operations, what to expect, noise expectancy, duration of operations etc.

b Participation and consultation

i The Contractor shall establish a Safety Committee within 4 weeks of commencement that shall be chaired by the Contractor's Project Manager.

ii The Contractor shall notify the Engineer of the establishment of the Committee together with the committee members' names and designation. The Contractor's Chief Safety Manager, Senior Safety Manager, Plant & procurement Manager and Human Resources Manager shall form the minimum committee members. Site based personal shall be represented within the Committee by the attendance of Site Manager(s) and the Workforce OHS&E Representative.

iii The Engineer shall be invited to attend the Contractor's Safety Committee meetings.

iv The Contractor's OHS&E Committee shall meet on a monthly basis throughout the duration of the Contract.

v The Committee shall review the previous month's performance, to include, inspections and audits undertaken, accidents and incidents and any concerns or complaints that have been raised. Short term objectives and targets for improvement shall be set for completion by the next scheduled Committee meeting.

vi The Safety committee shall undertake a formal site inspection to be scheduled on a 2 monthly basis. The inspection shall review progress regarding the achievement of short term targets. The Committee shall produce a report stating progress made together with any corrective actions required and issue to the Engineer within 7 days following the Inspection.

vii Minutes of the Committee meeting shall be issued within 2 days and promulgated to all members including the Engineer. The minutes of meeting shall also be posted on all sites within the workforce area. The minutes

intended for site communication shall be in both Marathi\Hindi and English.

c Engineer's OHS&E Committee

i A Safety Health and Environmental Committee shall be established by the Engineer and shall sit every 3 months throughout the project period. All Contractors shall be required to attend the quarterly meetings who shall be represented by their General Manager and Chief Safety Manager.

ii The Committee shall review previous performances project wide and set short and medium term objectives and targets for achievement within the next reporting period.

iii The Engineer reserves the right to call an Emergency Meeting of the Committee members in the event of a serious incident that requires immediate change to the operational methods of working.

iv Minutes of the Engineers OHS&E Committee shall be promulgated to all Contractor's within 3 days.

d Workforce Representation

i All workers shall have access to a Workforce OHS&E Representative who is responsible to communicate directly with the labour force with regard to safety and health. The representative's name and contact number shall be posted on all sites externally to the site office.

ii The Workforce OHS&E Representative shall be made a member of the OHS&E Committee and attend all meetings.

iii The OHS&E Representative shall meet the labor force on a monthly basis to discuss health, welfare, safety initiatives and or concerns the workforce may have. Minutes are to be produced by the Representative and issued formally within 2 days after the meeting date to the Contractor's Project Manager, General Manager and Engineer

iv A lockable site suggestion box to which only the workforce OHS&E Representative shall have access shall be installed on all sites and within any labour accommodation camps. The suggestion box shall be located independent from any offices, in a public area and protected from bad weather. The OHS&E Representative shall inform the workforce that the purpose of the suggestion box is to provide a means of participation, communicating ideas and initiatives and also for raising concerns without fear of reprisal.

v The contents of all suggestion boxes shall be collected and collated on a weekly basis. Where concerns or complaints regarding the standards of health, safety or welfare have been reported these shall be immediately reported to the Chief OHS&E Manager and Project Manager who shall investigate the concern(s). Records of such investigations and resultant outcomes shall be maintained.

vi Ideas, suggestions and concerns raised by the workforce during the OHS&E representative's on site monthly meetings shall form an agenda item within the Contractor's OHS&E Committee meeting.

vii Where an idea or specific suggestion is subsequently adopted for use by the Contractor's OHS&E Committee, the individual shall receive an OHS&E

award as determined by the Contractor.

viii 4.4.3.4.7 Where Employee awards are issued this shall be notified to the Engineer to ensure inclusion within the Quarterly Newsletter.

ix 4.4.3.5 Contractor Awards

x The Employer shall recognize the effort, participation and commitment demonstrated by the Contractor by nominating awards. The award type shall be at the discretion of the Employer.

4.4.4 Documentation

a Management System procedures

b The Contractor is required to submit for notice of no objection, the organization's top tier Management System Procedures as listed in Table 3 that shall be adopted for use on the MMRC project.

c System procedures shall be submitted to the Engineer within 4 weeks of commencement.

d Construction works shall not commence until such time as a notice of no objection has been received; applicable to all management system procedures as listed in Table 3. Should the Contractor commence operations on site without notice, the Engineer shall award a 'Zero' audit score for every month of non-compliance with this clause.

e The Engineer shall evaluate the suitability of the Contractor's system procedures against the BS EN 18001:2007 and ISO 14001:2004 standards.

f The submitted procedures shall be individually identified with a unique reference and detail in sequence the scope, purpose, referenced material and procedure processes.

g Where such procedures as listed in Table 3 exist within other areas of the Contractor's organizational management systems such as quality management, these shall not be subject to replication if the procedure makes specific reference to Health, Safety and Environmental control.

h Compliance standards against the Contractor's management system procedures shall be subject to audit by the Engineer.

Table 3 OHS&E Management System Procedures

Hazard identification, risk assessment and determining controls	Communication, participation & consultation	Environmental Impact Aspect Assessment	Objectives and program(s)
Training, awareness and competence	Implementation and operation	Accident & Incident Investigation	Legal requirements
Documentation	Monitoring & Measurement	Emergency Preparedness	Change control
Procurement	Record keeping	Audit	Management review

4.4.5 Control of documents

a All plans, procedures and method statements shall be controlled and subject to review and formal approval by the Contractor's Project Manager prior to issue to the Engineer.

b All documents subject to review by the Engineer shall be signed by the Contractor's Project Manager and issued formally.

c Documents shall be issued as per the Engineer's requirements regarding Quality Management.

d OHS&E Documents shall be issued, maintained, traceable and available for retrieval pursuant to the Contractor's ISO accredited Quality Management System.

4.4.6 Operational control

a Operational control shall be maintained through the implementation of the provisions stated within the Contractor's site specific Construction Health Safety and Environmental Plans, the contents of which are outlined in Safety, Health and Environmental Appendix 17 & 18 (refer Volume 3-GS) to which the Contractor shall comply.

b Construction Phase Health & Safety Plan

i The Contractor shall produce a Contract specific Construction Health & Safety Plan (CHSP) and submit to the Engineer within 28 days of commencement.

ii The Construction Health and Safety Plan shall contain the informational requirements as per the CHSP contents as prescript within the MMRC OHS&E Appendix 17 (refer Volume 3-GS), Safety Plan contents.

iii The CHSP shall be assessed by the Engineer against the provisions as stated within OHS&E Appendix 17 (refer Volume 3-GS). Where deficiencies exist to an extent where an objection is raised, construction activities shall be suspended until such time as the deficiencies are subject to corrective action, re-submittal and notice of no objection by the engineer.

iv Delays incurred as a result of the Contractor failing to achieve a 'No objection' status from failing to submit within the specified timescale or non-compliance with OHS&E Appendix 17 shall be entirely at the Contractor's risk and cost.

v The Contractor shall undertake a monthly review of the CHSP. The review shall be recorded and the Engineer notified of any updates.

c Construction Phase Site Environmental Plan

i The Contractor shall produce a Contract specific Site Environmental Plan (SEP) and submit to the Engineer within 28 days of commencement.

ii The Site Environmental Plan (SEP) shall contain the informational requirements as per the contents as prescript within the MMRC Environmental Management Arrangements Appendix 18 (refer Volume 3–GS), Environmental Plan contents.

iii The SEP shall be assessed by the Engineer against the provisions as stated within the Environmental Management Arrangements Appendix 18 (refer Volume 3–GS). Where deficiencies exist to an extent where an objection is raised, construction activities shall be suspended until such time as the deficiencies are subject to corrective action, re-submittal and notice of no objection by the Engineer.

iv Delays incurred as a result of the Contractor failing to achieve a 'No objection' status from failing to submit within the specified timescale or non-compliance with Environmental Management Arrangements Appendix 18 (refer Volume 3–GS) shall be entirely at the Contractor's risk and cost.

v The Contractor shall undertake a monthly review of the SEP. The review shall be recorded and the Engineer notified of any updates.

d Operational procedures

i The Contractor shall identify within the Hazard Log and Risk Register the operational control procedures that shall be applicable for the MMRC project under their individual scope of works.

ii Operational procedures shall be submitted for review to the Engineer for notice of no objection together with the Construction Site Safety Plan within 4 weeks of commencement.

iii The operational procedures shall be evaluated by the Engineer against the requirements stated within OHS&E Appendix 17 (refer Volume 3–GS), international safety standards such as the International Labour Organisation, European Norms and British Standards where an equivalent Indian Standard does not exist.

iv Construction works shall not commence until such time as a notice of no objection has been received; applicable to all operational procedures as identified within Table 4 and the Contractor's Hazard Log & Risk Register. Should the Contractor commence operations on site without notice, the Engineer shall award a 'Zero' audit score for every month of non-compliance with this clause.

v The submitted procedures shall be individually identified with a unique reference and detail in sequence the scope, purpose, referenced material and procedure processes.

vi In the event that the Contractor is unable to comply with the 28 day timeframe for submittal of the minimum operational procedures as detailed within Table 4, the

vii Contractor shall assign an individual identification reference for the outstanding procedure within the Construction Health, Safety & Environmental Plan together with the statement 'Under process'. The 'Under Process' procedure shall be required to be submitted for notice of no objection a minimum of 28 days prior to commencement of any activity that involves the application of the procedure.

Table 4 Operational Procedures

Lifting Operations & Lifting Equipment	Plant & Equipment	Occupational Health provisions	Emergency Medical Facilities & First Aid
Personal Protective Equipment	Permit to Work Systems	Site Electricity & Distribution	Welding & Cutting operations
Incident Investigation	Traffic Management	Working at Height	Hazardous Substances
Site Security	Fire Safety	Manual Handling	Site Set-up

Abrasive Wheels	Public Interface	Noise and Vibration	Welfare Arrangements

viii The Contractor shall adopt the following colour code scheme across all MMRC Sites to ensure efficient recognition of relevant personnel.

Safety Helmet Colour with Logo	Designation
White	MMRC Staff and Engineer
Violet	Contractor's Engineers & Supervisors
Blue	Sub-Contractor's Engineers & Supervisors
Red	All Electricians
Green	Safety personnel
Orange	Security Guards & Traffic Marshals
Yellow	General Workforce
White (With VISITOR Sticker)	Visitors

4.4.7 Emergency preparedness and response

a Emergency Response Plan

i The Contractor shall prepare a project specific Emergency Plan and submit to the Engineer for notice of no objection. The Emergency Plan shall be submitted within 4 weeks of contract Commencement.

ii The plan must identify the potential for emergencies and the provisions for responding to such emergencies, particular to their environment and location. The Emergency planning arrangements shall be assessed as per the provisions in OHS&E Appendix 17 for suitability.

iii The Contractor shall ensure that all persons including Sub-contractors on site are aware of the emergency to follow in the event of an emergency. Awareness training shall commences at induction and therefore through refresher training such as toolbox talks and monthly emergency drills. Records of refresher training and emergency drills shall be maintained.

iv Site signage shall be erected and detail the emergency process to follow and include emergency telephone numbers, fire, ambulance, police, nearest hospital etc.

v Arrangements shall be made by the Contractor for casualty evacuation and emergency medical treatment. The Contractor shall enter into an agreement with a hospital to provide ambulance services. Alternatively the Contractor shall provide a fully equipped ambulance on-site that shall be manned by a paramedic. This provision shall be subject to the Engineers audit.

4.5 Checking

4.5.1 Performance measurement and monitoring

a The Contractor shall submit a Monthly OHS&E Progress Report no later than 7th of each month to the Engineer. The Report shall contain the minimum information specified within OHS&E Appendix 17 (refer Volume 3–GS). The report shall contain text, tables and colour photographs.

b Site Inspection

i Independent of the plant and equipment inspection, testing and maintenance regimes that shall be stated within the Contractor's Plant and Equipment Procedures, the Contractor shall carry out site monitoring exercises on a daily and weekly basis.

ii The Contractor shall ensure that all monitoring equipment is calibrated as per the manufactures requirements. The Engineer shall be provided with test certificates for such equipment

iii Site Engineers shall be required to participate in daily internal OHS&E inspections to facilitate prompt communication and rectification of minor deviations. Records of such inspections and rectification needs shall be maintained at site level and made available for review by the Engineer other interested parties.

iv Formal site inspection reports shall be produced on a weekly basis by the Contractor's OHS&E personnel for each site and submitted to the Project Director and copied to the Contractor's General Manager.

v The Contractor may choose inspection format of his/her choice, however format shall contain the minimum information as provided within OHS&E Appendix 17 (refer Volume 3–GS) regarding weekly inspection form.

vi The Contractor's OHS&E Personnel shall be accompanied during a formal site inspection by the Site Manager responsible for the particular site. The resulting inspection report shall be signed by both the Site Manager and the OHS&E officer.

vii The Engineer shall formally inspect and report the Contractor's site conditions against the compliance criteria set within the Contractor's operational procedures and the Engineer's requirements on a weekly basis. These inspections shall include batching plant and associated yards.

viii The Contractor shall undertake specific inspections at the Engineer's request where concerns have been raised regarding the suitability of control measures and or plant or equipment condition. Such inspections shall be carried out with immediate effect. Refer IS Standards regarding the maximum permissible age of the plants and equipment.

4.5.2 Evaluation of compliance

a The information submitted by the Contractor within the OHS&E Monthly Progress Report together with the Engineer's Reports shall be evaluated against the Employer's compliance requirements and OHS&E objectives.

b Inspection reports shall be evaluated against the Legal Requirements (4.3.2) to which the Contractor is bound to comply.

c The Contractor's OHS&E Committee shall formally evaluate reports and results of accidents and or injury on a monthly basis. The results of this evaluation such as identified changes to safe systems of working' shall be included with the Committee minutes

d The Engineer shall evaluate 'Accident Injury Rates' and 'Frequency Rates' per

individual Contractor and as a project to determine performance against the international rates. The international rates used to benchmark performance shall be promulgated to all Contractor's and other interested parties.

e A Project Monthly Progress Report shall be produced by the Engineer. Evaluation results shall be included within the relevant sections for Health Safety & the Environment.

f The Contractor's External OHS&E Audits (4.5.5) shall be evaluated by the Engineer against the internal Standards BS EN 18001:2007 AND ISO 14001:2004.

4.5.3 Incident investigation, nonconformity, corrective action and preventive action

a Incident investigation

i The Contractor shall undertake accident investigation for all fatal accidents, major injuries and dangerous occurrences as defined within the OHS&E Appendix 17 (refer Volume 3–GS).

ii In the event of a fatality, major injury or dangerous occurrence, the Contractor shall not disturb the accident scene or remove equipment beyond that required to make the area safe and/or for the treatment and/or removal of casualty(s) to hospital.

iii Should the Engineer find an accident scene disturbed beyond that reasonably expected with making an area safe, this shall be subject to thorough investigation by the Engineer

iv The Engineer shall be informed immediately of all fatalities, major injuries or dangerous occurrences. Any delay in reporting to the Engineer may be subject to disciplinary action.

v The Contractor is responsible to report accidents, incidents and dangerous occurrences to the relevant governing bodies as per their statutory obligations. The Contractor shall maintain responsibility for ensuring Sub-contractor's under their direct control also comply with this requirement.

vi A preliminary accident notification report shall be issued to the Engineer for all fatal and major injuries and or dangerous occurrences within 12 hours as per OHS&E Appendix 17 (refer Volume 3–GS). This shall be followed by the detailed accident report as per OHS&E Appendix 17 within 48 hours of the investigation completion.

vii Near misses and minor accidents should also be investigated by the Contractor as soon as possible as they are signals that there are inadequacies in the safety management system.

viii In case of fatal accidents, major injuries or dangerous occurrences the Engineer shall conduct an independent investigation. The Contractor and his staff shall extend the necessary co-operation.

b Nonconformity, corrective action and preventive action

i The Contractor shall conform to their internal procedures regarding nonconformity, corrective action and preventive action. The Contractor shall be audited by the Engineer for compliance with internal procedures.

ii Major and Minor non-conformances shall be raised by the Engineer as per the

Employer's Quality Management requirements and the OHS&E Audit criteria as defined within OHS&E Appendix 17 .

iii Open non-conformances shall be reflected in the Contractor's Monthly Audit Report and are subject to verification by the (refer Volume 3–GS) as detailed in OHS&E Appendix 17. Failure to successfully take corrective action and close out non- conformances will impact negatively on the Contractor's total quarterly audit score 4.5.5.

iv Where non-conformances have been raised by an External Auditor against the BS EN 18001:2007 or ISO 14001 Standard, the Contractor shall produce and submit for review within 2 weeks, an action plan of how and within what timescale shall the non- conformance(s) be closed-out.

v Where the corrective action and preventive action identifies new or changed hazards or the need for new or changed controls, the proposed actions shall be taken through the risk assessment process. The associated method statement and risk assessment shall be amended and re-submitted to the Engineer for notice of no objection.

vi A change in work methodology shall be communicated to the workforce. Evidence of such communications shall be made available for inspection by the Engineer. The Engineer shall also make random enquiries at site level to establish workforce awareness.

4.5.4 Control of records

a The Contractor shall maintain all OHS&E records in accordance with the Contactors ISO 9001 Quality Management System.

b Records shall be made available to the Engineer upon request for the purpose of incident investigation and management review.

4.5.5 Audit

a Monthly Audit Report (MAR)

i The Contractor shall undertake an internal monthly audit using the process and audit report form (MAR) as prescribed within OHS&E Appendix 17

ii The Contractor shall submit the completed audit report no later than the 7^{th} of each month within the Contractor's monthly OHS&E Report. Failure to submit the monthly audit report within the stipulated timescale shall result in the Engineer awarding a 'Zero' scores for the month.

iii The audit scores awarded internally by the Contractor shall be subject to review and verification by the Engineer. The Engineer shall substantiate the awarded scores through making comparison with the results of a physical site inspection against the model audit scores criteria as provided within OHS&E Appendix 17.

iv The Engineer shall formally verify that the Contractor's self-awarded scores comply with the audit scoring system and scoring criteria as defined within OHS&E Appendix 17 Where discrepancy exists the Engineer shall provide supporting evidence (Photographic) and instruct the Contractor to amend the initial awarded score. Following adjustment, the monthly audit report shall be re-submitted to the Engineer within 3 days.

v The Contractor shall be required to achieve a minimum 65% overall audit score

on a monthly basis.

vi Monthly audit scores shall be totaled over a 3 month (3 audit results) period. Where the average score for three (3) months of audits is below 65%, then the OHS&E lump sum item in the preliminaries section pricing shall be withheld.

vii If non-payment of the lump sum item in preliminaries occurs as a result of failing to achieve the required 65% over a single quarterly reporting period, the Engineer may reinstate the lump sum item at his discretion should the Contractor achieve above 65% for the following six (6) consecutive monthly OHS&E audits equating to two (2) quarterly reporting periods. This repayment of the lump sum item shall not occur if the quarterly aggregate is less than 50%.

viii In the event the Contractor fails to achieve a minimum of 65% on a monthly audit, an action plan shall be submitted together with the audit results detailing the actions that shall be taken within timescales.

ix Monthly audits shall be conducted prior to the sitting of the Contractor's Safety Committee and shall form part of the agenda.

b External OHS&E Audit

i The Contractor is required to conduct external audits by Govt Recognized auditor either as per the BS EN 18001:2007 & ISO 14001:2004 international standards or IS 14489 on a quarterly basis throughout the Contract period

ii External audit through Govt. Recognized auditor and follow up audit reports shall be submitted to the Engineer for review within 7 days of audit completion.

iii Should the Contractor fail to undertake external audits within the 3 month period the Engineer shall appoint an ISO accredited 3rd party agency to conduct the audit at the Contractor's cost.

iv Where 'Major' non-conformances with international standards are identified, a follow- up external audit shall be carried out within 28 days for closing out of the non- conformance(s). Follow-up audits shall continue on a 28 day rotation until such time as Major non-conformances are closed to the satisfaction of the 3rd Party ISO accredited auditor.

4.6 Management review

4.6.1 Management Reviews shall be undertaken annually by the Engineer in compliance with ISO 9001:2008.

4.6.2 The Management Review Report shall make recommendations for improvement.

a The Contractor shall carry out a formal Management Review on an annual basis as a minimum. The Management Review may form part of the review under the organizations Quality Management System.

b The Contractor shall submit Management Review Report to the Engineer within 7 days after meeting completion together with the organizations new objectives.

For contents, refer to **Appendix-17** of this specification.

MUMBAI METRO LINE 3
(COLABA-BANDRA-SEEPZ)

CONTRACT NO: MM 3-CBS-DEM

Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

VOLUME 3 OF 6

EMPLOYER'S REQUIREMENTS
GENERAL SPECIFICATIONS

APPENDIX-7
QUALITY ASSURANCE FORMS

DECEMBER - 2017

Mumbai Metro Rail Corporation Ltd.
Plot No. R-13, 'E' Block,
Namttri Building
Bandra - Kurla Complex,
Bandra (East), Mumbai – 400051, India

Table of Contents

Mumbai Metro Rail Corporation
Request for Inspection (RFI) Form

REQUEST FOR INSPECTION (RFI) (*Detail area to be Inspected)*	
Client:	Contractor:
RFI No:	Date:
We request you kindly arrange for the inspections / checking for the following Works. *(Provide brief description of the salient details of the Contract No)*	
Contract Item No: Specification Clause No: ITP/Hold Point details:	*(Specific area and detail that are requested to be inspected)*
1.Chainage/location: Brief Description of Works:	Safety Precautions taken: Yes/No Check list to be enclosed: Yes/No
Requested by: Name:	Position:
Date & Time:	Signature:
Enclosures: *(Attach QA/QC forms/checklist etc appropriate to inspection)*	
Comments / Recommendations of Employer's Representative	
Employer's Representative OBJECTION / NOTICE OF NO OBJECTION: *(Provide details if OBJECTION)*	
Received Copy by Contractor's Representative: Name:	Position:
Date & Time:	Signature:

Note: R.F.I. to be submitted at least 24 HRS prior to inspection.

Mumbai Metro Rail Corporation

Mumbai Metro Rail Corporation

Transmittal Form

Name		Transmittal Ref no.	
Contract no.		Date of Submission	
Sign			
Project Manager / His representative name			

Stages of submission –

Design	Execution	Test

We submit:

☐ Plans ☐ Specification ☐ Separately Via _____

☐ Work plan & Methodology ☐ BOQ

☐ Design criteria & Studies ☐ Report ☐ Items (specify)n_____

☐ Calculation ☐ Print

☐ Drawings ☐ Samples Others_____

SUBJECT:			
Date of document	**No. of Copies**	**Document reference**	**Revision**

These are transmitted as checked below (tick appropriate)

For information	1st submission	Re-submission with correction
Others		

Remarks	Issuing Identity
	The document (s) hereby submitted have been properly reviewed according to our QA system, to confirm its completeness, accuracy, adequacy and validity
	Name
	Sign
	Date

Copies to	**ACKNOWLEDGMENT OF RECEIPT**
1	Date
2	Sign
3	Name

Mumbai Metro Rail Corporation

Document Submission Report (DSR) - status

STATUS SHEET

Contract No.	_____	DSR code	_____
Ref of letter /Transmittal	_____	Discipline	_____
Received letter date	_____	Assessor	_____
		Discipline co-ord/leader	_____

SUBJECT:

List of documents submitted

No	Document reference	Revision	Date	Notification		
				A	B	C
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

Definition of notification:

A. Objection. A complete resubmission is required

B. No Objection with comments.

C. Notice of No Objection

Area of deficiencies	Comment No. (Note)	
	Repeated Comment	New Comment
	No of comment in PR*	No of comment in NS*
	PR=Partial Resubmission	NS=Next Submission

Discipline Leader

Name	Position	Date	Sign.

The comments are given to ensure the submission conforms to the Contract provisions

Mumbai Metro Line 3

Document Submission Report (DSR) - Comments

Contract No.:-		Discipline :-		Area of Deficiency (1) 1. Design not complying with functional requirement. 2. Detail incomplete 3. Detail not submitted 4. Undesirable design features 5. Conflict data 6. others	Status of comments(2) A- Resubmission B- Partial resubmission C- Notice of No objection
Contract submission		Assessor			Comment status P= Pending H= On hold C = Closed
Date revd		Designate discipline coordinator			
DSR code		Team leader			

No	C/S doc ref			Project Manager Comments	Issue		Area of deficiency (1)	Status (2)	Contractors/ Suppliers Answers	Comment Status (3)	Closure	
	Ref./ Code	Rev.	Page No,		Format	Funda-mental				By contractor	PM	Date
1												

-- End of Appendix 7 --

Annexure-A to Appendix-17

MMRCL Proposed Penalty

SL. NO.	Content	UNSAFE ACT/UNSAFE CONDITION	MMRC rate in 2017 @ 5% increase / Year
1.	OHS&E Policy & Plan	OHS&E policy a) Not formulate a OHS&E policy as per Section 39 of the BOCW Act and not approved by DG/LC respectively b) Not displayed it at conspicuous places at work sites in Hindi and a local language understood by the majority of construction workers.	Rs.7,000 per single violation, compounded to a maximum of Rs.35,000 at any single instance.
		ii) OHS&E plan: a) Not as per Employers' content and coverage (Refer General Employers Requirement Chapter 18 Clause no4.4) b) Not submitted to the Engineer within 28 days of commencement of work (Refer General Employers Requirement Chapter 18 Clause no-4.4.6.2) c) Not updated as per employer's instruction. d) Copies not provided for communication to all required supervisors / engineers (Refer General Employers Requirement Chapter 18 Clause no-4.4.1.17) e) Not undertake and not recorded a monthly review of the CHSP (construction health and safety plan). (Refer General Employers Requirement Chapter 18 Clause no-4.4.6.2)	Single violation Rs. 140000. Compounded to a maximum of 280000 at any single instance.
2.	OHS&E Organisation	OHS&E Organisation i) Not complying to the minimum manpower requirements as mentioned in contractual requirements f) Not filling up the vacancies created due to OHS&E personnel leaving the contractor within 30 days. (Refer General Employers Requirement Chapter 18 Clause no-4.4.1)) g) OHS&E organization not provided with required Audio-visual and other essential equipment's ((Refer General Employers Requirement Chapter 18 Clause no-4.4.1)) ii) All OHS&E manpower not on the payroll of the main contractor and from any outsourcing agencies. iii) Conduct and competency- the Contractor is unable to demonstrate the competency of any person whose activities can directly impact on the Works' OHS&E performance h) The Chief OHS&E Manager not reporting directly to the General Manager or Corporate Safety Director of the Contractor's organization. ((Refer General Employers Requirement Chapter 18 Clause no-4.4.1)) iv) Non-compliance of any rule of **Schedule VI** of MBOCWR 2007 with in one month of commencement of work.	i) Rs.1,40,000 per month for first month and Rs.2,80,000 for subsequent months ii) Rs.70,000 per month for first month and Rs.1,40,000 for subsequent months For items iii), iv), v) ,vi) and vii) Rs.70,000 for first violation and Rs.1,40,000 for subsequent violations
3.	OHS&E committee	OHS&E committee i) Failed to formulate or conduct OHS&E Committee meeting for any month. (Refer General Employers Requirement Chapter 18 Clause no-4.4.3) j) Contractor and Sub-contractor representatives not attending OHS&E Committee meetings. (Refer General Employers Requirement Chapter 18 Clause no-4.4.3) k) Failed to conduct Site inspection before conducting OHS&E Committee meeting ((Refer General Employers Requirement Chapter 18 Clause no-4.4.3) i) Failed to send OHS&E Committee Meeting minutes or Agenda to Employer in time. ii) A minimum period of **21 days** not maintained between any two OHS&E monthly committee meetings. iii) Failed to formulate equal participants of management and non-Management staff for OHS&E Committee meeting as per MBOCWR 2007.	i. Rs.1,40,000 for the first violation and Rs.7,00,000 for the subsequent violations ii. Rs.7,000 to the contractor of the member who had not attended the meeting for first violation and Rs.35,000 for subsequent violations. For item iii), iv), v) and vi) Rs. 35,000 for first violation and Rs.70,000 for subsequent violations

4.	ID card	i. The Contractor not ensure that all personnel working at the site receive an induction OHS&E training explaining the nature of the work, the hazards that may be encountered during the site work and the particular hazards attached to their own function within the operation. ii. All personnel not issued a photo identity card of size 85mm x 55mm duly signed by the authorized representative of the contractor before they are engaged for any work. iii. Contractor not issued a personnel OHS&E handbook in a language known to the workers, which provides information on OHS&E and emergency procedures that all personnel working on contract are required to know and the need to follow and ensured that this is distributed and its content introduced to all personnel working at the site. l) ID card not provided to all staff and workers as per (Refer General Employers Requirement Chapter 18 Clause no-4.4.2.3.10, 4.4.2.3.11) iv. and 5.1.2 (OHS&E MANUAL Vol-3)	Single violation Rs. 140000.Compounded to a maximum of 280000 at any single instance.
5.	OHS&E Training	OHS&E Training 1. Not complying to the requirements as mentioned in conditions of contract on OHS&E and project OHS&E manual with regard to: i) Induction training not given (OHS&E MANUAL Vol-3: 5.1.2) m) Supervisor/engineer/Manager training not conducted ((Refer General Employers Requirement Chapter 18 Clause no-4.4.2) ii) Refresher/ Skill development training not conducted iii) Tool-box talk not conducted as per clause 5.1.5(OHS&E MANUAL Vol-3) iv) Every employee including workman not take safety Oath daily v) The contractor not arranged behavioral-based training programmes for all the executives to identify, recognize and eliminate unsafe act and unsafe conditions. n) The Contractor not assess the training requirements for all the employees including Sub-contractors against an individual's role, responsibility, ability, language skill and risk(Refer General Employers Requirement Chapter 18 Clause no4.4.2-) o) Not submitted a 'Training Implementation Plan' to incorporate the findings of the needs assessment within 4 weeks of commencement to Engineer. (Refer General Employers Requirement Chapter 18 Clause no-4.4.2) p) Not able to produce adequate records as per submitted training plan (Refer General Employers Requirement Chapter 18 Clause no-4.4.2) q) Not able to conduct training on construction safety plan, operational and systems procedures with records of durations. (Refer General Specification Appendices) (Refer General Employers Requirement Chapter 18 Clause no-4.4.2)	For item 1 i) to x) Rs.70,000 for first violation on and Rs.1,40,000 for subsequent violations
6.	OHS&E Inspection	OHS&E Inspection i) Not complying to the requirements as mentioned in conditions of contract on OHS&E and project OHS&E manual ii) All inspection records and reports not properly kept and filed for audit purpose. Inspection reports of Planned General Inspection and Routine Inspection not used for discussion during Safety Committee Meetings with MOM. r) Not conducted Independent of the plant and equipment inspection, testing and maintenance that has been stated in the Contractor's Plant and Equipment Procedures with records. (Refer General Employers Requirement Chapter 18 Clause no-4.5) s) Not calibrated any of monitoring equipment as per manufacturing requirements. (Refer General Employers Requirement Chapter 18 Clause no4.5-) t) Not conducting internal OHS&E inspections ((Refer General Employers Requirement Chapter 18 Clause no-4.5) u) Site Engineers (Contractors) not participating in internal OHS&E inspections((Refer General Employers Requirement Chapter 18 Clause no-4.5.1.5) v) Not submitting the Formal site inspection report for each sites on weekly basis to Project director((Refer General Employers Requirement Chapter 18 Clause no-4.5) w) Formal site inspection report not to be signed by both the Site Manager and the OHS&E officer. (Refer General Employers Requirement Chapter 18 Clause no-4.5)	Rs.70000 for first violation and Rs.140000 for subsequent violations
7.	OHS&E audit	**A)** Internal Audit (MARS), i. Not conducted as per OHS&E Plan ii. Report not sent to Employer iii. Action not taken for any month x) Fail to conduct MARS before the monthly safety committee meeting to form a part of agenda (Refer General Employers Requirement Chapter 18 Clause no-4.5.5)	item i) to iv) Rs. 70,000 for first violation and Rs.1,40,000 for subsequent violations. For item v) to viii) Rs.1,40,000 for first

		B) External OH&S Audit v) Not conducted as per OHS&E Plan vi) Report not sent to employer vii) Action not taken for any quarter. y) Fail to conduct compulsory External third party audit as per BOCW rule , with or without ISO certification by govt. recognized qualified auditors ((Refer General Employers Requirement Chapter 18 Clause no4.5.5-)	violation and Rs.2,80,000 for subsequent violations
8.	OHS&E Communication	OHS&E Communication i. Important days to be observed for OHS&E awareness as furnished by employer not observed ii. Posters as furnished by Employer not printed and displayed. z) Contractor fails to produce a 'High Quality' quarterly newsletter ((Refer General Employers Requirement Chapter 18 Clause no-4.4.3)) aa) Contractor fail to change signage and posters on a monthly basis to bring pertinent awareness. ((Refer General Employers Requirement Chapter 18 Clause no-4.4.3)) bb) Poster campaigns not discussed at the Engineer's Committee meeting and not recorded with improvement program. (Refer General Employers Requirement Chapter 18 Clause no4.4.3)-) cc) Informational posters, banners note provided both in Marathi /Hindi and English(Refer General Employers Requirement Chapter 18 Clause no-4.4.3)) dd) Records of all toolbox talks undertaken together with the date, topic, participant's names and signatures not maintained on daily basis. (Refer General Employers Requirement Chapter 18 Clause no4.4.3)-) ee) Not maintaining the records of briefings/communications of Method statement and risk assessment before commencement of a new task or when a change to the method of working arises(Refer General Employers Requirement Chapter 18 Clause no-4.4.3)) ff) Public informational signage and Contractor contact information not posted externally to the site including all legal communications. (Refer General Specification Appendices)) (Refer General Employers Requirement Chapter 18 Clause no4.4.3)-)	i) Rs.14,000 for first violation and Rs.70,000 for subsequent violations For item ii) to ix) 2,80,000 per violation
9.	OHS&E Submittals **(Hazard identification, risk assessment and determining controls)**	i. The contractor's OHS&E management not send the following reports to the Employer periodically: a. Daily Reporting of total no of workmen b. Monthly OHS&E Report c. OHS&E Committee Meeting Minutes d. OHS&E Inspection Reports e. OHS&E Audit Reports f. Monthly Audit Rating Score (MARS) report g. External OHS&E Audit h. Electrical Safety Audit i. Air and Noise Quality monitoring report. gg) ii) Not submitted procedure detailing the process in place and associated Hazards and Risks and their control measures as per Employer's Requirements (Refer General Employers Requirement Chapter 18 Clause no-4.3.1) hh) Changes made in organizational, personnel, systems, procedures, equipment, products, materials or substances not communicated by the Contractor((Refer General Employers Requirement Chapter 18 Clause no-4.4. 4.3.1) ii) Contractor's Construction Health and safety Plan not contain a detailed 'Risk Register' and 'Hazard Log' specific to the project. (Refer General Employers Requirement Chapter 18 Clause no-4.3.1) jj) Method statements not submitted to the Engineer before the 21 days of the commencement of the work(Refer General Employers Requirement Chapter 18 Clause no-4.3.1)	For item i) Rs.70,000 for first violation and Rs.1,40,000 for subsequent violations For item ii) and v) Rs.1,40,000 for first violation and Rs.2,80,000 for subsequent violations
10.	Injury and Incidence reporting	Injury and Incidence reporting i) Fatal accidents ii) Injury accident iii) Abnormal delay in reporting accidents or willful suppression of information about any accidents / dangerous occurrence.	i. Rs.7,00,000 for first fatality and Rs.14,00,000 for every subsequent fatality.

		iv) Any willful delay in verbal and written not reporting to the Employer. v) **Employers' independent incident investigation** a. Contractor and his staff not extend necessary co-operation and do not testify about the accident. b. The contractor not take every effort to preserve the scene of accident till the Employer completes the investigation. c. All persons summoned by the Employer in connection to witness recording not obey the instructions.	ii. Rs.1,40,000 for first grievously injured person and Rs.2,80,000 for every subsequent grievously injured person (Grievous Injury as defined by Workmen Compensation Act) iii. Rs.1,40,000 for first violation and Rs.2,80,000 for subsequent violations For items iv) and v) Rs.70,000 for first violation and Rs.1,40,000 for subsequent violations. For items iv) and v) Rs.70,000 for first violation and Rs.1,40,000 for subsequent violations
11.	**Emergency preparedness and response**	i) The Contractor not prepared as required under Rule 36 of MBOCWR, an Emergency Response Plan for all work sites as a part of the Contractor OHS&E Plan. ii) The contractor not ensured that an Emergency Response Plan is prepared to deal with emergencies arising out of: a. Fire and explosion b. Collapse of lifting appliances and transport equipment c. Collapse of building, sheds or structure etc. d. Gas leakage or spillage of dangerous goods or chemicals e. Bomb threatening, Criminal or Terrorist attack f. Drowning of workers g. Landslides getting workers buried floods, Earthquake, storms and other natural calamities. iii) Arrangements not made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the contractor with their telephone numbers and addresses for quick communication not adequately publicized and conspicuously displayed in the workplace. kk) Contractors not tied-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose(Refer General Employers Requirement Chapter 18 Clause no-4.4.7) iv) Contractor not conducted an onsite emergency mock drill once in every month for all his workers and his subcontractor's workers. v) Contractor not keep the Local Law & Order Authorities informed along with communication to MMRC to mitigate the consequences of an emergency. ll) Not submitting the project specific Emergency Plan within 4 weeks of Commencement of contract(Refer General Employers Requirement Chapter 18 Clause no-4.4.7) mm) Not provide training with records for emergency preparedness and response plan to all contractors direct and indirect employees (Refer General Employers Requirement Chapter 18 Clause no-4.4.7) nn) Not conducted the mock drilled Emergency preparedness and response procedures on monthly basis with records. (Refer General Employers Requirement Chapter 18 Clause no-4.4.7) oo) Not erected hording for Emergency Process flow charts on conspicuous places. (Refer General Employers Requirement Chapter 18 Clause no-4.4.7) pp) Not erected hording for emergency telephone numbers like fire, ambulance, police, nearest hospital and any other legal relevant. (Refer General Employers Requirement Chapter 18 Clause no-4.4.7) qq) the Contractor not provided a fully equipped ambulance on-site as per legal requirement((Refer General Employers Requirement Chapter 18 Clause no-4.4.7) rr) The ambulance van not maned by adequate number of paramedics (Refer General Employers Requirement Chapter 18 Clause no-4.4.7)	For item i) to xiii) Rs.70,000 for first violation and Rs.1,40,000 for subsequent violations

12.	Housekeeping	Housekeeping i) Surrounding areas of drinking water tanks / taps not hygienically cleaned / maintained ii) Office, stores, toilet / urinals not properly cleaned and maintained. iii) Required dustbins at appropriate places no provided / not cleaned. iv) Stairways gangways, passageways blocked. iii) Lumber with protruding nails left as such iv) Openings unprotected v) Excavated earth not removed within a reasonable time. vi) Truck carrying excavated earth not covered / tires not cleaned. vii) Vehicles / equipment's parked / placed on roads obstructing free flow of traffic with or without pedestrian. viii) Unused surplus cables / steel scraps lying scattered ix) Wooden scraps, empty wooden cable drums lying scattered x) Water stagnation leading to mosquito breeding xi) Contractor not constituted a special group of housekeeping personnel in charge of each work section [11.1-OHS&E MANUAL VOLUME 3]. xii) Proper Housekeeping not carried out at work sites, Labour Camps, Stores and Offices with Housekeeping maintenance register (11.3-OHS&E MANUAL VOLUME 3) xiii) Full height fence, barriers etc. not installed at the site in order to preserve the surrounding area from excavated soil and rubbish. (11.4-OHS&E MANUAL VOLUME 3) xiv) supervisors and engineers working at the site not educated and trained on the necessity of good housekeeping (11.6-OHS&E MANUAL VOLUME 3) xv) The Contractor not provided at site, metal or heavy-duty plastic 'Refuse Containers' with tight fitting lids for disposal of all garbage or trash associated with food.(11.8- OHS&E MANUAL VOLUME 3.) xvi) Not maintain different containers for bio-degradable/recyclable and hazardous (flammable) wastes and not emptied at least once daily. (11.8- OHS&E MANUAL VOLUME 3.) xvii)Not maintained Drip pans for oil leakages and spills of suitable size while servicing of plants/ equipment/machinery and not disposed off generated waste in approved manner.(11.8- OHS&E MANUAL VOLUME 3.) xviii) Not treating Still waters once every week with oil in order to prevent mosquito breading. (11.9-OHS&E MANUAL VOLUME 3.) xix) Posters in both local language and English not displayed prominently to draw attention for the dangers of permitting mosquito breeding. (11.9- OHS&E MANUAL VOLUME 3.)	For item i) to xxv) Rs. 14,000 per single violation Compounded to a maximum of Rs.1,40,000 at any single instance
13.	Working at Height / Ladders and Scaffolds	i) Working at Height / Ladders and Scaffolds i. Not using or anchoring Safety Belt ii. Not using Safety Net iii. Absence of life line or anchorage point to anchor safety belt iv. Using Bamboo ladders v. Painting of ladders, Improper usage (less than 1m extension above landing point, not maintaining 1:4 ratio) vi. Aluminum ladders without base rubber bush/proper locking vii. Usage of broken / weak ladder viii. Usage of re-bar welded ladders ix. Improper guardrail, toe board, barriers and other means of collective protection x. Improper working platform xi. Working at unprotected fragile surface xii. Working at unprotected edges xiii. Worker Not passed vertigo test. ii) contractor not carried out risk assessments for all work where workers or materials can fall from more than two meters. (15.1.1- OHS&E MANUAL VOLUME 3) iii) Not Provided Edge protection to work above two meters specified below (15.1.1- OHS&E MANUAL VOLUME 3) a) A main guardrail at least 1 meter above the edge. b) A toe board at least 200 mm high	Rs.14,000 per single violation Compounded to a maximum of Rs.1,40,000 at any single instance

		c) An intermediate guard rail or other barrier so that there is no gap more than 470 mm. iv) All scaffolds not inspected by a competent person at least in every three days after erection and not recorded. (15.2.2- OHS&E MANUAL VOLUME 3) v) Tags not fitted to all scaffolds to show whether they are safe for use or not and All Safe for Use tags not signed by a senior site engineer from the Contractor. . (15.2.3- OHS&E MANUAL VOLUME 3) vi) All scaffolds not constructed of sound materials and not free from patent defect. (15.2.4- OHS&E MANUAL VOLUME 3) vii) The measures not taken by contractor (15.2.5- OHS&E MANUAL VOLUME 3) i) The scaffold not constructed for the correct use (Light or Heavy Duty) ii) securely not fixed to existing structures or adequately buttressed; iii) The use of barrels, boxes, loose tiles or other unsuitable material used as supports for working platforms; iv) All working platforms not fully boarded and not covered with Net to prevent Hight phobia. v) All working platforms not provided guard rails at one metre height and not provided an intermediate rail at half height; vi) all working platforms not provided with toe boards; vii) all working platforms not kept free of unnecessary obstruction or rubbish viii) secure ladder access shall be provided; viii) All ladders not of sound construction and not free from patent defect (15.3.1- OHS&E MANUAL VOLUME 3) ix) Ladders not checked weekly and not recorded and defective ladders shall be promptly and properly repaired or replaced. (15.3.2 OHS&E MANUAL VOLUME 3)) x) Ladder used for work for more than thirty minutes. (15.3.3 OHS&E MANUAL VOLUME 3)) xi) Metal ladders used near or adjacent to overhead live power lines. (15.3.4 OHS&E MANUAL VOLUME 3)) xii) Non usage of full body safety harness at safe working platform with secure anchorage points (15.4 OHS&E MANUAL VOLUME 3))	
14.	Lifting appliances and gear	Lifting appliances and gear i. Non availability of fitness certificate ii. Documents not displayed on the machine or not available with the operator iii. Maximum Safe Working Load not written on the machine iv. The contractor not maintain a register containing a system of identification of all tools and tackles, its date of purchase, safe working load, competent person date of Examination v. Test and periodical examination of lifting appliances and gears not done. vi. Automatic safe load indicator and Anemometer not provided or not in working condition. vii. Age of the operator less than 20 years or without any possesses a valid heavy transport vehicle driving license as per Motor Vehicle Act and Rules and non-compliance specified in schedule VII of BOCW Rules viii. Non-compliance of Lifting appliances and gear as per BOCW act and rule ix. Non-compliance of any of the items mentioned regarding rigging requirements x. Failure to submit method statement in case of all critical lifting xi. Person riding on crane. xii. Creating more noise and smoke xiii. Absence of portable fire extinguisher in driver cabin xiv. Fail to guard hoist platform xv. No fencing of hoist rope movement area xvi. Hoist platform not in the horizontal position xvii. All lifting appliances, including synchronized mobile jacks, pit jacks, mobile cranes, tower cranes, gantry cranes, launching beams and lorry mounted cranes not inspected and not certified by competent person.(17.1.1- OHS&E MANUAL VOLUME 3) xviii. The Competent Person not approved by MMRC.(17.1.1- OHS&E MANUAL VOLUME 3) xix. lifting capacity of more than one ton not fitted with Automatic Safe Load Indicators, Anemometer and Audible Warning Devices with no proper records of inspection. (17.1.2- OHS&E MANUAL VOLUME 3) xx. lifting appliances not maintained in accordance with the manufacturer's instructions and irregular preventative maintenance program with available schedule. (17.1.3- OHS&E MANUAL VOLUME 3) xxi. All lifting appliances not inspected every three months by a third party competent person with records (17.1.4- OHS&E MANUAL VOLUME 3)	Rs.70,000 per single violation Compounded to a maximum of Rs.7,00,000 at any single instance

		xxii. The operators of lifting appliances not conducted daily record of inspections of their respective lifting appliances (17.1.5- OHS&E MANUAL VOLUME 3) xxiii. The Contractor not ensured only thoroughly trained and experienced persons aged more than twenty years (17.1.5- OHS&E MANUAL VOLUME 3) xxiv. The Contractor not ensured that all lifting gear in good condition and not tested and certified in every six months by competent person. (17.2.2- OHS&E MANUAL VOLUME 3) xxv. Not embossed the Safe Working Load clearly for display on lifting gears. (17.2.2- OHS&E MANUAL VOLUME 3) xxvi. All lifting gear not visually inspected before any use and if any defects are found then it shall be removed from site with daily records (17.2.3- OHS&E MANUAL VOLUME 3) xxvii. All lifting gear not properly stored and left lying on the ground (17.2.4- OHS&E MANUAL VOLUME 3) xviii. The lifting operation is not carried out under appointed competent lifting supervisor by contractor. (17.3.1-a- OHS&E MANUAL VOLUME 3) xxix. untrained and unexperienced person deployed as crane driver. (17.3.1-b- OHS&E MANUAL VOLUME 3) xxx. Untrained and unexperienced slingers and riggers deployed to give directions to crane operators (17.3.1-c- OHS&E MANUAL VOLUME 3) xxxi. A standard code of hand signals not adopted by signaler and crane driver for controlling the movements of crane during day and night (17.3.1-d- OHS&E MANUAL VOLUME 3) xxxii. Load slewed over public areas without stopping pedestrians and vehicles (17.3.1-h- OHS&E MANUAL VOLUME 3) xxiii. unauthorized persons allowed by contractor in the lifting zone (17.3.1-i- OHS&E MANUAL VOLUME 3) xxiv. an operable safety catch not fitted with a crane hook. (17.3.1-l- OHS&E MANUAL VOLUME 3) xxxv. while working Near isolated overhead power-lines, the lifting appliances not grounded to earth as a secondary precaution against accidental energization (17.3.1-p- OHS&E MANUAL VOLUME 3) xxvi. working closer to any live overhead power lines without the operation of a strict Permit to Work system being in place. (17.3.1-q- OHS&E MANUAL VOLUME 3)	
15.	Launching operation	[(deleted)]	[(deleted)]
16.	Site Electrical safety	Site Electrical safety i. The contractor not employ qualified and competent electrical personnel as per law. ii. The main contractor not take consideration, the requirements of the sub / petty contractors' electric power supply and arrive at the capacity of main source of power supply from diesel generators. small capacity diesel generators allowed for whatsoever the type of job to be executed under this contract. iii. Unsafe noise making small capacity diesel generators are found used by sub / petty contractors. iv. The contractor not submitted electrical single line diagram, schematic diagram and the details of the equipment for all temporary electrical installation and these diagrams together with the temporary electrical equipment not submitted to the Employer's for necessary approval**.** v. Cables not selected after full consideration of the condition to which exposed and the duties for which they are required. Supply cable up to 3.3 kV not in accordance with BS 6346. vi. Damage to 1. civil utilities such as water pipe line, sewer pipe line, storm water pipe line, drainage pipeline and structures etc. 2. Electrical and telecom utilities such as all type of cable and installations, street lights, poles, and panels, Bus Q Shelters, Joints, feeder pillars, cable ducts, junction boxes, transformers, ring main and structures provided for both telecom as well as telecom etc. 3. Traffic signal cables, CCTV cables and CCTV cameras and poles, LPG/CNG Gas Pipeline, petroleum tanks/ pipeline, dispensers etc. vii. Inserting of wires directly into the socket viii. Improper grounding for the electrical appliances ix. Electrical cables running on the ground x. The Contractor not appointed an electrical engineer with c certificate to comply IEA. (19.1.1- OHS&E MANUAL VOLUME 3) xi. The name and contact telephone number of the Electrical Engineer not displayed at the main distribution board for the temporary electrical supply. xii. The Contractor not submitted schematic diagrams and the details of the equipment for all temporary electrical installations, for approval. (19.1.3. - OHS&E MANUAL VOLUME 3) xiii. All Electrical work not supervised or executed by qualified and suitably categorized electricians as per the law. (19.1.4- OHS&E MANUAL VOLUME 3) xiv. All cabling expose a hazard or obstruction to people and equipment (19.2.2- OHS&E MANUAL VOLUME 3)	Rs.14000 per single Violation Compounded to a maximum of Rs.140000 at any single instance.

		xv. The installation on Site not allow convenient access to authorized and competent operatives to work on the apparatus contained within. (19.2.3. - OHS&E MANUAL VOLUME 3) xvi. voltages not adhered to for typical applications throughout the distribution systems like :(19.3.2- OHS&E MANUAL VOLUME 3) a. fixed plant - 415V 3 phase; b. (b) movable plant fed by trailing cable - 415V 3 phase; c. installations in Site buildings - 240V 1 phase; d. (d) fixed flood lighting - 240V 1 phase; e. portable and hand held tools - 110V 1 phase; f. Site lighting (other than flood lighting) - 110V 1 phase; and g. portable hand-lamps (general use) - 110V 1 phase. xvii. Protection not provided for all main and sub-circuits against excess current, residual current, earth faults and short circuit by protective devices.(19.3.4- OHS&E MANUAL VOLUME 3) xviii. Earthing and bonding not provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises cleared by installed circuit protection.(19.3.5- OHS&E MANUAL VOLUME 3) xix. Maintenance of control apparatus and wiring distribution systems not carried out by an approved electrician on weekly basis with records (19.5.1- OHS&E MANUAL VOLUME 3) xx. All portable electrical appliances not numbered with records of date of issue, date of the last inspection carried out (19.5.2- OHS&E MANUAL VOLUME 3) xxi. Inserting of bare wires into the socket xxii. Improper grounding for the electrical appliances and metallic barricades xxiii. Electrical live cables running on the ground as per IE act xxiv. Electrical live cable immersed in water. xxv. Not provided ELCB DP xxvi. Not Providing adequate earthing as per IE act . xxvii. Not maintain safe distance from HV or LV lines while Woking as per the law. xviii. Non usage of rubber mat near HV or LV distribution panels and switches as per the IE act. xxix. Non usage of change over switch for DG sets and power utility. xxx. Use of inadequate capacity fuse wire/ HRC(high ruptured capacity fuse) as per the IE act. xxxi. Violation of Rule 74 of MBOCWR 2007	
17.	Hand tools and Power tools	The contractor not ensure that i. Electric tools are properly grounded or / and double insulated. ii. GFCIs/ RCCBs shall be used with all portable electric tool operated especially outdoors or in wet condition. iii. Before making any adjustments or changing attachments, his workers shall disconnect the tool from the power source. iv. When operating in confined spaces or for prolonged periods, hearing protection shall be required. The same shall also apply to working with equipment's, which gives out more noise. v. Tool is held firmly and the material is properly secured before turning on the tool. vi. All drills shall have suitable attachments respective of the operations and powerful for ease of operation. vii. When any work / operation need to be performed repeatedly or continuously, tools specifically designed for that work shall be used. The same is applicable to detachable tool bit also. viii. Size of the drill shall be determined by the maximum opening of the chuck n case of drill bit. ix. Attachments such as speed reducing screwdrivers and buffers shall be provided to prevent fatigue and undue muscle strain to his workers. x. Stock should be clamped or otherwise secured firmly to prevent it from moving. xi. Workers shall never stand on the top of the ladder to drill holes in walls / ceilings, which can be hazardous, instead standing on the fourth or fifth rung shall be recommended. xii. Electric plane shall not be operated with loose clothing or long scarf or open jacket.	Rs.14000 per single violation Compounded to a maximum of Rs.140000 at any single instance.

		xiii. Safety guards used on right angle head or vertical portable grinders must cover a minimum of 1800 of the wheel and the spindle / wheel specifications shall be checked. xiv. All power tools / hand tools shall have guards at their nip points. xv. Low profile safety chain shall be used in case of wood working machines and the saw shall run at high rpm when cutting and also correct chain tension shall be ensured to avoid "kickback". xvi. Leather aprons and gloves shall be used as an additional personal protection auxiliary to withstand kickback. xvii. Push sticks shall be provided and properly used to hold the job down on the table while the heels moves the stock forward and thus preventing kickbacks. xviii. Air pressure is set at a suitable level for air actuated tool or equipment being used. Before changing or adjusting pneumatic tools, air pressure shall be turned off. xix. Only trained employees shall use explosive actuated tools and the tool shall also be unloaded when not in use. xx. Usage of such explosive actuated tools shall be avoided in case of places where explosive/flammable vapours or gases may be present. xxi. Explosive actuated tools and their explosives shall be stored separately and be taken out and loaded only before the time of immediate use. xxii. Misfired cartridges of explosive actuated tools must be placed in a container of water and be removed safely from the project. xxiii. No worker shall point any power operated / hand tool to any other person especially during loading / unloading. xxiv. Violation of Rule 186 of MBOCWR 2007	
18.	Gas Cutting	Gas Cutting & welding i. Wrong colour coding of cylinder. Cylinders not stored in upright position. ii. Flash back arrester, non-return valve and regulator not present or not in working condition. iii. Fail to put cylinders in a cylinder trolley iv. Damaged hose and fail to use hose clamps v. Using domestic LPG cylinders vi. Fail to store cylinder 6.6m away from fire prone materials vii. Fire extinguisher not placed in the vicinity during operation viii. Contractors not issued work permit for all welding, cutting and gouging while working in tunnels, welding over areas where others are working and areas with increased fire risks or hazardous environments (20.1.1- OHS&E MANUAL VOLUME 3) ix. All Gas Cutting & welding Equipment not inspected by a competent person with records on weekly basis. (20.1.2- OHS&E MANUAL VOLUME 3) x. Welders not wear the correct personal protective equipment like Face and eye protection with correct grade of shield, Gauntlet gloves Safety footwear(20.1.4- OHS&E MANUAL VOLUME 3) xi. Efficient ventilation and fume extraction system not provided in enclosed areas and pits. (20.1.5- OHS&E MANUAL VOLUME 3) xii. Naked flames or high temperature surfaces allowed in the vicinity (with in 6 meter) of volatile solvents.(20.1.7- OHS&E MANUAL VOLUME3) xiii. Cylinders kept in enclosed areas (unventilated) with unsecure upright position.(20.2.1- OHS&E MANUAL VOLUME 3) xiv. Flash back arresters not fitted to both the fuel gas and oxygen cylinders (20.2.2- OHS&E MANUAL VOLUME 3) xv. Non return valves not fitted to the torch or cutting torch(20.2.3- OHS&E MANUAL VOLUME 3) xvi. Screwed fittings and hoses are not screwed properly and sealed to free from contaminants, (20.2.4- OHS&E MANUAL VOLUME 3) xvii. Daily Checks for gas leaks not carried out by using soapy water(20.2.7- OHS&E MANUAL VOLUME 3) xviii. Not Removed all torches from enclosed areas when not in use (20.2.8- OHS&E MANUAL VOLUME 3) xix. Suitable fire extinguisher not available at all places where hot work is being carried out.(20.2.9- OHS&E MANUAL VOLUME 3) xx. Firewatchers not present if there is a possibility of ignition unobserved by the operator (e.g. on the other side of bulkheads)(20.2.10- OHS&E MANUAL VOLUME 3) xxi. The equipment earthing and work piece earthing is same.(20.3.1- OHS&E MANUAL VOLUME 3) xxii. Duckboards or rubber protection is not used to Avoid being in contact with water or wet floors when welding. (20.3.3 - OHS&E MANUAL VOLUME 3) xxiii. Screens not provided to limit exposure of others to glare from arcs.(20.3.4- OHS&E MANUAL VOLUME 3) xxiv. The correct codified eye and face protection with the correct filter glass is not issued (20.3.5- OHS&E MANUAL VOLUME 3) xxv. Violation of any other provision as per BOCWR 2007	Rs.14,000 per single violation Compounded to a maximum of Rs.70,000 at any single instance

19.	Welding	Gas Welding i. Voltmeter and Ammeter not working ii. Improper grounding and return path. iii. Damaged welding cable iv. Bare openings in the cable. v. Non-availability of separate switch in the transformer vi. Non-availability of main switch control to switch off power to the welding unit. vii. Usage of reinforcement rod as return conductor viii. Damaged holder ix. Fire extinguisher not placed in the vicinity during operation. x. Violation of Rule 190 of MBOCWR 2007	Rs.14,000 per single violation Compounded to a maximum of Rs.70,000 at any single instance
20.	Fire precaution	**Fire Precaution** i. Smoking and open flames in fire prone area ii. Using more than 24V portable electrical appliances in the fire prone area iii. Not proper ventilation in cylinder storage area. iv. Absence of fire extinguisher v. Fire extinguishers not refilled once in a year and not inspected monthly with records. vi. Fire extinguisher placed in a not easily accessible location. vii. The Contractor not deployed specially trained personnel to deal with fires due to electrical causes, gas explosions etc as per the specified law or manual (34.1.2- OHS&E MANUAL VOLUME 3). viii. Combustible scrap and other construction debris not disposed off from site on a regular basis with records(33.1.5- OHS&E MANUAL VOLUME 3) ix. Signage not erected at prominent positions showing the correct use of portable first aid fire extinguisher (33.1.6- OHS&E MANUAL VOLUME 3) x. Emergency plans and Fire Evacuation plans not prepared (33.1.7 - OHS&E MANUAL VOLUME 3) xi. Mock drills not conducted once in three month to ensure the effectiveness of the arrangements. (33.1.7 - OHS&E MANUAL VOLUME 3) xii. site clearly visible fire points not established for use in an emergency either with Dry Powder Extinguisher or Water Type Extinguisher. (33.2.1- OHS&E MANUAL VOLUME 3) xiii. Recharging of fire extinguishers and their proper maintenance not done as per Indian National Standards (33.2.2- OHS&E MANUAL VOLUME 3) xiv. Water not supplied for fire fighting purposes in the form of static water tank of adequate capacity or a hydrant line with adequate water pressure at outlet points as per Indian National Standards (33.2.3- OHS&E MANUAL VOLUME 3) xv. Sufficient number of fire hoses with branch pipes ,emergency lights not provided at site as per Indian National Standards.(33.2.4- OHS&E MANUAL VOLUME 3) xvi. The Telephone Number of the site fire brigade not prominently displayed near each telephone on site.(33.2.6- OHS&E MANUAL VOLUME 3) xvii. Supervisors and workmen at the site not trained in the use of firefighting equipment provided at the site as per Indian National Standards (33.2.7- OHS&E MANUAL VOLUME 3) xviii. All flammable liquids not kept in a secure fire resistant store and spark proof installations and fittings.(33.3.1- OHS&E MANUAL VOLUME 3) xix. Cans carrying flammable liquids without any leaks and proper stopper without marked "FLAMMABLE LIQUID" (33.3.2- OHS&E MANUAL VOLUME 3) xx. Rags soaked in paints, kerosene and other flammable liquids not disposed of daily under supervision (33.3.3- OHS&E MANUAL VOLUME 3) xxi. All Diesel fuel storage tanks not bunded around in order to control any spillage or leakage (33.3.4- OHS&E MANUAL VOLUME 3) xxii. "NO SMOKING" signs not prominently displayed at all areas of potential location of fire (33.3.5- OHS&E MANUAL VOLUME 3)	Rs.7000 per single violation Compounded to a maximum of Rs.35000 at any single instance.
21.	Excavation, Tunnelling and confined space	**1.Excavation** i. The contractor not ensure a. where any construction building worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than one 1.5 m above his footing, such worker is protected by adequate piling and bracing against such bank or side. b. where banks of an excavation are undercut, adequate shoring is provided to support the material or article overhanging such bank.	For any item from i) and ii) Rs.14,000 per single violation Compounded to a maximum of Rs.70,000 at any single instance. For all violation item Rs.14,000 per first

		c. excavated material is not stored at least 0.65 m from the edge of an open excavation or trench and banks of such excavation or trench are stripped of loose rocks and the banks of such excavation or trench are stripped of loose rocks and other materials which may slide, roll or fall upon a construction building worker working below such bank d. metal ladders and staircases or ramps are provided, as the case may be, for safe access to and egress from excavation where, the depth of such excavation exceeds 1.5 m and such ladders, staircases or ramps comply with the IS 3696 Part 1&2 and other relevant national standards. e. trench and excavation is protected against falling of a person by suitable measures if the depth of such trench or excavation exceeds 1.5 m and such protection is an improved protection in accordance with the design and drawing of a professional engineer, where such depth exceeds 4m. ii. The contractor not ensure that a. suitable warning signs or notices, required for the safety of building workers carrying out the work of an excavation or tunneling, displayed or erected at conspicuous places in Hindi and in a language understood by majority of such building workers at such building such excavation or tunneling work b. such warning signs and notices with regard to compressed air working include 1. the danger involved in such compressed air work 2. fire and explosion hazard 3. the emergency procedures for rescue from such danger or hazards. iii. The integrity of the excavation and the support system not inspected prior to the commencement of any works on a daily basis with records of checklist (16.1.3) iv. Emergency pumping sumps and ladders not placed for use in the event of an emergency evacuation (16.1.4- OHS&E MANUAL VOLUME 3) v. The contractor not plan in excavations against the following;(16.2.1- OHS&E MANUAL VOLUME 3) (a) Collapse of the sides; (b) Materials falling onto people working in the excavation; (c) People and vehicles falling into the excavation; (d) People being struck by plant; (e) Undermining nearby structures; (f) Contact with underground services; (g) Fumes; and (h) Make sure the necessary equipment needed such as trench sheets, props, vii. The contractor not taken following precautions: a. The sides battering them to a safe angle or supporting them with timber, sheeting or proprietary support systems. b. Unsupported excavations. c. In shallow trenches contractor need to provide support if the work involves bending or kneeling in the trench. d. Prevention of materials falling into excavations e. Make sure the edges of the excavation are protected against falling materials/ f. Wear a hard hat when working in excavations. g. provide substantial barriers, e.g. guard rails and toe boards. h. Keep vehicles away from excavations Use brightly painted baulks or barriers i. Where vehicles have to tip materials into excavations, use stop blocks to prevent them from over-running. i) supervising excavation work of contractor does not have service plans(16.5.1(c)- -OHS&E MANUAL VOLUME 3) **4. Tunnelling** The contractor not ensure i. every compressed air system in a tunnel is provided with emergency power supply for maintained continued supply of compressed air as per Rule 155 of BOCWR ii. watertight bulkhead doors are installed at the entrance of a tunnel to prevent flooding. iii. reliable and effective means of communication such as telephone or walkie-talkie or any audio visual live media are provided and maintained for arranging better effective communication at an excavation or tunneling work as per Rule 136 of BOCWR.	violation and Rs.70,000 for subsequent violations

		iv. all portable electrical hand tools and inspection lamp used in under ground and confined space at an excavation or tunneling work is operated at a voltage not exceeding 24V. v. only flame proof equipment of appropriate type as per IS: 5571:2000 and or other relevant national standard is used inside the tunnel vi. petrol or LPG of any other flammable substances are used, stored inside the tunnel except with prior approval from Employer, and also oxy-acetylene gas is used in a compressed air environment in excavation or tunneling. vii. adequate number of water outlets provided for fire fighting purpose, an audible fire alarm and adequate number and types of fire extinguishers are provided and maintained. viii. temperature in any working chamber in an excavation or tunneling work where workers employed does not exceed 29□C as per Rule 165 of BOCWR. ix. Vibration measurement on each movement or any displacement in nearby object to Tunneling activities. x. all working areas in a free air tunnel are provided with ventilation system as approved by competent authority and the fresh air supplied in such tunnel is not less than 6 m3/ min for each worker employed in tunnel as per Rule 153 of BOCWR. xi. The Contractor not developed safety procedures and methods (statement)of working to be adopted during the course of tunnelling operations (24.1.1- OHS&E MANUAL VOLUME 3) xii. In more than 500 metres long tunnel, cleaned and disinfectants sanitation facilities not provided with Suitable toilets of one unit for every 50 men on the shift. (24.2.1- OHS&E MANUAL VOLUME 3) xiii. In more than 500 metres long tunnel, 5 litres of clean drinking water (tested and certified monthly) per person inside the work location (24.2.2- OHS&E MANUAL VOLUME 3) xiv. Washing and cleaning facilities not provided for all workers near the site(24.2.3- OHS&E MANUAL VOLUME 3) xv. The Contractor not provided lighting minimum of 50 lux where work is in progress. A minimum of 50 lux ,trolley tracks a minimum of 30 lux and all remaining areas less than 10 lux.(24.2.4- OHS&E MANUAL VOLUME 3) **3. confined space** i) Contractors undertaken works in Confined Spaces without Permit to Work, prepared and issued(unsigned)(18.3.1- OHS&E MANUAL VOLUME 3) ii) Unauthorised, untrained, un experienced and physically unfit allowed to work in Confined Spaces.(18.3.2- OHS&E MANUAL VOLUME 3) iii) Persons with any of the following medical conditions allowed to work in confined spaces: (18.3.3- OHS&E MANUAL VOLUME 3) a) a history of fits, blackouts or fainting attacks, b) a history of heart disease or disorder, c) high blood pressure, d) asthma bronchitis, or shortness of breath on exertion, e) deafness f) meniers disease or disease involving giddiness or loss of balance, g) claustrophobia or nervous or mental disorder, h) back pain or joint trouble that would limit mobility in confined spaces, i) deformity or disease of the lower limbs limiting movement. j) Chronic skin disease, k) Serious defects in eye sight or lack of sense of smell iv) suitable warning signs of "No smoking" not positioned (18.3.4- OHS&E MANUAL VOLUME 3) v) Before the entry to confined space following equipment not available for use in case after requisite training:(18.3.5- OHS&E MANUAL VOLUME 3) 1. Multi Gas Monitor; or other suitable gas monitoring equipment. 2. Sufficient sets of Self Contained Breathing Apparatus 3. Full Body Type Harness for each worker; 4. Tripod and Lifeline Hoist Rope; 5. Flame-proof lighting. (Hand lamps not more than 24 volts.); 6. Adequate Resuscitation Equipment; 7. Ventilation Equipment.	
22.	Work permit system	Work permit system i. A permit is not taken for construction work. a. Entry into confined spaces	Rs.70000 per first violation and Rs.140000 for subsequent violations

		b. Work in close proximity to overhead power lines and telecommunication cables. c. Hot work. d. To dig—where underground services may be located. e. Work with heavy moving machinery. f. Working on electrical equipment g. Work with radioactive isotopes. h. Heavy lifting operations and lifting operations closer to live power line ii. working to any live overhead power line is permitted without the operation of a strict Permit to Work. iii. The Contractor not develop a permit-to-work system(11.3.1- OHS&E MANUAL VOLUME 3) iv. The permit to work not issued for activities listed in clause no -11.3.2- OHS&E MANUAL VOLUME 3 v. The permit-to-work system not covered(11.3.3- OHS&E MANUAL VOLUME 3) a. How the system works; b. The jobs it is to be used for; c. The responsibilities and training of those involved; and d. How to check its operation vi) The permit-to-work not forms the communication between everyone involved of respective site conditions and requirements. (11.3.4- OHS&E MANUAL VOLUME 3) vii) The permit to work form does not contain (11.3.5- OHS&E MANUAL VOLUME 3) a. Authorised person for the jobs (and any limits to their authority); b. responsibility for precautions (e.g. isolation, emergency arrangements, etc); c. associated hazards; d. plans and diagrams its location and limitations e. precautionary measures; f. procedure to control or abandon in the case of an emergency; g. time limitations h. job specific toolbox talk conducted by the supervisor viii) A Permit To Work authorised more than a period of twenty four hours (11.3.6- OHS&E MANUAL VOLUME 3) ix) A copy of each Permit To Work not displayed, during its validity, in a conspicuous location in close proximity to the actual works location to which it apply (11.3.7- OHS&E MANUAL VOLUME 3) x) A pre-permit activation job specific toolbox talk not conducted by the supervisor with following details (11.3.8- OHS&E MANUAL VOLUME 3) a. All identified hazards are explained; b. Risk mitigation process clarified; c. Method of work explained stressing points (a) and (b) above; d. Emergency response procedure is clarified and persons assigned tasks in the event of an emergency e. Personal Protective Equipment (PPE) requirements including PPE serviceability checks and training	
23.	Traffic Management	**TRAFFIC MANAGEMENT** i. In all cases, the contractor not employ proper precautions. Wherever operations undertaken are likely to interfere with public traffic, specific traffic management plans not drawn up and implemented by the contractor in consultation with the approval of local police authorities and/or the concerned metropolitan/civil authorities/competent authorities ii. A warning not installed at all secondary road which merges with the primary road where the construction work is in progress at sufficient distance before it merges with the primary road regarding the 'Mumbai Metro Work in Progress'. iii. Traffic cones of 500mm, 750mm and 1000mm high and 300mm to 500mm in diameter or in square shape at base and are often made of plastic or rubber and normally have retro-reflectorized red and white band not used wherever required. iv. Drums about 800mm to 1000mm high and 300mm in diameter not used either as channelizing or warning devices. v. The contractor not make arrangements keeping tow away van / manpower to tow away any breakdown vehicle in the traffic flow. vi. The contractor not ensure the cleanliness of roads and footpaths by deploying proper manpower for the same. The contractor not ensure proper brooming, cleaning washing of roads and footpaths on all the time.	Rs.1,40,000 per first Violation and Rs.2,80,000 for subsequent violations For item ii) and xix) a) Rs.1,40,000 on first observation. b) Rs. 2,80,000 on second observation c) Rs. 4,60,000 on third and subsequent

		vii. All barricades not conspicuously seen in the dark/night time by the road users. Conspicuity not ensured by affixing retro reflective stripes of required size and shape at appropriate angle at the bottom and middle portion of the barricade at a minimum gap of 1000mm. In addition minimum one red light or red light blinker not placed at the top of each barricade. 1. Barricades and pedestrian walk way a. Not Cleaned b. Not in alignment c. Not numbered d. Not painted e. Red lights / reflectors not working f. Damages not repaired g. Not secured properly h. Barricade inspector not employed i. Protruding parts / portions repaired j. Barricades maintaining register not properly maintained up to date 2. Contractor Vehicles a. Over loading of vehicles b. Unfit drivers or operators c. Unlicensed vehicles d. Absence of traffic marshals e. Absence of reversing alarm f. Absence of fog light (at winter) g. Power / hand brakes not in working condition. 3. Splashing of Bentonite on roads / non-cleaning of tyres of dumpers and transit mixers i. Mishandling of bentonite like splashing of bentonite outside specified width of barricading ii. Non-cleaning of tyres of dumpers and transit mixers before leaving the site and thereby creating a traffic safety hazard to road users. viii. Adequate and clear warning signs not displayed at appropriate distances before the commencement of the site workings.(35.1.2- OHS&E MANUAL VOLUME 3) ix. Prior warning not given concerning the location of the approaching site entry and exit points. (35.1.2- OHS&E MANUAL VOLUME 3) x. All traffic signs, barriers, cones and lighting not kept maintained and clean (35.1.3- OHS&E MANUAL VOLUME 3). xi. Regular inspections of the traffic management schemes not conducted by the Contractors in both the daytime and night time hours with records (35.1.5- OHS&E MANUAL VOLUME 3) xii. The removal of excavated spoil from the sites not done by licensed vehicle(35.3.1- OHS&E MANUAL VOLUME 3) xiii. Unchecked medical examination of the drivers allowed for removal of excavated spoil (35.3.2- OHS&E MANUAL VOLUME 3) xiv. overloaded vehicle allowed for movement excavated spoil (35.3.3- OHS&E MANUAL VOLUME 3) xv. Any vehicles leaving the sites carrying load produces airborne contaminants during transportation on the public highway.(35.3.4- OHS&E MANUAL VOLUME 3) xvi. Any vehicles reversed without the control of a trained banksman(35.3.6- OHS&E MANUAL VOLUME 3) xvii. vehicles prior to leaving the site shall did not wheels washed.(35.3.7- OHS&E MANUAL VOLUME 3) xviii. Any spoil that is removed from the work-sites disposed of at unauthorised dumping sites.(35.3.8- OHS&E MANUAL VOLUME 3) xix. Not maintained and painted all the traffic barriers on yearly basis.	observations
24.	Batching plant / Casting yard	**Batching Plant and Casting Yard layout** i. The batching plant / casting yard not effectively planned for smooth flow of unloading and stacking the aggregates reinforcements and cement, batching plant, transport of concrete, casting the segment, stacking the segment and loading the segments to the trucks. ii. The batching plant / casting yard not barricaded and not made as a compulsory PPE zone	i) Rs. 14000 for single violation compounded to a maximum of Rs.140000 at any single instant. ii) Rs 420000 for violation

		iii. Electrical system not suitably not planned for diesel generator, iv. Drainage not effectively provided and waste water not disposed after proper treatment as per the law. v. Time office, canteen, drinking water, toilet and rest place not suitably located for the easy access to workers. vi. Manual handling of cement not avoided to a larger extent. vii. The PPEs provided to cement handling workmen not conform to international standards. viii. Access roads and internal circulation roads not well laid and maintained properly at all time. ix. Material stacking is not provided as IS 4082 x. Not provide 50 Lux of illumination or as per law. xi. Batching plant / Casting yard i) The Contractor release dust due to their activities beyond the permissible exposure limit as power the relevant law. ii) The waste treatment plant not provided and the MPCB norms not followed.	For item iii) and xi) a) Rs.1,40,000 on first observation. b) Rs. 2,80,000 on second observation c) Rs. 4,60,000 on third and subsequent iii) observations
25.	PPE	PPE (Personal Protective Equipment) i. Not having ii. Not wearing (or) using and kept it elsewhere iii. Using damaged one iv. Using wrong type v. Using wrong color helmet or helmet without logo vi. Using for other operation (e.g. Using safety helmet for storing materials or carrying water from one place to other) vii. Not conforming to BIS standard. viii. The contractor not pay any cash amount in lieu of PPE to the workers / subcontractors and expect them to buy and use during work. ix. The contractor not at all time maintain a minimum of 10% spare PPEs and safety appliances and properly record and not showed to the Employer during the inspections. x. Adequate Quantity of PPEs not kept always at the security post. xi. The Contractor not all times keep and maintain an adequate supply of suitable personnel protective equipment for use at all times like(31.1.1) (a) Safety Helmets. (b) Hearing Protection. (c) Respiratory Protection. (d) Eye Protection. (e) Protective Gloves. (f) Safety Footwear. (g) High Visibility Clothing to BS EN 471 Class 3 standard xii. In All construction sites person identified either without HARD HAT or SAFETY BOOTS or both (31.1.2)]	From item i) to vi) Rs.300 per single Violation For item vii) Rs.14000 for first violation and Rs.70000 for subsequent violations For item viii) to xi) Rs.70000 for first violation and Rs.140000 for subsequent violations
26.	Occupational Health	**Industrial Health and welfare** i. Fail to conduct Medical examination to workers as per MBOCW rule 2007, Absence of ambulance van & room ii. Workers not having ID card iii. Absence of first-aid person in work site iv. Absence or inadequacy of first-aid box. v. Misuse of first-aid box. vi. First-aid box not satisfy the minimum Indian standard. vii. Smoking inside the construction site viii. Drink and drive or work ix. Fumigation / insecticides not sprayed to prevent Mosquito breeding x. The Contractor not maintain Material Safety Data Sheets (MSDS) for all substances at the point of inventory (14.2.1- OHS&E MANUAL VOLUME 3) xi. The Contractor not conducted an assessment of the hazardous substances would be used in confined space with assessment record (14.2.2- OHS&E MANUAL VOLUME 3) xii. For continuous exposure of noise , i.e. for eight hours in any one-day, the sound level exceed 90dB (A).(14.3.2- OHS&E MANUAL VOLUME 3)	Rs.14000 per single violation Compounded to a maximum of Rs.140000 at any single instance

		xiii. noise levels exceed 120dB (A) and suitable hearing protectors not used(14.3.3- OHS&E MANUAL VOLUME 3) xiv. Contractor not introduced a noise control programme If noise levels exceed above 90dB (A) (14.3.4- OHS&E MANUAL VOLUME 3) xv. The ventilation system not adequate to maintain circulation of following any one :(14.4.2- OHS&E MANUAL VOLUME 3) (a) Less than 19.5% oxygen by volume. (b) More than 0.005% carbon dioxide by volume. (c) More than 0.01% carbon monoxide by volume. (d) More than 0.001% hydrogen sulphide by volume. (e) More than 0.005% oxides of nitrogen. (f) More than 0.5% of methane at any place in the tunnel. (g) More than 0.0002% of aldehyde. (h) Any other poisonous gas in harmful amounts. xvi. The Contractor not provided at least 6m3 of fresh air per minute per employee(Volume flow rate/person)(14.4.4- OHS&E MANUAL VOLUME 3) xvii. A regular analysis of the gases inside the tunnel not done with advance of the tunnel.(14.4.5- OHS&E MANUAL VOLUME 3) viii. Tools made of light alloys (such as Al and Mg) are used inside the tunnel (14.4.6- OHS&E MANUAL VOLUME 3) xix. Regular checking of gas (referred at 14.4.3) at the faces not done before each Shift by using a multi gas detector.(14.4.7- OHS&E MANUAL VOLUME 3) xx. Motive power other than electric or petrol used(14.4.8- OHS&E MANUAL VOLUME 3) xxi. Diesel engines used underground without filters to remove all carbon monoxide and oxides of nitrogen. (14.4.8- OHS&E MANUAL VOLUME 3)	
27.	Labour Welfare measures	Labour Welfare measures i. Inadequate number of toilets ii. Toilets not cleaned properly iii. Absence of water facilities for toilets and washing places iv. Toilet placed more than 500m from the work site v. Accommodation not provided as per BOCWA vi. Absence of drinking water vii. Excessive noise and vibration viii. Canteen not provided ix. Food stuff not served on no loss no profit basis x. Crèche not provided Non adherence of Labour welfare provisions of BOCWA xi. Fail to register establishment and display the registration certificate at workplace xii. Absence of workers register and record xiii. Absence of muster roll and wages register xiv. Fail to display an abstract of BOCWA and BOCWR and compliance (clause 3.3.1.2)	Rs.14000 per single violation Compounded to a maximum of Rs.70000 at any single instance
28.	Environmental Management	i. Tyre wash facility not provided ii. Spillage from vehicles not arrest iii. Air monitoring not practiced iv. Noise monitoring not practiced v. The values of air monitoring and noise monitoring not within acceptable limits vi. Dust control measures at sites not practiced vii. Improper disposal of debris / residues. viii. Non-compliance in legal provisions for water treatment and disposal and environmental laws	Rs.14000 per single violation Compounded to a maximum of Rs.70000 at any single instance

MUMBAI METRO LINE 3
(COLABA-BANDRA-SEEPZ)

CONTRACT NO: MM 3-CBS-DEM

Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

VOLUME 3 OF 6

EMPLOYER'S REQUIREMENTS
GENERAL SPECIFICATIONS

APPENDIX-28
INDICATIVE LIST OF MANUFACTURERS / SUPPLIERS / MAKES FOR E&M WORK

DECEMBER - 2017

Mumbai Metro Rail Corporation Ltd.
Plot No. R-13, 'E' Block,
Namttri Building
Bandra - Kurla Complex,
Bandra (East), Mumbai – 400051, India

INDICATIVE LIST OF MAKES

1. Contractor shall use the main items material of makes as indicated below unless specified otherwise in BOQ or as approved by the Employer's representative.

2. The contractor shall ensure the correct selection of the approved make meeting the specifications and application duties. The technical submission made by the contractor should clearly indicate deviation or improvements if any, for specification/BOQ. Before placing order for procurement, the Engineer may ask for the sample of proposed make to be got verified for its suitability to the specification and application duty. However, in case Employer's representative / Engineer considers that the make / model proposed by the contractor does not meet the requirement, the contractor will be required to propose an alternative make acceptable to the Employers representative. The decision of Engineer/Employer's representative in this regard shall be final and binding on the both parties.

3. The Contractor shall quote the rate for material and equipment as per the list of indicative ~~approved~~ makes. In the event of Contractor wanting to use alternate makes other than those stipulated for any reason, the contractor can send a proposal after ensuring that what he proposes at least meets both the quality, and safety standard of the stipulated makes and specifications as stated in the Particular specifications. He shall also stand full guarantee to his alternate proposal. The alternate makes can be used only after an approval accorded by the Engineer/Employer, whose decision will be final in the matter.

4. Vendor selected by the contractor should be capable of providing good after sales service available in Mumbai area during DLP and thereafter.

MAKES OF MATERIAL / PRODUCTS ELECTRICAL WORKS

S. no.	Details of Materials / Equipment	MAKES OF MATERIALS / PRODUCTS
LIST A – CORE ELECTRICAL ITEMS INCLUDING UPS, DG, EOT CRANE AND AIR COMPRESSOR		
1.	Transformer (Dry type)	Kirloskar, Voltamp, Crompton,Electro Mechanica, BHEL, Megawin Switchgear, ABB India Ltd, Schneider, Kirloskar Electric Company Ltd. India, China Railway Electric Industries Company Ltd.(China), SUNTEN Electric Equipment Company Ltd., India, JSHP, China, DTPL-SGB Chennai India, Electro Mechanicca India Pvt. Ltd., Raychem RPG Pvt Ltd.(India)
2.	GIS	Alstom, Schneider, Siemens Guangzhou Baiyun Electric Equipment Co., Ltd, China, ABB India Ltd. Schneider Electric Ltd., Larsen & Toubro Ltd
3.	HT Cables	LAPP India Pvt. Ltd., Finolex Cables Ltd., Gloster Cables, Havells, KEI, Polycab, KEC International Ltd India, Phelps dodge International (Thailand) Ltd, Universal cables Ltd, Hangzhou Cable Co. , China, LS Hong Qi Cable & System (Hubei) Co. Ltd., China,
4.	HT termination Kit	Raychem, 3M, Dension

S. no.	Details of Materials / Equipment	MAKES OF MATERIALS / PRODUCTS
5.	LV Switchboards	Tricolite Electrical industries, L&T, GE, Schneider, Unilec, Neptune, Adlec, Suddhir Genset Ltd, ABB, Siemens C&S
6.	Air Circuit Breaker (ACB's)	L&T, Siemens, ABB, Schneider, Legrand,
7.	Moulded Case Circuit Breaker (MCCB)	L&T, Siemens, ABB, Legrand, , Schneider
8.	Distribution Board	L&T Hager, Legrand, Siemens, ABB, Havells, Tricolite, Schneider, Unilec, Neptune, Adlec, Sudhir Genset Ltd.C&S
9.	ELCB/RCBO/RCCB	L&T Hager, Legrand, Siemens, Schneider, ABB, Havells C&S
10.	Miniature Circuit Breaker (MCB)	L&T Hager, Legrand, Siemens, Schneider, ABB,,Havells C&S
11.	Switch Fuse Units with HRC Fuses	L&T, Siemens, Control & Switchgear ltd, ABB, Schneider Electric, Havells
12.	Protective relays	Alstom (AREVA), ABB, L&T, Siemens, Schneider, GE
13.	Capacitors	Crompton, Mehar (Schneider), L&T, Siemens, Ducati, ABB, GE
14.	Current Transformer (Epoxy Cast Resin)	AE, Kappa, Control & Switchgear, Precise, G&M (Gilbert & Maxwell), Volt-amp
15.	Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display	MECO, DUCATI, Allen Bradely, Motwane, AE, Enercon, HPL, Schneider, L&T Secure,
16.	Selector Switch, Toggle switch	Kaycee, L&T (Salzer), BCH, Teknic, Schneider, ABB, C&S
17.	Indicating Lamps LED type, Push Button	L&T, BCH, Vaishno, Siemens, Teknic, RAAS, Schneider, C&S
18.	APFC Relay	Enercon, L&T, Ducati, Epcos, Emerson, Schneider
19.	Contactors	ABB, Siemens, Schneider, L&T, C&S
20.	Motor Starters	Schneider, Siemens, Socomec, ABB, Havells, BCH, C&S
MV CABLING		
21.	XLPE aluminium / copper conductor Armoured MV Cables (FRLS)	Finolex, Asian/RPG, KEI, Havells, Cords cable, Scot innovation, Polycab, Universal,
22.	Copper / Aluminium (Crimping type) Cable lugs for 1100V grade cables	Dowell's, Jainson, Universal
23.	Compression glands for 1100V grade cables	Peeco, Comet, Polycab, HMI

S. no.	Details of Materials / Equipment	MAKES OF MATERIALS / PRODUCTS
24.	Copper conductor FR PVC insulated wires ISI marked.	KEI, Finolex, Havells, Bonton, Polycab, Lapp Kabel, Universal, RR Kabel
25.	Terminal Blocks & Cage clamps	ELMEXX, PHOENIX, WAGO, CONNECTWEL
26.	Cable Trays / Raceways	Bharti, Unitech, Steelways, MEM, BEC, OBO, VPL,Legrand, Slottco, Hireach, Fitwell
CONDUIT WIRING & ASSOCIATED ACCESSORIES		
27.	GI Conduit ISI Marked	BEC, AKG, Steel Kraft,
28.	GI Conduit accessories	Conforming to BIS/IS as per approved samples
29.	Modular system, switches, socket outlets and wiring accessories with moulded cover plates	Crabtree, Legrand, Schneider, SSK, ABB
30.	Industrial Sockets	Siemens, BCH, Hensel, Mennekes, Balls, Schneider, Legrand
UNINTERRUPTED POWER SUPPLY (UPS) & INVERTER		
31.	UPS System	Tata Liebert, Numeric, APC, Seimens, Piller, Schneider, GE, Aros-PCI, Emerson, Hitachi, Mitsubishi
32.	UPS Battery	Exide, Furukawa, Standard, Panasonic, Amara Raja, HBL-Nife
33.	Inverter	Luminous, Micro Tek, Su-Kam
COMPACT SANDWITCH TYPE BUS DUCT & LV LIGHT BUS TRUNKING		
34.	Busduct	EAE, Henikwon, Schneider, Siemens, L&T, C&S, Megabarre, Legrand, GE
35.	Light Bus Trunking	Legrand, MK, EAE, Schneider, Siemens, C&S, Megabarre, GE
DG SETS		
36.	Diesel Engine	Cummins, Perkins, Caterpillar, Mitsubishi
37.	Alternator	Stamford, Leroy–somer, Kirloskar, AVK
38.	PLC Make	Woodward, Power-R-Con, DIEF, Schneider, Allen Bradley, Siemens
39.	AMF Panels	Tricolite Electrical industries, ECS, L&T, GE, Associated switchgear, Schneider, Unilec, Neptune, Anand Power, Adlec, ABB, Sudhir Genset Ltd. Gourav Energen
40.	Silencers	Neilson or any other equivalent confirming the CPCB norms.
EOT CRANE		
41.	EOT Cranes	M/s. Demag Cranes & Components (India) Pvt. Ltd., M/s. Saico Engineers & Fabricators, M/s. Furnace & Foundry Co., M/s, Mukund Ltd., UNIQUE IND. HANDLERS, ANUPAM INDUSTRIES
AIR COMPRESSED SYSTEM		
42.	Air Compressor	Atlas Copco, Ingersoll Rand, M/s. Elgi compressor, M/s. Kirloskar Copland, Chicago Pneumatic

S. no.	Details of Materials / Equipment	MAKES OF MATERIALS / PRODUCTS
LIST B – OTHER ELECTRICAL / VAC / FIRE-FIGHTING / GENERAL ITEMS		
INTELLIGENT ADDRESSABLE FIRE DETECTION & ALARAM SYSTEM		
1.	FACP	Notifire, Simplex (Tyco), Apollo, Cerberus, Schrek or equivalent
2.	Smoke & Heat Detectors	Edward, Phillips, Appolo, Cerberus, Tyco, Notifier, System Sensor or equivalent
FIRE HYDRANT & FIRE FIGHTING SYSTEM		
3.	Pumps	Kirloskar, Mather & Platt, Grundfos , Xylem or equivalent
4.	Motors	Kirloskar. ABB, Siemens, NGEF, GEC, Alshthom, Jyoti, Crompton greaves or equivalent
5.	Pressure Switch	Indfoss, Switzer, Morley, System Sensor, Danfoss, or equivalent
6.	Pressure Gauge	H Guru, Fiebig, Newage, Sukan, waaree, wika or equivalent
7.	Pipes (MS & GI)	TATA, Jindal Hissar, or equivalent
8.	MS/GI forged steel fittings	Vs, Suru, B&M or equivalent
9.	MS/GI butt welded ERW fittings	Deccan metal or equivalent
10.	Sluice valve	Kirloskar, Leader or equivalent
11.	Gunmetal stainless steel valves (full way & check valves)	
A.	Class- i	Zoloto, Leader or equivalent
B.	Class –ii	Leader, Sant or equivalent
C.	Non-return valves	Kirloskar, Leader, Audco or equivalent
D.	Butterfly valve	Audco, KSB, Leader or equivalent
E.	Hydrant valve	Newage, Minimax or equivalent
12.	Hose reel tube (Thermoplastic Synthetic reinforced)	KESARA PLAST, SYNTEX or equivalent
13.	Hose pipe (RRL Type)	Jaayshree, Newage, CRC, Jyoti,Maruti Dunlop, Minimax, Safex, Zenith or equivalent
14.	Branch pipe with nozzle	Newage, Safeguard, Minimax or equivalent
15.	Hose Box	Safegaurd, Newage or Reputed make as per IS specification subject to MMRC approval
16.	Paints exposed pipes	Asian paints, Berger, Shalimar or equivalent
17.	Anchor Fasteners	Hilti, hi-tech supports, Fischer or equivalent
18.	Wrapping & coating materials for underground pipes	IWL (pypkote), Grace Industries or equivalent.

19.	Primer paints for painting for above ground pipes	Shalimar bitumanstic paints or equivalent
20.	Y-type suction strainer	Kirloskar, Leader or equivalent
21.	Foot valve with strainer	Kirloskar, Leader, Zoloto, Sarkar or equivalent
22.	Sprinklers	Tyco, Spray safe(UK), Reliable(USA), Grinnel, Star or equivalent
23.	Alarm Valve (installation Valve)	HD fire, Mather & platt, Spraysafe, Central or equivalent
24.	Water motor gong & trims	HD fire, Mather & platt, Spraysafe, Central or equivalent
25.	Flow switches	Switzer, Forbes, Marshell, Viking, Gem, Macdonald, Grinnel, System sensors, morlay IAS, or equivalent
26.	Air release valve	Newage, Kirloskar or equivalent
27.	Ball valve	TBS, IBP or equivalent
28.	Cast iron non-return valve double flanged	Kirloskar, Leader, Kalpana or equivalent
29.	Rubber gasket	Reputed make as per IS specification subject to MMRC approval
30.	Portable fire extinguisher	Minimax, Niti, Safex, Zenith, Safeguard or equivalent
31.	Welding Electrode	Advani oerlikon, L&T or equivalent
32.	Vibration Eliminator pads	Resistoflex, Flenonics (USA), GERB or equivalent
33.	Sprinkler head, Alarm Valve	Tyco, SPRAYSAFE (UK), RELIABLE (USA), GRINNEL, STAR, HD Fire/ Mather & Platt, Central or equivalent
AIR-CONDITIONING AND VENTILATION SYSTEM		
34.	Circulator fans / Exhaust fans/ Inline Fans	Crompton Greaves, Orient, Khaitan, Alstom, Almonard, Systemaire (Sweden) – Kanalflakt, Nuaire (UK) or equivalent
35.	Air Conditioning system	Carrier, Blue Star, LG, Daikin, Toshiba, Hitachi or equivalent
36.	VRV/ VRF	Daikin, Mitsubishi, York, Hitachi, LG, Toshiba, Bluestar, Panasonic, Voltas or equivalent
37.	AHU	Waves, Aircon, Systemair India, Trane,Edgetech,Daikin Mcquay, Blue Star or equivalent
38.	Centrifugal fan (AHU)	Kruger Singapore, Greenheck or equivalent
39.	Air Filters	Spectrum, AAF, Thermodyne or equivalent
40.	FCU	Waves Aircon, ETA, Blue Star or equivalent
41.	Water Cooled Chiller (Screw)	Trane, Dunhambush, York, Daikin, Jonson & Control or equivalent
42.	Pump Set	Kirloskar, ITT or equivalent
43.	GI Sheet	Tata, Jindal or equivalent
44.	Prefabricated Duct	Rolastar, Zeco, Techno fab, Technoaircon, or equivalent
45.	Motorised Fire Damper	Ruskin India, Greenheck India
46.	Fusible Link Fire Dampers	Ruskin India, Greenheck India or equivalent
47.	Motor Operated Damper	Systemair India, Caryaire or equivalent
48.	Manual Damper	Systemair India, Rolastar or equivalent

49.	Volume control Damper	Systemair India, Greenheck, Ruskin Titus, Trox, Air master or equivalent
50.	Grills & Diffuser	Systemair India, Caryaire, Waterloo Ravistar, Air Master, Dynacraft, MAPRO or equivalent
51.	Fire Rated Paint	Firespray International Ltd. or equivalent
52.	Insulation (Non fire rated)	UP Twiga or equivalent
53.	Insulation (fire rated)	Rockwool India Pvt. Ltd., Lloyd Insulation Ltd. or equivalent
54.	Duct & Pipe Insulation	Armacell, Aeroflex, Thermobreak, Trocellin, or equivalent
55.	Cooling Tower	Paharpur India, Baltimore, Marle or equivalent
56.	MS & GI pipes	Jindal, Tata or equivalent
57.	Balancing Valve	Advance India, Danfoss, T&A Hydronics or equivalent
58.	Check Valve	Advance India, Kirloskar or equivalent
59.	Butterfly Valve (Non-Motorised)	Advance India, Kitz Japan,Audco or equivalent
60.	Butterfly Valve (Motorised)	Belimo, Kitz Japan or equivalent
61.	PICV- AHU/FCU & Flow Switch	Flowcon, Danfoss , Landis & Staefa, Johnson,Sauter ,Anergy or equivalent
62.	Y- Strainer	Emerald, Sant or equivalent
63.	Axial Flow Fans	Kruger, Systemair or equivalent
64.	Propeller Fan	Kruger, Systemair or equivalent
65.	Flexible Coupling	Resistoflex or equivalent
66.	ECS sound attenuator	Systemair, Ruskin or equivalent
67.	Motor	ABB, Crompton, Siemens, Alstom or equivalent
68.	Automatic Expansion Tank	Anergy, CIMM, TACO,Elbi or equivalent
69.	Automatic Air Vent	Anergy, Flamco,Taco or equivalent
70.	Temperature Gauge	Waree, Fiebig or equivalent
71.	Pressure Gauge	Waree, Fiebig, H Guru, Newage, Sukan, Wika or equivalent
72.	VFD	ABB, Danfoss or equivalent
73.	Water Treatment System	Thermax, Ion Exchange, GE or equivalent
74.	Anti-Fouling Device	Danfoss or equivalent
75.	Vibration isolator	Flexionics (USA), Resistoflex or equivalent
76.	Ball valve/gate valve	Audco,Kirloskar
77.	Dampers/Louvers	BETEC CAD(Dubai),Greenheck,Ravi Star
78.	Thermostats	Landis & Staefa, Honeywell, Anergy,Johnson,Sauter
79.	Precision AC	Emerson,Climeveneta,Uniflair,Stulz
80.	AHU Fans	Kruger ,Greenheck
81.	Ventilation/Jet Fans	Kruger, Greenheck
82.	Air&Dirt Separator &Vaccum Degasser	Spirotech,Spirotherm
LIGHTING & FANS		

83.	LED Light Fittings	Philips, Bajaj, Keselac-Schreder, Instapower, Crompton Greaves, Wipro, Havells, Surya, or equivalent
84.	Ceiling Fan	Crompton greaves, Orient, Khaitan, or equivalent
85.	Lighting Poles	Paruthi, Bajaj or equivalent
86.	LED Chips	Philips, Nitchia, Cree, Seoul semiconductors or equivalent
87.	Area Lighting Mast	Philips, Bajaj, Crompton, GE, METAL COATS (KLITE) or equivalent
BMS-PLC & SYSTEM INTEGRATOR		
88.	Master Control Equipment's (PLC)	GE-FANUC, Schneider, Rockwell or equivalent
89.	Air Flow Differential Pressure Switches	Honeywell, Rockwell or equivalent
90.	Duct Temperature Sensor	Greystone, Rockwell or equivalent
91.	Two way and three way motorised valve with actuators	Honeywell, Siemens or equivalent
92.	AC Current Transducer	AE, MECO or equivalent
93.	AC Voltage Transducer	AE, MECO or equivalent
94.	Differential transducer	Honeywell, or equivalent
95.	Flow Meter	JN Marshall, Tyco, Victaulic, Viking or equivalent
96.	Space—Sensor	OEM, Greystone or equivalent
97.	Pressure Transducer	Greystone, or equivalent
98.	Dot Matrix Printer	EPSON, HP, Canon or equivalent
99.	HUB for TCP AP	Emulux, Cisco, Aruba, HP or equivalent
100.	Liquids Level Switch	Techtrol, Level Tech or equivalent
101.	Server PC	DELL, HP, Lenevo or equivalent
102.	Monitor	DELL, HP, Lenevo or equivalent
103.	Notebook PC	DELL, HP, Lenevo or equivalent
104.	Cables	KEI, Cisco, D-link or equivalent

General:

(a) It shall be obligatory for the Contractor to obtain Notice of 'No Objection' from the Engineer for the selection of the vendors for all items of work, even if the name of the vendor is specified in the Contractor's Technical Submission and the works to be done including purchase of materials and equipment is in accordance with the Technical Specifications and Standards specified in the Contract.

(b) In case of vendor selected from the indicative list provided in the contract,

I. A list of indicative make/vendors is provided in this contract.

II. Contractor in general shall use the material of indicative make as per indicative vendor list unless specified in BOQ or makes meeting the tender specifications as approved by the Engineer/Employer's representative.

III. The contractor shall ensure the correct selection of the indicated make meeting the specifications and its application. Before placing the order for procurement, the sample of indicated make shall be verified for its suitability to the specification and application. In case Employer's representative/ engineer, (whose decision will be final and binding on both parties) considers that the make/ model proposed by the contractor does not meet the tender requirement, the contractor will be required to propose an alternative make acceptable to the Employer's Representative.

(c) The contractor will submit a list 'A' of vendors for all the items of the BOQ contract

I. The list should include the items for which the contractor is proposing the product of the indicated vendor.

II. The contractor will be advised 'No Objection' with following caveat: -

- The model etc. to be supplied will be the latest or superior one.
- The contractor will be required to submit the technical proposal for the scrutiny

III. For the items, contractor desires to propose new vendor, proposal to be submitted in accordance as List 'B'.

IV. The contractor will submit the undertaking that above lists i.e. List 'A' and List 'B' includes all the items required in the contract.

(d) Vendor to be selected who are capable to provide good after sales services available in Mumbai during DLP and thereafter.

Vendor Approval and Selection Procedure

(a) In the event of contractor wanting to use alternate makes other than those stipulated, for any reason, the contractor can send a proposal after ensuring that what he proposes at least meets the specifications both, the quality and safety standard of the stipulated makes and the financial benefit that will accrue to the employer. The alternate proposed product should be a proven one. He shall also stand full guarantee to his alternate proposal and if at any stage it is found that the material is not suitable or meeting the tender requirement, the contractor shall replace the material and provide the material from the indicated vendor without any additional cost to MMRC. The alternate makes can be used only after an approval accorded by the Employer, whose decision will be final in the matter.

(b) The approval of any equipment or product to be used shall be done in two stages: -

I. Stage-I

- Assessment of capability of proposed Vendor to supply a particular equipment or product, with quality and performance requirements, as required by Specifications

as well as other contract conditions. The proposed product should be a proven product in service for at least 3 years.

- Assessment of the financial and functional strength of the Vendor to supply the requisite quantity of equipment and product as per delivery schedule acceptable to contractor and engineer to deliver the project in time.

II. Stage-II

Stage-II called as Technical Submission Approval Stage, selection of Equipment or product from the equipment / products manufactured / supplied by the approved vendor will be done. This stage includes thorough technical assessments about the conformance of the offered equipment / product to the Specifications and other requirements.

III. To obtain **Vendor** Approval the Contractor must apply with the four sets of the following documents to the Engineer

(i) Company Profile and Experience of the Vendor
(ii) Clause wise compliance of the relevant Clauses of Specifications.
(iii) Details of supplies / orders executed in last ten years for the type of equipment / product offered. Supplies / orders executed for Metro Systems shall be specifically mentioned
(iv) Details of the facilities available at the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured.
(v) ISO 9000 Certification for the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured (The Works / Manufacturing Unit where the proposed equipment / product shall be manufactured must have ISO 9000 Certification)
(vi) Proof regarding compliance to Manufacturer's Qualifications. The offered products must be proven in service.
(vii) Audited Financial Statements of the Vendor for the last three years.
(viii) Type test certificates/ Performance certificate from accredited laboratories for the proposed type of equipment / products to establish the technical capability of the vendor (In case, specific requirements are mentioned in the relevant sections of Specifications with regard to type testing, same shall also be complied additionally).
(ix) The vendor shall not have been blacklisted by any Govt. Agency in India.
(x) Any other item as required by Employer / Engineer.

IV. Contractor must certify the check list provided that vendor Proposal is complete and all the above documents are available in the Vendor Proposal. In addition, the Contractor must check / certify compliance to the Specifications before forwarding the same.

V. Incomplete Vendor Proposal will not be treated as a submission and will be returned.

VI. Engineer will give Approval to the Vendor Proposal (received complete with all the documents mentioned above) expeditiously.

VII. Technical submission shall be accompanied with the calculations / other technical documents to justify the selection of any particular model of equipment / product, detailed technical features / parameters of the selected product, type test certificates from the accredited laboratories for the offered products, any other document required by the Engineer.

VIII. Engineer will give Approval to the Technical Proposal (received complete with all the documents mentioned above) expeditiously.

(c) It may be noted that Approval of Vendors as per Point III above shall only be done by Employer / Engineer after the award of the work. Vendor submissions shall not be evaluated during the tender evaluation. Conditional Tender offers received from Tenderers with particular Vendors for supply of equipment/ products will not be evaluated during evaluation and will be dealt with after award of the work.

(d) It may further be noted that Employer / Engineer shall be under no obligation to accept equipment / products manufactured by the successful Tenderer, unless it meets the entire criterion mentioned above.

The Employer /Engineer's decision on contractor's proposal shall be final and binding.

For sourcing the equipment from indigenous manufacturing facilities, following conditions shall be complied: -

a) In case the vendor uses his own facilities for indigenization after part supply of equipment from the approved manufacturing unit, no change in design, component type/make, quality standards, manufacture procedure, etc. shall be made without specific approval of the Engineer.
b) In case OEM wants to use manufacturing facilities in India (other than his own) for items for which the OEM has been approved, it shall enter into an agreement with such selected Indian equipment manufacturer and obtain prior approval from MMRC. No change in composition, rating, type, model no., manufacturing process, quality standards, design, etc. and make of the components used in assemblies/sub-assemblies of such equipment as manufactured by the approved parent vendor shall be made without specific approval of the Engineer.
c) In case OEM wishes to change/make/type specifications, etc. of any sub-components for supplies to be sourced from Indian facility, specific prior approval of the Engineer shall be obtained for changes made, model, specification, etc. Responsibility for obtaining such prior approval shall rest solely with the contractor.

Format for submitting the vendor approval request shall be given to the contractor during initial stages and approved format shall be followed throughout the contract.

Add Under
Clause 1.26 MAINTENANCE DURING DEFECTS LIABILITY PERIOD

Annexure-4

MINIMUM MANDATORY SPARES FOR DLP

S.No.	Item	Quantity
A	**ACB**	
1	ACB OF EACH RATING OF EACH MAKE	1 nos. for each rating for each make
2	COMMUNICATION PROT FOR BREAKER RS. 485	2 nos. for each rating for each make
3	SHUNT TRIP	2 nos. for each rating for each make
4	UNDER VOLTAGE WITH CONNECTOR	2 set for each rating for each make
5	SMPS FOR CONTROL SUPPLY	1 nos. for each rating for each make
6	ACB RELEASE	2 nos. for each rating for each make
7	3P ACB NEUTRAL CT	2 nos. for each rating for each make
8	AUX CONTACTOR SET (NO-NC)	2 nos. for each rating for each make
9	CLOSING MECHANISM (CLOSING COIL, MOTOR, ACCESSORIES ETC.)	2 SETS
10	FAULT SIGNILING CONTACT	2 SETS
B	**MCCB**	
1	MCCB OF EACH RATING OF EACH MAKE	1 nos. for each rating for each make
2	MOTOR MECHANISM	2 nos. for each rating for each make
3	AUX + TRIP CONTACT	2 nos. for each rating for each make
4	NETURAL SENSER CT	1 nos. for each rating for each make
5	SHUNT TRIP COIL	4 nos. for each rating for each make
6	EXTENDED ROM	2 nos. for each rating for each make
7	ULP COMMUNICATION MODULE	1 nos. for each rating for each make
8	ANY OTHER PART OF SIMILAR NATURE RECOMMENDED BY OEM	As recommended
C	**MPCB**	
1	MPCB OF EACH RATING OF EACH MAKE	1 nos. for each rating for each make
2	AUX CONTACT 1NO+1NC	2 nos. for each rating for each make
3	FAULT TRIP CONTACT 1NO+1NC	2 nos. for each rating for each make
4	ANY OTHER PART OF SIMILAR NATURE RECOMMENDED BY OEM	As recommended
D	**METERS**	
1	MULTIFUNCTION METER	2 nos. for each rating for each make
2	AMMETER	2 nos. for each rating for each make
3	VOLTMETER	2 nos. for each rating for each make
E	**CT**	

1	CURRENT T/F WITH MOUNTING INSERT & TERMINAL SHROUDING	2 nos. for each rating for each make
F	**LIGHT & PUSH BUTTON**	
1	INDICATING LAMP RED	5% of total qty installed
2	INDICATING LAMP YELLOW	5% of total qty installed
3	INDICATING LAMP BLUE	5% of total qty installed
4	INDICATING LAMP GREEN	5% of total qty installed
5	INDICATING LAMP AMBER	5% of total qty installed
6	EMERGENCY PUSH BUTTON LOCKABLE	5% of total qty installed
7	RED PUSH BUTTON WITH NO.	5% of total qty installed
8	GREEN PUSH BUTTON WITH NC	5% of total qty installed
G	**RELAY & TIMERS**	
1	MICRO RELAY WITH 14PIN BASE WITH SURGE SUPPRESSOR	20 nos.
2	RELAY BASE, RELAY WITH LED, RC CIRCUIT	20 nos.
3	MULTIFUNCTION TIMER	02 nos.
4	S/D TIMER	02 nos.
5	HOUR METER	02 nos.
6	MOISTURE PROTECTION RELAY AUX SUPP.230VAC WITH O/P CONTACT 1C/O RESET MODE AUTO (1NO+1NC)	02 nos.
7	TVMR RELAY	02 nos.
H	**SWITCHES**	
1	TNC SWITCH WITH KEY WITH ELEMENT	5% of total qty installed
2	LOCAL/REMOTE WITH SWITCH 2 STAY PUT, LOCKABLE	5% of total qty installed
3	AUTO/LOCAL/REMOTE WITH SWITCH 3 STAY PUT, LOCKABLE	5% of total qty installed
4	WORK STAND BY S/S 1P2W, LOCKABLE	5% of total qty installed
I	**MCB & RCCB**	
1	MCB	10 nos. of each rating of each make
2	RCCB	10 nos. of each rating of each make
3	RCCB AUX CONTACT	10 nos.
J	**CONTACTORS**	
1	AUX CONTACTOR	05 nos. of each rating of each make
2	POWER CONTACTOR 3P	05 nos. of each rating of each make
3	CAP. DUTY CONTACTOR 3P	05 nos. of each rating of each make
4	ADD ON BLOCK 2NO+2NC	05 nos. of each rating of each make

5	ADD ON BLOCK 1NO+1NC	05 nos. of each rating of each make
K	**HEATER & FAN & HUMIDISTAT**	
1	HUMIDISTAT	10 nos.
2	SPACE HEATER	10 nos.
3	CFL WITH DOOR SWITCH	10 nos.
4	CONTROL TERMINAL	10 nos.
L	**FUSES**	
1	FUSES	10 nos. of each rating
M	**LIGHTS**	
1	LIGHT FIXTURES (COMPLETE ASSEMBLY WITH FIXTURE, BALLAST, LAMP, etc.	10 nos. of each type of light
2	BALLAST	10 nos. of each type of light
3	LAMP	10 nos. of each type of light
4	HOLDER	10 nos. of each type of light
N	**ATS**	
1	ATS (COMPLETE ASSEMBLY)	01 nos. of each type
2	CONTROLLER	01 nos. of each type
3	AUXILLARY CONTACT BLOCK	01 nos. of each type
4	MOTOR MECHANISM/MOTOR	01 nos. of each type
O	**UPS**	
1	FUSES	20 nos. of each type
2	CARDS	01 nos. of each type
3	MCB/MCCBs	02 nos. of each type
P	**FIRE ALARM SYSTEM**	
1	FIRE ALARM LOOP CONTROL MODULE	2 nos. of each type
2	FIRE ALARM LOOP EXPANDER MODULE	2 nos. of each type
3	ADDRESSABLE POWER SUPPLY, 240 VAC	2 nos. of each type
4	INTELLIGENT MULTI SENSING DETECTOR	5% of total qty installed
5	INTELLIGENT HEAT DETECTOR	5% of total qty installed
6	INTELLIGENT DETECTOR BASE	5% of total qty installed
7	INTELLIGENT ADDRESSABLE DUCT PHOTO DETECTOR	5% of total qty installed
8	LOOP ISOLATOR MODULE	5% of total qty installed
9	ADDRESSABLE CONTROL MODULE	5% of total qty installed
10	ADDRESSABLE RELAY MODULE	5% of total qty installed
11	ADDRESSABLE MONITOR MODULE	5% of total qty installed
12	ADDRESSABLE PULL STATION	5% of total qty installed

13	POWER SUPPLY FOR ADDRESSABLE PULL STATION	5% of total qty installed
14	HOOTER STROBE	5% of total qty installed
15	FLOW SWITCHES	5% of total qty installed
16	ISOLATOR BASE	5% of total qty installed
17	RESPONSE INDICATOR	5% of total qty installed
18	CPU OF FACP	5% of total qty installed
Q	**PANEL GAS FLOODING SYSTEM**	
1	FILLING ADAPTER	05 nos.
2	OUTLET ADAPTER	05 nos.
3	END OF LINE ADAPTER	05 nos.
4	PRESSURE SWITCH	05 nos.
5	DETECTION TUBE	100 meters
6	MASTER CONTROL UNIT	2 nos.
7	AUTO WEIGHT MEASURING UNIT	1 nos.
R	**PUMPS**	
1	JOCKEY PUMP HYDRANT	1 nos.
2	JOCKEY PUMP SPRINKLER	1 nos.
3	SHAFT SLEEVE	5 nos. for each type of pump
4	SET OF O RINGS	5 nos. for each type of pump
5	GASKET SET	5 nos. for each type of pump
6	MECHANICAL SEAL	5 nos. for each type of pump
7	SEEPAGE PUMPS	2 nos. of each rating
8	WATER SUPPLY PUMPS	2 nos. of each rating
9	SEWAGE PUMPS	2 nos. of each rating
10	WEAR RINGS	5 nos. for each type of pump
11	GLAND PACKING	5 nos. for each type of pump
S	**LEVEL CONTROLLERS**	
1	LEVEL SENSOR	10 nos. of each type
2	LEVEL CONTROLLERS	10 nos. of each type
T	**PRESSURE GAUGE/SWITCH**	
1	PRESSURE GAUGE	5 nos. of each type
2	PRESSURE SWITCH	5 nos. for each type
U	**VALVES**	
1	HYDRANT VALVES	5 nos. of each type
2	HYDRANT HAND WHEELS	5% of total qty installed
3	HYDRANT BLANK CAP WITH CHAIN	5% of total qty installed
4	BUTTERFLY VALVES	5 nos. of each type
5	GATE VALVES	5 nos. of each type

6	BALL VALVES	5 nos. of each type
7	MOTORIZED BUTTERFLY VALVES	5 nos. of each type
8	EXPANSION BELLOW	5 nos. of each type
9	POT STRAINER	5 nos. of each type
10	STRAINER OF Y-STRAINER	10 nos. of each type
11	PRESSURE RELIEF VALVE(PRV)	5 nos. of each type
12	GLOBE VALUE	5 nos. of each type
13	GASKETS	50 nos. of each type of valve
14	AUTO COUPLING	5 nos. of each type
V	**Compressed air system**	
1	Air filter	
2	Oil filter equipment	56 Nos
3	Oil seperator	56 Nos
4	Complete unloader valve kit assembly	28 Nos
5	Non return valve	5 Nos
6	Pre-Filter Panel	8 Nos
7	Greese for fans	8 Nos
W	**AHU**	
1	UV lights	4 Sets
2	Pressure Gauge & thermometer	8 Set
3	Bearings	4 Sets
4	Door limit Switch	1 Set
5	Marine lamp bulb	6 nos
6	Filters	4 Sets
7	Flexible canvas connection	2 Nos
8	Chemical for Coil Cleaning	1 Lot
X	**FCU**	
1	Filter FCU	1 Nos.
2	Ball Vlaves with strainers	3 Nos
3	Motor for FCU	2 Nos
4	Thermostat	2 Nos
5	Door Locking Clip	5 Nos
6	Capacitor	3 Nos
Y	**PUMPS**	
1	Bearing for Cond. Water Pump	1 Set
2	Bearing for Chill Water Pump(P)	1 Set
3	Pressure Gauge & thermometer	8 Sets
Z	**WATER COOLED CHILLER**	
1	Pressure Gauge & thermometer	8 Set

2	FLOW SWITCHES	1 Nos
3	MOV	1 Nos
4	Refrigerant	30KG
5	Coolant	3 Gallons
6	Filter Drier	6 Nos
7	Oil filter	6 Nos
8	Fuse 5 A	6 Nos
9	Fuse 2 A	6 Nos
10	Condenser Descaling Chemicals	4 Lots
AA	**COOLING TOWER**	
1	Level Sensor	3 Nos
2	Float Valve	4 nos.
3	Gate valves	4 Nos
4	MBV	1 No
5	Filter & Nozzles	2 Nos
AB	**DAMPERS**	
1	Fusible Links	20 Nos
2	Actuators	6 Nos
AC	**PROPLLER/AXIAL FAN**	
1	Flexible canvas connection	6 Nos
2	Grease	6 Kg
3	Lubricating oil CAN(500ml)	6 Nos
4	Filters	1 Set
AD	**BMS-ECS System**	
1	Input 24V DC POS/NEG Logic (4 Groups of 8) 32 Points	1 Nos
2	Output 12/24V DC POS Logic 0.5A 2 Groups of 16,32 Points	1 Nos
3	Analog input 15 Bit, Current 15 Channel	1 Nos
4	Analog input 13 Bit, Current 8 Channel	1 Nos
5	Power supply with extended 3.3C DC 24V DC input	1 Nos
6	Relay Board 16 channel with 2C/O omron G2R2 Relay 24V DC Coil and contact Rating 230V AC/24V DC 5A	1 Nos
7	PS/1AC/24DC/20 power supply- input AC: 85-264, Output: 24VC DC , 20A	1 Nos
8	PS/1AC/24DC/20 power supply- input AC: 85-264, Output: 24VC DC , 10A	1 Nos
9	Fan 220V AC Operated, 4 Inch	1 Nos
10	Glass Cartridge Fuse link, 0.5A	50 Nos

11	Glass Cartridge Fuse link, 1.0A	50 Nos
12	Glass Cartridge Fuse link, 50MA	50 Nos
13	Noraml Terminals	50 Nos
14	Terminal Block 4 SQ.MM-Grey Fuse Type	50 Nos
15	Terminal Block 4 SQ.MM-Grey Fuse Type with 230V AC LED	50 Nos
16	MCB, 16A, DP	1 Nos
17	MCB, 16A, DP	1 Nos
18	Panel Tube	1 Nos
19	Indicating Lamp	12 Nos
20	Interface/comm module	1 Nos
AE	**For EOT Cranes per crane**	
1	Wear and tear Set (each for Hoist, CT and LT motor)	1 set
2	Magnet body set(each for hoist, CT and LT motor)	1 set
3	Over Hauling set (each for Hoist, CT and LT motor)	1 set
4	Pendant switching element	1 set
5	Current collector trolley	1 set
6	Hoist wire ropes with rope guide	1 set
7	Brake set with shoe	1 set
8	Brake Drum - 2 nos	1 set
9	Brake Shoe Complete - 2 nos	1 set
10	DC Disc brake - 2 nos	1 set
11	Long travel wheels in set of 4 wheels	1 set
12	Wire Ropes for each hoist	1 set

2.14. LIGHT FIXTURES (INDOOR AND OUTDOOR AREA)

2.14.1 SCOPE

Scope of work under this section shall include inspection at suppliers /manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of **INDOOR & OUTDOOR LED** light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc as required.

2.14.2 OBJECTIVE

The main lighting objectives are:

a) Safety and health
The lighting should enable the occupant to see sufficiently well to work and move about in safety, both under normal condition and in the event of emergency involving a power failure. The lighting must not create conditions which are injurious to health, requiring for example, the elimination of harmful radiation, the prevention of eye strain and prevention of glare.

b) Performance
Visual performance is the term used to describe both the speed at which the eyes function and the accuracy with which the visual task can be carried out.

c) Appearance and comfort
The way in which a space is illuminated can affect its character and the object with in it .Where the creation of mood or atmosphere is predominant this must be the prime lighting objective, but some consideration should be given to this factor in all the designs.

d) Energy and cost effectiveness
Significant saving in energy consumption , and therefore cost of providing lighting without reducing standards can be achieved by applying an energy-effective-design approach to lighting installation, the cost of owning and installation can be divided as follows:

i. Investment Cost
The investment cost for a particular installation can be split up as follows:
(i) Luminaries cost, including control gear and very often the initial lamp costs
(ii) Lighting control system
(iii) Mounting accessories
(iv) Electrical wiring
(v) Installation cost

Where a number of alternative lighting solution based upon similar luminaries arrangement have been proposed, all of them satisfy the quality criteria, the difference in the cost of electric wiring and the installation is considerably less as compared to total system cost whereas, use of different luminaries and mounting accessory would make substantial difference in investment costs. Different luminaire choice has direct implication on the running cost either in the energy cost or the cost of maintenance. Also, the luminaries chosen and the way these are arranged and mounted can affect the cost of wiring.

ii. Running Costs
The most important running costs are those involving
(i) Energy
(ii) Lamp replacement
(iii) Maintenance of system

Maintenance costs represent a relatively small part of the total annual costs. This is particularly important in environments where disturbance to the work routine should be avoided. The major running cost factor is the cost of energy .This means that the lighting, apart from meeting all the other demands likely to be placed upon it, must also be as efficient as possible so as to keep electricity consumption to a minimum.

2.14.3 STANADARDS AND CODES

The scope of work shall cover the supply, installation, testing, and commissioning of lighting system comprising light fittings (LED, chokes, control gear, lamps, fixing arrangement etc. as specified standard.

The LED lighting and their associated accessories such as lamps, reflectors, housings, control modules etc., shall comply with the latest applicable standards, more specifically the following:

IS 3646 (All 3 parts)	Code of practice for interior Illumination
IS 16102 Part-1	Self-ballasted LED lamps for general lighting services.(Part1-Safety Requirements)
IS 16102 Part-2	Self-ballasted LED lamps for general lighting services. (Part2-Performance Requirements).
IS 16103 Part-1	LED modules for general lighting. (Part 1 Safety Requirements).
IS 16103 Part-2	Self-ballasted LED lamps for general lighting services. (Part2-Performance Requirements).
IS 16104	Method of measurement of lumen maintenance of solid state light (LED) sources.
IS 16105	Method of measurement of lumen maintenance of solid state light (LED) sources.
IS 16106	Method of electrical & photometric measurements of solid state lighting products.
IS 16107 Part-1	LED Luminaire performance general Requirements.
IS 16107 Part-2	LED Luminaire performance particular Requirements.
IEC 55015/EN 55015	Limits and method of Measurements of radio disturbance characteristics of electrical lighting and similar equipment.
IEC 60529/EN 60529	Specification of degrees of protection provided by enclosures (IP code).
IEC 60555/EN 60555	Disturbances in supply systems caused by household appliances and similar electrical equipment.
IEC 60947-4-1/EN 60947 – 4- 1	Specification for low – voltage switchgear and control – gear, Contractors, motor – starters, electromechanical contractor and motor-starters.
IEC 60555, EN 55015	Electromagnetic Compatibility: Emission
IS 16108	Photo-biological safety of lamps & lamps system.
BS 646	Cartridge fuse- links (rated up to 5 amperes) for AC/DC service.
IEC 60742 / EN 60742/BS 3535	Isolating transformers and safety isolation transformers.
IS 3646 Part 1 & 2	Code of Practice for Interior Illumination.
IS 1777 – 1978	Industrial luminaire with metal reflectors
IS 10322 (All Parts)	Specification for Luminaires
NBC 2016	National Building Code India
NLC 2010	National Lighting Code

IE Rules	Indian Electricity Act and Rules issued there under
IS 16101	General lighting - LED's and LED modules – Terms and condition
IS 15885: (Part-2 Section-13	Safety of Lamp, Control Gear Part2 Particular requirements section-13. DC supplied electronic control gear for LED module.

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Codes of Practice or the relevant British Standard Codes of Practice in the absence of Standard

2.14.4 LIGHT FITTING GENERAL REQUIREMENTS

a) All fixtures shall be complete with accessories necessary for installation whether so detailed under fixture description or not.
b) Fixture housing frame or canopy shall provide a suitable cover for the fixture outlet box or fixture opening.
c) Fixture shall be installed at mounting heights as detailed on the drawings or instruction on site by the Employers representative.
d) Fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the fixture highly secured to a fixture stud in the outlet box. Extension pieces shall be installed where required to facilitate proper installation. Design of hangers and method of fastening other than shown on the drawings or here in specified shall be submitted to the Engineer for approval.
e) Pendant fixture within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustments of height shall be made during installation as per instructions of Engineer.
f) Flush mounted and recessed fixtures shall be installed so as to completely eliminate light leakage within the fixture and between the fixture and adjacent finished surface.
g) Fixture shall be completely wired and constructed to comply with the regulations and standards for Electric light fixtures, unless otherwise specified. Fixture shall bear manufactures name and the factory inspection label unless otherwise approved.
h) Fixture with visible frames shall have concealed hinged and catches. Pendant fixtures and lamp holder shall be provided with ball type aligners or similar approved means. Recessed fixtures shall be constructed so as to fit into an acoustic tile ceiling
Or plaster ceiling. Flanges shall be provided for plaster ceiling. Fixtures with hinged diffuser doors shall be provided with spring clips or other retaining device to prevent the diffuser from moving.
i) Detailed catalogue cuts for all fixtures or if so required by the Engineer sample fixtures shall be submitted for approval to the Engineer before orders for the fixture are placed. Shop drawings for non-standard fixture types shall be submitted for approval to the Engineer.
j) Recessed fixtures shall be constructed so that all components are replace-able without removing housing from the ceiling.
k) Lamp shall be supplied and installed in all lighting fixtures furnished under this contract. All lamps shall be rated for 250 volts. Lamps for temporary lighting services shall not be used in the final lamping of fixture units. Lamp shall be wattage and type as shown on the drawings and schedule. Where not shown the details shall be ascertained from the Engineer before procurement.
l) Lamps for permanent installation shall not be placed in the fixtures until so directed by the Engineer and this shall be accomplished directly before building portions are ready for occupation
m) Each fitting shall have a terminal block suitable of loop out connection by 1100V PVC Insulated copper conductors wires. The internal wiring should be completed by manufacturer by means of standard copper wire and terminated on the terminal block.

n) Each light fitting shall be provided with an Earthing terminal. All metal or metal enclosed parts of the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

2.14.5 LED LIGHTS TECHNICAL REQUIREMENT

a) LED Luminaire

This specification covers for supply of Light Emitting Diode (LED) lighting that shall be used as general lighting in system. The product should be latest state of art and compliant to relevant IEC 60598-1, 2, 3, IEC 62031and IEC/PAS 62612 or their latest edition depending on the type of luminaire. In addition to the above luminaire shall adhere to relevant BIS standards IS 15885, 16101, 16102, 16103, 16104, 16105, 16106, 16107 (Part I & II) as per the application. The supplier shall have proven design capabilities and should provide type test certificate / performance certificate from an NABL accredited laboratory. The manufacturer shall have at least five years' experience of design and manufacturing of similar products. The proposed products from the proposed manufacturing unit shall have established their satisfactory performance and reliability for three years in minimum. The product and its major components shall be state of art and of proven design.

b) Fixture

i. The fixture shall be suitable to work under following ambient conditions.
   - Maximum ambient temperature of 50° C.
   - Atmosphere - The product shall be designed to work in coastal, humid, salt laden and corrosive atmosphere.

ii. Housing, if not used as a heat sink shall be made of at least 0.5 mm thick sheet Steel/ extruded Aluminium (minimum 2 mm thickness) or pressure die cast (minimum 2 mm thickness), conforming to relevant standards, polyester powder coated of at least 40 microns) and high U.V. & corrosion resistance.

iii. Heat sink used should be extruded Aluminium or Pressure Die-Cast Aluminium having high conductivity preferably ADC 12 or LM 6.

iv. Luminaire should be covered with suitable Glass or diffuser with High Transitivity. Outdoor luminaire shall be with clear toughened glass or clear polycarbonate cover.

v. Lighting fixtures and accessories shall be designed for continuous trouble free operation under diverse atmospheric conditions without deterioration of materials. Degree of protection of enclosure shall be at least IP-65 for outdoor fixtures. However, down lighter and other internal fixture shall be provided with at least IP-54/20 protection.

vi. The fixture should conform to applicable IS 10322 / IEC 60598 (All parts & amendments) and should have the associated LM-79 and LM-80 report from accredited lab. Test report shall be submitted along with relevant catalogues.

c) LED Approved Make Compliances shall be as below but not limited to

IS certified. High lumen efficacy LEDs suitable for the application along with following features shall be used:

i. LED Efficacy at the chip level shall > 120 lumen/watt (For High power LED')
   (i) The efficiency of the LED at 85 Degree C junction temperatures shall be more than 85%.
   (ii) The system luminous efficacy of LED luminaire' shall be as under
      - Efficacy > 75 lumen/Watt for low wattage luminaries (<45W); and
      - Efficacy > 85 lumen/watt for high wattage luminaries (>45W)

ii. Adequate heat sink with proper thermal management shall be provided.

iii. Minimum view angle of the LED shall not be less than 120°.

iv. Power factor of complete fitting shall be more than 0.9

v. LED shall be surface mounted type duly soldered to PCB by Reflow system or COB type. The Solder used shall be ROHS compatible for environment friendliness.

vi. Input frequency range shall be between 50Hz ± 3%.

vii. Minimum Color rendering index CRI >=70 unless specified in item description.
viii. Correlated Color Temperature shall be in the range of 3000 K - 6500 K.

d) LED Driver

LED driver shall have following features:

i. Input voltage Range within 160V (RMS) to 270V (RMS) o Driver shall be designed to withstand surges of at least 1.5 KV.
ii. Output voltage of the driver shall be designed to meet the Power Requirement of the system.
iii. Output voltage ripple should be within 3%
iv. Output over voltage protection 125 V DC
v. Full Load Efficiency ≥ 85%
vi. Total Harmonic Distortion
   - For 0- 50 W for shall be less than 25%
   - Above 50 W rating shall be less than 15%.
vii. Current waveform should meet EN 61000-3-2
viii. LED Driver shall withstand voltage of 350V for 2 hours and restore normal working when normal voltage is applied
ix. The driver should comply with CISPR 15 for limits and methods of measurement of Radio disturbance characteristics.
x. The equipment should comply with IEC 61547 for EMC immunity requirements.
xi. The control gear should be compliant to IEC 61347-2-13, IEC 62031 and IEC 62384.

e) General

The lumen maintenance of the LED lightings shall not be less than 70% after 50,000 hours. The supplier shall provide evidence that the LED chipset manufacturer has the patent right to produce the supplied LED chipset to avoid infringement of white LED patent. Free warranty shall commence after delivery and end at 60 months after delivery. The warranty of replaced item shall re-start from date of attending defect / replaced.

Test reports for various parameters i.e. flux, power, efficacy, chromaticity, temperature, protection etc. issued by an NABL accredited laboratory shall be furnished. Estimation on product's life and performance shall also be furnished.

Client reserves the right of testing of products for its conformity in accordance with above specifications.

2.14.6 INDOOR LIGHT FITTING

a) SURFACE MOUNTED LIGHT FITTING

i. Only single and/or two LED tube lamps with accessories shall be used in any one fixture.
ii. Surface mounted fixtures longer than two feet shall have one additional point of support besides the outlet box fixture stud when installed individually. Pendant, individually fixtures four feet long and smaller shall be provided with twin stem/conduit hangers. Stems shall have ball aligners or similar devices and provided for a minimum of 25 mm vertically adjustment. Stems shall be of appropriate length to suspend fixtures at require mounting height.
iii. Light fitting housing shall be CRCA sheet steel, powder coated and minimum IP 20 protection required
iv. Lamps shall maximum energy savings and a minimum guaranteed of 50000 burning hours and a lumen output of 4000 lm.colour shall be approved from employer representative.
v. The surface mounted light fitting shall be using without false celling area like pump room, ASS, Electrical room, stair case, stores, workshop, stabling shed etc.,

b) RECESS MOUNTED LIGHT FITTING

i. Where ever false celling will come like office area, supervisor room, staff room, canteen, toilet

etc., using that recess mounting LED light fitting with supporting arrangement.

ii. Light fixtures lamps shall be maximum energy savings and a required maximum guaranteed of life burning hours and fitting selection , lumen output based on the lux level requirement
iii. Light fitting housing shall be CRCA sheet steel, powder coated.
iv. Decorative LED fitting shall be provided with mounting/housing channel cum reflectors of CRCA sheet steel. Stove enamelled diffusers or louvers shall be translucent white polystyrene, as specified.

c) SHED LIGHT FIXTURES

i. High bay and low bay industrial type LED light fixtures shall be used the shed area.
ii. Light fitting out let box shall be provided with hanging arrangements, adequate support the complete light fixtures Wight.
iii. Shed light fitting shall be provided the High pressure die cast aluminium housing arrangement with tempered glass cover.

2.14.7 INSTALLATION OF LIGHT FIXTURES

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Engineer. Pendant fixtures specified with overall stem lengths are subject to change and shall be checked with conditions on the job and installed as directed. All suspended fixtures shall be mounted rigid and fixed in position in accordance with drawings, instructions and to the approval of the engineer.

2.14.8 LIGHTING LUX LEVELS

GENERAL LUX REQUIREMENTS

The Contractor shall Design, supply, install and commission a high efficiency lighting system for all area and buildings of the Depot including emergency lighting system Light fittings for all areas shall be selected to suit various architectural design and finishes and the Contractor shall allow for the design co-ordination process that this shall entail. The light fittings and all associated accessories shall be subject to the Notice of No objection of the Employer.

The Contractor shall engage a specialist lighting system consultant for carrying out a detailed review of the lighting design proposed by the Contractor in order to meet the following objectives:

a) State of art, LED lighting system with modern smart luminaires;
b) Energy efficiency;
c) Integration with Architectural design and finishes including signage's;
d) Aesthetic appearance.

Lighting fixtures shall be manufactured locally by approved factory or imported.

The design of mounting details of the light fitting shall take into consideration the ease of maintenance. Where light fittings are mounted at high levels, the Contractor shall provide suitable means to enable the light fittings be maintained without the use of portable ladders or other portable equipment with minimum interruption to the railway operation.

The Contractor shall design, supply, install and commission of light fittings for all areas.

Emergency lighting in the escape corridors and staircases shall be un-switched.
Lighting in public areas shall be controlled via Lighting Control System's Workstation at OCC. The circuitry shall be designed such that the lighting could be controlled to achieve 25 Lux, 33%, 66% and 100% illumination level

The lighting on escape route shall be connected to dedicate UPS serving Very Essential Loads. Selected lighting loads of other areas shall be connected to DG serving Essential load remaining lighting shall be on normal supply.

Lighting levels shall be uniformly distributed throughout the whole depot, and shall be designed such that glare, dark recesses and areas of poor lighting levels are avoided. Highlight of 2 times the general illumination level shall be provided by down lighting for main entrance, lift front doors, tops and bottoms of stairs.

All offices, plant rooms, workshop, stabling yard and stores shall have local switches to control the lighting in that area apart from BMS control. Where six or more luminaires are provided in a single room, circuits shall be split and the multi-gang switches shall be provided. Manual override switch at relay panel shall be provided in case of BMS is failed.

The street lighting shall consist of luminaries on galvanized steel pole, for road lighting.
Illumination levels

The lux levels to be achieved in various areas of station buildings, both in normal and emergency conditions are indicted in the table below. Contractor shall verify and demonstrate the achieving of the light level as per the table below:-

Sr. No	**Activity Areas for Depot**	**Recommandations**		**UPS Lighting**
		Normal (Lux)	DG Set (Lux)	Essential (Lux)
1	Workshop Bay	300	100	-
2	Inspection Bay	300	100	-
3	Interior Cleaning Bay, ETU Workshop	300	100	-
4	Stabling Shed	100	50	-
5	Entrance, Reception Areas	250	125	5- 10
6	Workshop Repair Section	300	100	-
7	Workshop Offices	250	125	-
8	Circulating areas, Corridors etc.	200	100	5-10
9	Store Rooms	150	50-75	-
10	System wide Equipment Rooms	250	125-150	5-10
12	General Offices	300	100	5-10
13	Toilets	100	25	5-10
14	Outdoor Lighting (Street Lighting)	25	10	-
15	Outdoor Parking	30	15	-
16	ASS, LT Panel Room, DG Set Room, Traction Equipment Rooms	300	100	5-10
17	Technical Rooms	300	100	5 - 10
18	Pump Room	150-200	25-50	-
19	Transformer Room (ASS Room)	200 – 250	25-50	5 - 10
20	Signalling Equipment Room	300 – 500	50	5 - 10
21	Telecommunication Equipment Room	300 – 500	50	5 -10
22	Signalling Control Panel Room	300 -500	50	5-10

23	Communication Equipment Room	300 – 500	50	5-10
24	Communication Maintenance Room	300 -500	50	5-10
25	Security Room	200 – 300	25-50	5-10
26	Lift Lobby	200 -300	50	5-10
27	Refuse Room or Spare Room	100 - 150	25-50	-
Sr. No	**Activity Area for Station**	**Illumination**		**UPS Lighting**
		Normal (Lux)	Emergency (Lux)	Essential (Lux)
1	Circulating area	200	10	5 - 10
2	Entrance area	250	125	5 - 10
3	Concourse	200	100	5 – 10
4	Booking counters, Ticketing machines Time table	300 (Localized)	150	5 - 10
5	Passenger staircase/ subway	250	100	5-10
6	Escalators	250	100	5-10
7	Platforms (General)	200	100	5-10
8	Platforms (Edge)	250	125	5-10
Operation areas				
1	Control room	300	150	5-10
2	Equipment rooms and Other operation areas	200	100	5-10

Note: If any areas or rooms are not specified in above table, consider suitable illumination levels for the same should be followed as per LED lighting standards and references mentioned in technical specifications clause no. 2.14.3

2.14.9 OUTDOOR LIGHT FITTING (High mast and Street light)

2.14.9.1 Scope

The scope of work covers the design, manufacture, supply, installation and testing of lighting poles, weather proof light fixtures, wiring to the fixtures, cable laying, earthing as specified and shown on the drawing.

2.14.9.2 Standards

The following standards shall be applicable:

IS: 3528 – 1966	Water proof electric lighting fitting
IS 1239 : Part 1 : 2004	Steel Tubes, Tubulars and Other Wrought Steel Fittings - Specification - Part 1 : Steel Tubes
IS 1239 : Part 2 : 1992	Mild steel tubes, tubulars and other wrought steel fittings, Part 2 Mild steel tubulars and other wrought steel pipe fittings
IS 10322 : Part 5 Sec 3 : 1987	Luminaires: Part 5 Particular requirements, Section 3 Luminaires for road and street lighting (superceding IS:2149)
IS 2713 : Parts 1 to 3 : 1980	Specification for Tubular Steel Poles for Overhead Power Lines
IS 1646 : 1997	Code of practice for fire safety of buildings (general): Electrical installations
IS 1255 : 1983	Code of practice for installation and maintenance of power cables up to and including 33 kV rating
	Indian Electricity Act, 2003 and IE Rules, 1956 as amended
	Regulations laid down by the Chief Electrical Inspector
	Any other regulations laid down by the Local Authorities
Note : All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Codes of Practice or the British Standard Codes of Practice in the absence of Indian Standards.	

2.14.9.3 HIGH MAST

a. Scope

This specification deals with the design, fabrication/manufacture, testing, supply and erection of outdoor high lighting equipment including 20.0 mtr, 30.0 mtr high mast with mobile lantern carriage, luminaries and associated accessories, fittings, etc. to be installed for lighting of yard.
High mast lighting shall be designed such that columns and fittings can be maintained without the need to close sections of the depot.
High mast lighting shall be designed such that photocells and drivers are installed at low level.
Where used, high lighting masts shall allow for lowering of hoisted light rings for ease of maintenance.

b. Codes and Standards

i. Design, manufacture and performance of the mast shall comply with all currently applicable statutory regularities and safety codes and standards in the locality where the equipment will be installed and generally in accordance to the following:
- British Code of Practice CP3: Chapter V Part 2: 1972
- Technical Report No.7: Second Edition, Section 2:1996 by the Institute of Lighting Engineers.

ii. The work shall be done to a high degree of workmanship in accordance with approved drawings and in conformity with this specification and the relevant specifications and code of practice of the bureau of Indian Standards, including the following:
- Indian Electricity Rules.
- IS: 1646-1982:- Code of Practice for fire safety of buildings (general); Electrical Installations
- IS: 1255-1983:- Code of Practice for installation and maintenance of power cables up to and including 33 kV rating
- Regulations laid down by the Chief Electrical Inspector.
- Any other regulations laid down by the Local Authorities.

c. Design

30mtrs high mast suitable for fixing 12/16 luminaries, in two sections, with confirm carriage and all accessories required to complete the supply and erection of High Masts at designated locations high mast shall be manufactured as for Technical Report No. 7 (latest edition) by the institution of lighting engineers and as per specification of high masts given in this document

d. General Constructional Features

i. The mast shaft shall be made with the best steel grade, in compliance with BS EN 10025 FE 510C, having the following guaranteed characteristics:
Minimum Yield Strength = 355 N/ sq. mm for thickness less than 30 mm
Tensile Strength ranging from 490 to 630 N/sq. mm
Minimum elongation for thickness between 3mm and 30 mm: 22%

ii. The steel grade for accessories shall be BS EN 10025 Fe 430A or equivalent, having the following guaranteed characteristics:
Minimum Yield Strength = 225 N/sq. mm for thickness less than 30 mm
Tensile Strength ranging from 340 to 470 N/sqmm
Minimum elongation for thickness between 3 mm and 30 mm: 26%

iii. All holding bolts are hot dip galvanized to BS: 729.

e. Mast Design Criteria

i. The high mast and the lowering system with the required number of floodlights and lamp control gears etc. in place shall be capable of withstanding a sustained basic wind speed of 180 km/h with 3 seconds gust.

ii. The design shall be in such a manner that it is capable of withstanding external forces exerted by wind pressure and should have a minimum wind load factor of 1.25 and material factor of 1.115. Design life of mast should be at least 25 years.

The mast shall be designed in accordance to the table below: (Contractor need to provide the technical data for high mast asked below By contractor)

Maximum Loading on Foundation	20m High Mast	30m High Mast
Shear Force		
Overturning Moment		
Torsion Moment		
Axial Load		
Max. Deflection		
Max. Base Flange O. D.		

& above data shall be submitted for further approval from the employer representative.

f. Mast structure and construction

i. Each mast section to be delivered to site shall have a minimum length of 9.0 m. the sections shall not be circumferential welded through slip joint of multiple short sections. Detailed instructions relating to site assembly shall be provided by contractor to engineer.

ii. The top section shall have a flange plate for bolted connection to the head frame. The base shall have a flange plate for fixing the high mast onto the concrete foundation by GI anchor bolts.

iii. The mast shall be fabricated as per technical report no.7 of institution of lighting engineers. It will be butt welded longitudinally to form a tapered section with (one) longitudinal seam weld is permissible. All welding shall be to BS 5135 having the following basic requirements:

iii-I. Mast sections to base flange and longitudinal weld within 150 mm of the female slip joints areas shall have:
- Full penetration between plates of all thickness.
- No fissures.
- No undercutting.
- No blow holes, porosity or spherical beyond 5% on the minimum thickness. No detectable angular inclusion.

iii-II. Longitudinal welds along the mast shaft shall have:- 60% minimum penetration between plates. No fissure on the inside and outside surface. No undercutting on the outside surface. No blow holes.

iii-III. Ultrasonic testing procedures shall be considered as minimum permissible testing method.

iii-IV. The wall thickness of each section shall be designed to withstand the loads to which the high mast will be subjected to but shall not be less than 3 mm.

iii-V. Unless otherwise specified connection between the various station shall be achieved by telescopic slip joints, the overlapping length being at least equal to 2.0 times the inside diameter of the female section. Slip joint assembly shall be performed at site. Shaft section shall not be joint by circumferential weld or bolting.

iii-VI. The base plate shall be free from lamination and shall be single flange constructed with holes jig drilled for anchor bolt passage. The bottom of the base mast section shall be securely welded to the base plate by complete penetration butt welding or fillet welding. The welded connection of the base plate to the mast section shall fully develop the strength of the section.

iii-VII. The base section shall be equipped with a hinged service door. The service door opening shall be completed with a close fitting weatherproof and equipped with a

vandal resistant lock. The service door shall not be smaller than 1400 mm X 300 mm. The opening shall be reinforced by a thick steel door frame.

iii-VIII. Base plate dimensions and thickness and the no. diameter, size and the placement of anchor bolts shall be determined by calculation and indicated in the drawings.

iii-IX. Anchor bolts shall be deformed steel reinforcement bars having the following minimum guaranteed characteristics:
Specified characteristic strength = 460 N /sqmm
Tensile strength = 480 N /sqmm

iii-X. Welding of two or more anchor rods of shorter lengths to achieve the design length shall not be permitted. No welding shall be allowed on the anchor rod body.

iii-XI. Adequate earthing and earthing terminal shall be provided within the access door area of each high mast. Details shall be submitted to the engineer for approval.

iii-XII. All high mast shall be hot dip galvanized, in accordance with British Standard 729/1971(1986).

iii-XIII. All mast component shall be hot dip galvanized after completion of fabrication. The galvanized of sections having overall length of up to 14m shall be achieved in a single dip operation. Double dipping of any mast section is strictly prohibited. Galvanising shall be inspected for adhesion, mass of zinc coating and uniformity of coating

g. Lantern Carriage
   i. The mobile luminaries ring shall be of steel construction and manufactured in three segments. Bolted flanges shall join the unit. All mobile components of the system shall be located on the mobile part in order to allow visual inspection during each operation. Proper luminaries carriage ring support arms shall be provided for supporting the luminaries carriage ring when the lantern is lowered for maintenance of luminaries.

   ii. The mobile luminaries carriage shall be designed to carry the assigned no. of luminaries and control gears and shall be evenly balanced. Nylon Paddle Guide Ring shall be incorporated as a buffer arrangement between mobile luminaries carriage and mast shaft. This is to prevent damaged to mast surface during raising and lowering operation of mobile luminaries carriage.

   iii. The complete mobile components shall be hot dip galvanised in accordance to BS 729.

   iv. The steel grades used for construction of the head frame assembly and mobile part shall be in compliance with BS EN 10025.

h. Raising and Lowering Mechanism:
   For installation and maintenance of luminaries and lamps, it shall be necessary to lower and raise the mobile luminary carriage by means of a suitable winching arrangement at the base of the mast. The speed of the rising and lowering of lantern carriage ring shall be at least 3.0 m per minute.

i. Winch:
   i. The winching system with the exception of the drive unit shall remain permanently inside the mast. Each mast shall be provided with a double drum winch suitable for raising and lowering the luminary carriage ring.

   ii. The winch must be robust design and completely self-sustaining type without the brake -

shoe, springs or clutches. It can be removed from the mast for maintenance if the need arise in future. The reduction gear of the winch shall be of endless worm gear. Operating in an oil bath. The minimum safe working limit of the winch shall be not less than 750 Kg.

iii. The capacity and operating speed of the winch shall be clearly marked on an indelible label together with the specification of the recommended lubricant.

iv. A minimum 6 turns of wire rope shall be on the grooved drum when the mobile luminary ring is fully lowered to rest on the supporting arms.

v. The winch is entirely self-sustaining under all normal circumstances and it will not depend on the brake or restarting of device. The uncontrolled or dangerous speeds will occur in the event of the total failure and concern reports to be submitted to engineer on request.

vi. Test certificates in support of the safe working limit shall be provided upon request.

j. Head Frame:
The head frame duly hot dip galvanized shall include a pulley system accommodate 3 stainless steel hoisting wire rope at any one time and separate pulley for the passage of flat electrical cables. The pulleys shall be of non-corrosive material and shall run on self-lubricating bearing with stainless steel axles.

k. Hoisting and Suspension Wire Ropes:
i. The high mast shall be fitted with flexible stranded stainless steel hoisting wire ropes of 7 x 19 constructions with a minimum breaking strength of 2350 Kgs. The combine lifting capacity of the hoisting wire rope shall have a factor of safety not less than 5 times the safe working load (SWL) of the winch and shall be entirely suitable for the design application.

ii. A transition plate shall be incorporated to connect the suspension wire ropes to the two stainless steel winching wire ropes ensuring ensure even distribution of loads between the two stainless winching-wires by means of an equaliser with a provision to fix electrical cables.

l. Electrical Cables:
Electrical cable shall be anti-twisting flat flexible 2.5 sqmm cable suitable for small bending radius. One standard 8 core flexible electrical cable with 2.5 sqmm conducting area shall be provide for connecting of power supply to the light source and shall terminate at the stationary connecting board in the base compartment with a multiple 10-pin weather proof plug and socket coupler fitted with locking levers.

m. Winch driving Power Tool:
i. The winch drive unit shall be complete with a 415V, 3-Phase, 50 Hz squirrel cage, reversible weather resistance, IP 55 protection, min. class B insulation induction motor, a coupling flange for winch to facilitate detachment and attachment on several masts in succession.

ii. For safety reasons and final precision docking of lantern carriage ring to the head frame, the drive motor must have a provision to operate manually by using external crank device without removing the drive motor from the winch unit.

n. Control Panel:
Control of raising and lowering operation shall be carried out a distance away the mast base by means of a portable pendant type control panel complete with power supply and control cable of appx.5m length. The control panel shall be usable on all masts and shall be equipped with Emergency stop button and Push button for raising and lowering of the mobile part. The push buttons shall operate on the 'dead man' principle i.e. action shall ceased as soon as the button is released. Portable control panel shall also include a portable panel for housing control switch

and relays. The portable panel shall be equipped with safety devices such as electronic torque control in case of overload or overheating of the hoist motor.

o. Luminaries

i. Flood light luminares, suitable for LED floodlight 200 - 250 W.

ii. Flood high luminaries, suitable for use with LED lamp 200 - 250 W watts for rotationally symmetric & asymmetric distribution. Complete with accessories including appropriate control gear and fixing arrangements, conforming to IS: 10322 1987. It should be comply with relavent LED luminaires standards as mentioned in technical specifications clause no. 2.14.3

iii. The luminaries shall be sturdy, having die-cast aluminium housing and back plate, corrosion resistant, high purity aluminium reflector, electrochemically brightened and anodised heat resistant and toughened glass cover, high resistant silicon rubber market appropriate disc facilitating proper aiming of the luminary, stainless steel toggles and conforming to IP-65 protection. The luminaries shall be suitable for fixing on lantern carriage of high masts.

p. Testing and Commissioning

The lighting installation shall be tested as per approved schedule and the instructions of Engineer and shall include but not be limited to the following:

i. Insulation resistance of each circuit shall be measured without the lamps being in place. It should not be less than 5 Mega ohms to earth.

ii. Current and voltage of all the outdoor lighting circuits shall be measured at the Main Distribution Board with all the lamps switched on to ensure that these are within designed values and in the case of 3- phase circuits, the load shall be balanced, preferably.

iii. Earth continuity shall be checked for all the circuits.

iv. After inserting all the lamps and switching on all the circuits, minimum and maximum illumination levels shall be measured in all areas and their conformity with designed levels established. The test results shall be entered in the approved pre-commissioning proforma and submitted to the Engineer for approval before final commissioning.

2.14.9.4 STREET LIGHTING

a. General

The steel tubular/ octagonal street lighting poles used for lighting of approach roads, traffic lanes and walkways in the circulating area, shall be erected at a distance of 300 mm from the edge of the road/walkway. The foundation for the poles shall be of 1:2:4 concrete. This shall be done by the Contractor as a part of the contract work as per the approved drawing. The pole with its base plate shall be grouted in the foundation which shall be provided with muffing. HDPE pipes/sleeves of suitable diameter shall be embedded in the concrete for the incoming and outgoing feeder cables. The MCBs shall be mounted suitably as per relevant IS specifications and as per drawings approved by engineer.

b. Lighting Fixture

(i) The light fixture construction shall be of die-cast/extruded aluminium with a separate compartment for drivers and as suitable for external LED Light fixture or LED lamp as required. The reflector shall be pre-anodized polished /high purity electrochemically brightened anodized aluminium.

(ii) The luminaire glass refractor /acrylic cover shall be heat-resistant suitably sealed with neoprene/PU seal gasket as specified and required. Lamp holder shall be of porcelain and shall comprise of a terminal block of non-hygroscopic material.

(iii) The luminaries shall have integral ballasts housed in water tight and dust tight metal cases. Drivers suitable for LED lamp as specified and required shall be energy efficient and pre-wired to the lamp socket and terminal block, requiring only power supply leads to the ballast primary terminals. Outdoor luminaries shall conform to IP55 protection or above as

required.

(iv) High Mast lighting luminaries Suitable for external use with high performance LED lamp for symmetric/asymmetric distribution. Complete with accessories including appropriate gear and fixing arrangements, confirming to IS 10322-1987. The luminaries shall be sturdy, having die-cast/extruded aluminium housing and black plate, corrosion resistant high purity aluminium reflector, electromechanically brightened and anodized heat resistant and toughened glass cover, high resistant silicon rubber marked appropriate disc facilitating proper aiming of the luminaries, suitable stainless steel togged confirming to IP -55 or above as required protection as specified as required. The luminaries shall be suitable for fixing on lantern carriage of high mast.

c. Street Lighting Poles

i. The lighting poles shall be octagonal / round type poles as per IS 2713 (PART 2) – 1980, hot dip galvanized (9.0 m height) as per drawings and as specified. The pole shall have a base plate, a large access panel, and necessary fixture mounting bracket at top and 2 Nos. 1.5m length of 40mm diameter bent GI/HDPE pipes for cable loop-in loop-out to be provided. The access panel shall provide easy access to a multi-way porcelain connector and fuse board, to be mounted inside the pole. The access shall be specially fabricated with adequate reinforcement and weather gasket to prevent ingress of moisture and vandal proofed. Poles shall have large diameter entries for incoming and outgoing cable and two earth studs. The pole fabrication shall conform to the drawings and where such drawing is not available; the contractor shall make drawing and have it approved from engineer before fabrication.

ii. The octagonal / round poles shall be made from steel of minimum tensile strength 490 N/ sq.mm.

iii. Grade of foundation bolts shall be 6.8 & confirming to IS: 1367 (Part-III) – 2002.

iv. Foundation – adequate size M30 grade RCC foundation with 100 mm raft including excavation are included in the rates of street light poles. Contractor shall submit design calculation in support of size of RCC foundation for external lighting poles for approval to engineer and work shall be commenced after approval.

v. The pole shall be provided with a 20 mm hole for wiring of street light pole and two nos. 20 mm studs are to be welded for earthing.

d. Junction Boxes and Connecting Cable

i. Each pole shall be complete with an MS junction box of pole-mounting type, manufactured from MS sheet of 14 sheet gauge painted with oil paint over red oxide zinc chromate primer. The junction box shall have a water proof lockable cover (IP55) of size 300 x 100 mm. It shall be fitted with 6A MCB and 6-way, 20A connector strip, a neutral link, earthing studs and suitable down pipes for the incoming and outgoing cable-lead. The junction box shall generally comply with the requirements of IS: 2675-1983. The supply of pole shall be complete with 2 x 2.5 sqmm copper wire/cable, PVC insulated, FRLS XLPE insulated drawn from the junction box to the luminaire terminal.

ii. Pole shall have a concrete coping of 200 mm height and 300 mm diameter in M30.

e. Cable Laying

i. Cabling shall be generally as specified in the section distribution ‘CABLING.’

ii. Cables shall be terminated in a 6-way terminal block inside the pole or attached there with as required.

iii. Cable route shall be as shown on the drawings or the contractor shall mark out the route and lay the cables only upon approval of the route by engineer.

f. Earthing

All street light fixtures and poles shall be earthed as specified under section ‘EARTHING.’ In each pole a through hole of 14 mm diameter shall be provided at a height of 300 mm for

earthing. Every lighting pole shall be earthed by connecting it to the continuity earth of the feeder cable from the feeder pillar. In addition, every 5th pole shall be connected to locally provided earth electrode pit.

g. Street Light Feeder Pillars
Suitable feeder pillars, 3-phase 415 V outdoor type, with a fixed canopy shall be provided for power distribution to masts & street lights. The feeder pillar shall have IP: 65 degree of protection & will be housed in stainless steel enclosure. It shall be provided with weather-proof lockable door, incoming and outgoing cable glands, earthing studs and other accessories.

h. Testing and commissioning
The lighting installation shall be tested as per approved schedule and the instructions of Engineer and shall include but not be limited to the following:

i. Insulation resistance of each circuit shall be measured without the lamps being in place. It should not be less than 0.5 mega ohms to earth.
ii. Current and voltage of all the outdoor lighting circuits shall be measured at the Main Street Light Panel, with all the lamps switched on to ensure that these are within designed values and in the case of 3-phase circuits, the load shall be balanced if required.
iii. Earth continuity shall be checked for all the circuits.

After inserting all the lamps and switching on all the circuits, minimum and maximum illumination levels shall be measured in all areas and their conformity with designed levels established. The test results shall be entered in the approved pre-commissioning proforma and submitted to the Engineer for approval before final commissioning.

2.14.9.5 DEPOT & YARD LIGHTING REQUIREMENTS

A. Depot & Yard Lighting

a. General Depot lighting shall provide safe and efficient levels of lighting in order to maintain 24-hour operations. Only administration area and Depot entrances shall have public street quality lighting standards. All other areas of Depot shall have industrial type lighting with uniform lighting level. Ultimate care to be taken to avoid glare or light pollution from inside the Depot boundaries to outlying areas, other than what is necessary for perimeter security.

b. The entire Depot site shall be illuminated to provide for secure and safe operation, 24 hours a day and during inclement weather.

c. Heavy-duty, protected fixtures shall be used to light pits, bridges and gangways.

d. The minimum levels of illumination for depot that will be maintained for at least three hours during the failure of the normal supply of electricity are:

Areas	Min. level	Emergency Average level	Normal level (average)
Depots – Exterior Stabling Area	3 Lux	5 Lux	10 Lux
Depots – Designated uncovered Exterior Walkways (Including footpaths & over bridges)	3 Lux	5 Lux	10 Lux
Depots – Designated covered Exterior Walkways	3 Lux	5 Lux	20 Lux
Depots – Covered Stabling Areas	5-7 Lux	30 Lux	125 Lux

Depots – Track within Depot (excluding Stabling Area)	3 Lux	5 Lux	10 Lux
Depots – Roads	5 Lux	5 Lux	15 Lux
Depots – Road Tunnels & Subway	5 Lux	25 Lux	50 Lux
Depots – Standard Inspection Pit	5-7 Lux	30 Lux	125 Lux
Depots – Lifting Sheds	5-7 Lux	50 Lux	250 Lux
Depots – Maintenance Sheds	5-7 Lux	50 Lux	200 Lux
Depots – Cleaning Shed	5-7 Lux	30 Lux	125 Lux
Depots – Loading Bay	5-7 Lux	50 Lux	150 Lux
Depots – Stores: General & Flammable	5-7 Lux	50 Lux	150 Lux
Depots – Office	5-7 Lux	30-45 Lux	250 Lux
Depot – Yard Lighting	3-5 Lux	5 Lux	15 Lux

B. . DAYLIGHT HARVESTING SPECIFICATION FOR STABLING SHED: -

PART 1 GENERAL

1.1 SUMMARY:

Section includes requirements for daylighting – double glazed, prismatic, moulded, high rise, dome shaped skylights as specified herein.

1.2 WORK INCLUDED:

A. A. Supply, installation, testing and commissioning of prismatic skylight daylighting system. An assembly of thermoformed, polycarbonate, double glazed skylights, incorporated into a complete metal framed kerb system that has been tested and warranted by the manufacturer as a single source system.

B. All anchors, brackets, and hardware attachments necessary to complete the specified structural assembly, weather ability and water-tightness performance requirements. All flashing up to but not penetrating adjoining work are also required as part of the system and shall be included.

C. Trained and factory authorized labor with supervision to complete the entire panel installation.

1.3 QUALITY ASSURANCE

A. Materials and Products shall be manufactured by a company continuously and regularly employed in the manufacturing, engineering, and designing, stocking and building of skylights using the specified material and system for a period of at least Ten (10) years. Manufacturers shall provide a list of at least five (5) projects having been in place a minimum of three (3) years.

B. Erection shall be by a factory-approved installer who has been in the business of erecting similar material for at least three (3) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

C. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system, in accordance with the requirements of this specification.

1.4 SUBMITTALS

A. Submit shop drawings and color samples.

B. Manufacturer shall submit written guarantee accompanied by substantiating data, stating that the products to be furnished are in accordance with or exceed these specifications.

C. The manufacturer shall submit test reports of materials of skylights. Reports shall verify that the material will meet all performance requirements of this specification. Test reports required are:
   1. Self-Ignition Temperature (ASTM 1929-3)
   2. Burning Extent (ASTM D-635)
   3. UV resistance
   4. Compliance with IBC building code for polycarbonate glazing as an approved light transmission plastic with CC1 rating.
   5. Water Penetration (ASTM E-331)

D. MAINTENANCE DATA: The manufacturer shall provide recommended maintenance procedures, schedule of maintenance and materials required or recommended for maintenance.

E. Submit Installer Certificate signed by installer, certifying compliance with project qualification requirements.

1.5 WARRANTY:

A. Provide a single source daylight system manufacturer warranty against defective materials and fabrication. Submit manufacturer's written warranty agreeing to repair daylight, mechanical and controls system work, which fails in materials within one year from date of delivery. Provide extended warranty for 5 years from the date of delivery.

B. Provide single source daylight's manufacturer 5 years warranty. Third party warranty for glazing panels shall not be acceptable. Glazing warranty to include:
   1. Change in light transmission of no more than 6% per ASTM D-1003
   2. No delamination of panel affecting appearance, performance or structural integrity of the panel or the system

C. In addition, submit installer's written warranty agreeing to repair installation workmanship, defects and leaks within 5 years from date of delivery.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

Manufacturers may bid this project provided they comply with all requirements of the specification and submit evidence of compliance with all performance criteria specified herein. This evidence must include proof of conformance and test reports as per section 1.4. Any exceptions taken from this specification must be noted on the approval request. If no exceptions are noted and approval is given, product performance will be as specified. Should non-compliance be subsequently discovered, the previously given approval will be invalidated and use of the product on the project will be disallowed. All manufacturers acceptable for use on this project under this section must be approved. Requests for approval, with all appropriate submittal data and samples must be received as per procedure. Listing manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein.

2.2 PRISMATIC, DOUBLE GLAZED, MOULDED SKYLIGHTS PERFORMANCE AND APPEARANCE

A. Daylighting system - Two Panel Assembly:
Design, engineer, manufacture and installation of double glazed translucent daylight system with 30 mm air gap between glazing for insulation. An assembly of TWO independent single panels of thermoformed polycarbonate into one glazing assembly, incorporated into a complete steel metal framed system that has been tested and warranted by the manufacturer as a single source system.

DOUBLE GLAZED, PRISMATIC SKYLIGHT-MATERIAL SPECIFICATION:

Skylight Glazing	Specifications

Double Glazed Glazing	1) **Outer Glazing**-Clear prismatic polycarbonate lens of 3mm thickness.
	2) **Inner Glazing**–Pigmented white color, light diffusing polycarbonate lens of 2mm thickness.

MATERIAL PROPERTIES OF GLAZING:

Property	Method	Units	Value
Impact strength- IZOD Notched	ASTMD-256	J/M	800
Long term Service Temperature		^0C	$-50^0$to + 100^0c
Heat Deflection Temperature	ASTMD – 648	^0C	135^0c
Light Transmission			MIN. 70 %
Yellowness Index	ASTMD-1925		<1
Flammability	ASTMD-635 DIN 4102	----	CC1 B1, B2

Skylight Dimensions:

Aperture dimensions	1000 mm x 1200 mm
Flange outer dimensions	1060mm x 1260 mm

B. **Thermal and Solar Performance**
1. U value for Center of Glazing per NFRC100 test methods & procedures: 0.74 or lesser
2. Light transmission: Minimum 70%

C. **WATER PROOFING:**
Three-part water proofing with two layers of dow corning 789 weather sealants with 4mm thick bead and intermediate EPDM rubber gasket of 25 mm x3mm.

D. **Flammability:**
1. The exterior and interior panels shall be an approved light transmitting panel with a CC1 fire rating classification per ASTM D-635.

E. **WARRANTY:**
- Product warranty 5 years.
- Leak proof warranty 5 years.

F. **WEATHERABILITY:**
1. The light transmission shall not decrease more than 6%.
2. The panel shall not change color more than 4.0 units DELTA-E after 60 months outdoor weather.

2.2 METAL FRAME STRUCTURE

A. The daylight framing is designed to be self-supporting between the support constructions. The daylight system should be loaded to roof structural purlin members and two additional transverse members connecting the two purlins. The skylight will impose reactions to the support construction. All adjacent and support construction must support the transfer of all loads including horizontal and vertical, exerted by the daylight. The skylight manufacturer should

supply the members connecting the purlins to support the skylight. Moulded, fibre reinforced plastic should not be used for roof kerb.

B. Water Penetration: The metal framed skylight panels shall allow no water penetration.
C. Water test of metal frame structure shall be conducted.

2.3 METAL MATERIALS

A. **Galvalume or galvanized sheet metal formed metal kerb of minimum thickness 0.5 mm and colour coated.**

Roof Mounting:
Material – Bare Galvalume of 240 – 275 Mpa of 0.5 mm thickness
Shape – Elevated Box Kerb welded and finished.
Metal kerb is colour powder coated.
Kerb Dimensions:
Height of the kerb 125 mm above roof level.

Fixing accessories

1. Skylight kerb foam gaskets 3 mm thickness.
2. Skylight fixing hardware – corrosion resistance screws.
3. Aluminum clamping plates for fixing screws.

PART 3 EXECUTIONS

3.1 EXAMINATION

A. Contractor to verify when structural support is ready to receive all work in this section and to convene a Pre-Installation Conference at least one week prior to commencing work of this Section. Attendance required of Contractor, daylight installer and all parties directly affecting and effected by the work of this section.
B. All submitted opening sizes, dimensions and tolerances are to be field verified by contractor unless otherwise stipulated.
C. Installer shall examine area of installation to verify readiness of site conditions. Notify contractor about any defects requiring correction. Do not work until conditions are satisfactory.

3.2 INSTALLATION

A. Install components in strict accordance with manufacturer's instructions and approved shop drawings. Use proper fasteners, caulking and hardware for material attachments as specified.
B. Use methods of attachment to structure allowing sufficient adjustment to accommodate tolerances.
C. Remove all protective coverings on panels immediately after installation.

3.3 CLEANING

A. Follow manufacturer's instructions when washing down exposed panel surfaces using a solution of mild detergent in warm water that is applied with soft, clean wiping cloths. Always test a small area before applying to the entire area.
B. Follow strict panel manufacturer guidelines when removing foreign substances from panel surfaces requiring mineral spirits or any solvents that are acceptable for use. Always test a small sample to validate compliance before applying to the entire panels
C. On completion of installation the installer shall completely clean and handover the entire panel system.

MUMBAI METRO LINE 3
(COLABA-BANDRA-SEEPZ)

CONTRACT NO: MM 3-CBS-DEM

Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

VOLUME- 4 OF 6

EMPLOYER'S REQUIREMENT'S-
TECHNICAL SPECIFICATION

Section VI – C- VENTILATION & AIR-CONDITIONING (VAC)

Mumbai Metro Rail Corporation Ltd.
Plot No. R-13, 'E' Block,
Namttri Building
Bandra - Kurla Complex,
Bandra (East), Mumbai – 400051, India

Composition of Documents

Volume 1	**Bidding Procedure**
Section I	Notice Inviting Tender (NIT)
Section II	Instructions To Tenderer
Section III	Form of Tenders
Volume 2	**Conditions of Contract and Contract Forms**
Section IV	General Conditions of Contract (GCC)
Section V	Special Conditions of Contract (SCC)
Volume 3	**Employer's Requirement- General Specification**
Volume 4	**Employer's Requirement – Technical Specifications**
Section VI – A	Electrical - HT
Section VI – B	Electrical - LT
Section VI – C	**Ventilation & Air Conditioning (VAC)**
Section VI – D	Fire Alarm and Detection System (FADS)
Section VI – E	Fire Suppression (Fire Fighting System)
Section VI – F	Building Management System (BMS)
Section VI – G	EOT Cranes (Electric Over Head Travelling Crane)
Section VI – H	Air Compressor (Compressed Air System)
Section VI – I	Plumbing Pumps (Drinking, Treated and Sewer)
Volume 5	**Tender Drawings**
Section VII – A	Electrical - HT
Section VII – B	Electrical - LT
Section VII– C	Ventilation & Air Conditioning (VAC)
Section VII – D	Fire Alarm and Detection System (FADS)
Section VII – E	Fire Suppression (Fire Fighting System)
Section VII – F	Building Management System (BMS)
Section VII – G	EOT Cranes (Electric Over Head Travelling Crane)
Section VII– H	Air Compressor (Compressed Air System)
Section VII – I	Plumbing Pumps (Drinking, Treated and Sewer)
Section VII – J	Civil Tender Drawings (Architectural / Utility)
Volume 6	**Bill of Quantities**

TABLE OF CONTENTS

1 INTRODUCTION

1.1 General

This Technical Specification describes the requirements of the Ventilation and Air-conditioning System of Aarey Depot for the Mumbai Metro Rail Corporation (MMRC) Line 3.

1.2 Definitions

In this Technical Specification, the following list of defines terms shall have the meanings ascribed to them below:

S. No	Description	Definition
1	Availability	The probability that an item will be in a state to perform a required function under given conditions, at a given instant in time or over a time interval, assuming that the given external resources are provided.
2	Command	The facility to perform or modify a function of the System.
3	Corrective Maintenance	Maintenance performed to correct the occurrence of equipment or system fault
4	Ducting or Ductwork	Shall include duct, dampers, fittings, flexible connectors, flexible duct, supports, insulation, test holes, and associated items
5	Expansion Joint	Mechanical joint for absorbing expansion of rigid contact due to temperature changes and at building expansion joints.
6	Failure	A failure is an event which causes loss of function or performance within any part of the VAC requires a maintenance intervention to restore full functionality and performance.
7	Furnish or Provide	Shall include Design, supply, and installation, Testing, Commission, complete and ready for safe and regular operation.
8	Install	Shall include erecting, mounting and connecting, completing with associated accessories, testing and commissioning.
9	Mimic	A graphical representation of the line and its global operating status
10	Motor Control Centres (MCC)	Where mentioned in the Employer's Requirements shall apply not only to the motor control centres but shall also be applicable to the sub-boards and DBs. It gives power to the field equipment.
11	Piping or pipe work	Shall include pipes, tube, fittings, flanges, valves, pipe work controls, strainers, hangers, supports, unions, traps, drains, insulation and associated items
12	Preventive Maintenance	Periodic or regular maintenance performed in order to prevent the occurrence of equipment faults in the future.
13	Recoverability	The measure of ability of a system to recover from a system failure
14	Sub-system	A part of the Ventilation and Air conditioning Works as defined in this Contract

S. No	Description	Definition
15	Supply	shall include to purchase, procure, acquire and deliver complete with associated accessories
16	Type Test	Functional test of the as-built component, assembly or system under environmental conditions similar to those to be encountered in the Permanent Works
17	Workstation	The collection of processors, screens and input devices necessary to provide one Controller with the necessary System displays and commands.
18	Wiring	Shall include conduits, trunkings, wire, boxes and associated items

1.3 List of Abbreviations

Abbreviation	Description
AC	Air Conditioning
ACB	Air Circuit Breaker
ACPH	Air Changes Per Hour
AHU	Air Handling Unit
CADD	Computer Aided Design and Drafting
CENELEC	European Committee for Electro technical Standards (Committee European de Normalization Electro technique
CFM	Cubic Feet per Minute
CMS	Cubic Meter per Second
DB	Distribution Board
DBT	Dry Bulb Temperature
DLP	Defect Liability Period
DOL	Direct On Line
DX	Direct Expansion
VAC	Environmental Control System
EAF	Exhaust Air Fan
EAG	Exhaust Air Grille
EPDM	Ethylene Propylene Diene Monomer
FAG	Fresh Air Grille
FAT	Factory Acceptance Test
FCU	Fan Coil Unit
FD	Fire Damper
FRP	Fiberglass Reinforced Polyester
HVAC	Heating Ventilation & Air conditioning
LCP	Local Control Panel
MCBF	Mean Cycle Between Failures
MD	Motorized Damper
MFD	Motorized Fire Damper
MFSD	Motorized Fire and Smoke Damper

Abbreviation	Description
OCC	Operations Control Centre
ODP	Ozone Depletion Potential
PAC	Precision Air Conditioner
PLC	Programmable Logic Controller
PPM	Parts Per Million
RAG	Return Air Grille
RH	Relative Humidity
SAD	Supply Air Damper
SAG	Supply Air Grille
SAR	Supply Air Register
BMS	Building Management System
SCP	Smoke Control Panel
SEF	Smoke Extract Fan
SFSRTS	Standard for Fire Safety in Rail Transit System
SWG	Standard Wire Gauge
UG	Underground
VAC	Ventilation and Air Conditioning
VCD	Volume Control Damper
VCP	Ventilation Control Panel
VRV/VRF	Variable Refrigerant Volume / Variable Refrigerant Flow
VSD/VFD	Variable Speed Drive / Variable Frequency Drive
WBT	Wet Bulb Temperature

1.4 Standards

This following list of Table 1.0 is provided solely for the convenience of the bidder. Standards referred within this document that are not identified in this list must still be complied with. Reference to any standards shall be taken as reference to the latest version of that standard.

Table 1.0: List of Standards

Standard	Standard no	Description
ADC		**Air Diffusion Council (airflow test code)**
	1062	Test Code for Grilles, Registers and Diffusers
AFBMA		**Anti-Friction Bearings Manufacturers Association**
	AFBMA 9	Load Ratings and Fatigue Life for Ball Bearings
	AFBMA 11	Load Ratings and Fatigue Life for Roller Bearings.
AMCA		**Air Moving and Control Association**
	AMCA 210	Laboratory Methods of Testing Fans for Rating
	AMCA 300	Test Code for Reverberant Room method for Sound Testing of Fans
	AMCA 301	Method for Publishing Sound Ratings for Air Moving Devices
ANSI		**American National Standards Institute**
	B46.1	Surface Texture, Surface Roughness, Waviness and Lay, Part 1.

Standard	Standard no	Description
	C 1	Specification of General Requirements of a Quality
	S12.34	Survey Methods for Determination of Sound Power Levels of Noise Sources
	S12.36	Survey Methods for Determination of Sound Power Levels of Noise Sources.
	Z49.1	Safety in Welding and Cutting
	Z55.1	Grey Finishes for Industrial Apparatus and equipment
ARI		**American Refrigeration Institute (USA)**
ASHRAE		**American Society of Heating, Refrigeration and Air Conditioning Engineers**
	51	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (AMCA Standard 210-99) (ANSI approved)
	52-76	Method of Testing Air Cleaning Devices used in General Ventilation for Removing Particulate Matter.
	62-89	EPA Ambient-Air Quality Standards for Outdoor Air
	68	Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans
	87.1	Method of Testing Fan Vibration -- Blade Vibrations and Critical Speeds (ANSI approved AMCA
	128	Method of Rating Unitary Spot Air Conditioners (ANSI Approved)
ASME		**American Society of Mechanical Engineers**
ASTM		**American Society for Testing and Materials**
	A 36	Structural Steel
	A53/A53M-04a	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
	A 123	Zinc (Hot Galvanised) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.
	A 193	Alloy-Steel and Stainless Steel bolting Materials for High-Temperature Service.
	A 194	Carbon and Alloy Steel Nuts for Bolts for High- Pressure and High-Temperature Service.
	A 239	Locating the Thinnest Spot in Zinc (Galvanised) Coating on Iron or Steel Articles by the Peerce Test (Copper Sulphate Dip).
	A 276	Stainless and Heat-Resisting Steel Bars and Shapes
	A 525	Steel Sheet, Zinc Coated (Hot Galvanised) by the Hot-Dip Process.
	A 588	High Strength Low Alloy Structural Steel with 50 Psi (345 MPa) Minimum Yield Point to 4 Inch (100 mm) Thick.
	A 666	Authentic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications.
	B247	Certification for Aluminium Alloy Die Forgings, Hand Forgings and Rolled Ring Footing.
	B75-02	Standard Specification for Seamless Copper Tube.

Standard	Standard no	Description
	B 88	Seamless Copper Tube for Water, Gas and Sanitation
	B 686	Aluminium Alloy Castings, High Strength
	C177	Steady State Heat Flux measurements and Thermal Transmission Properties by mean of the Guarded Hot Plate Apparatus
	C 423	Standard Test Method for Sound Absorption
	C 534	Perform flexible elastomeric cellular thermal insulation in sheet and tubular form
	D 635	Rate of Burning and/or Extend and Time of Burning of Plastics in the Horizontal Position
	D 781	Standard Test Methods for Puncture and Stiffness of Paperboard and Corrugated and Solid Fibreboard
	D1056	Flexible cellular materials-Sponge or Expanded Rubber
	E 84	Surface Burning Characteristics of Building Materials
	E 94	Radiographic Testing
	E 96	Water Vapour Transmission of Materials
	E 155	Reference Radiographs for Inspection of Aluminium and Magnesium Castings.
	E 477	Standard Test Method For Measuring Acoustical and Air Flow Performance of Duct Linear Materials and Prefabricated Silencers
	E 709	Wet Magnetic Particle Inspection
AWS		**American Welding Society**
	D 1.1	Structural Welding Code – Steel
	D 1.3	Structural Welding Code - Sheet Steel
BS		**British Standards**
	142	Electrical protection relays
	729	Hot Dip Galvanised Coatings on Iron and Steel Articles
	848	Method For Noise Testing
	874 Part 2	Determining thermal insulating property part 2. Test for thermal conductivity and related properties
	2757	Thermal classification of Electrical Insulation
	2871 Part 1	Copper Tube for water, gas and Sanitation
	4921	Specification for sherardized coatings on iron or steel
	5422	Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range
	5970	Code of practice for thermal insulation of pipe work and equipment (in the temperature range -100°C to +870°C)
	EN 312:2003	Part 1: Methods of Sampling, Conditioning and Test
	6387	Specification for performance requirements for cables required to maintain circuit integrity under fire conditions.
	7346-5	Components for smoke and heat control systems. Functional recommendations and calculation methods for smoke and heat exhaust ventilation systems, employing time-dependent design fires. Code of practice.

Standard	Standard no	Description
	EN 10142	Continuously Hot-Dip Zinc Coated Low
DIN		**German Institute for Standardization**
	52615	Test for Water Vapour Permeability
EN		**European Standard**
	50121-1	Railway Applications – Electromagnetic Compatibility Part 1: General
	50121-2	Railway Applications – Electromagnetic Compatibility Part 2: Emission of the Whole Railway System to the outside world
	50121-4	Emission and Immunity of the signalling and Telecommunication Apparatus
	50121 – 5	Emission and Immunity of Fixed Power Supply Installations and Apparatus
	50122-1	Railway applications: fixed installations; protective provisions relating to electrical safety and earthing
	50122-2	Railway applications: fixed installations; protective provisions against the effects of stray currents caused by D.C. traction systems
	50204	Radiated Electromagnetic Field from Digital Radio Telephones Immunity Test
	50126	Railway applications. The specification and demonstration of reliability, availability, maintainability and safety (RAMS)
	50128	Railway Applications - Communications, Signalling and Processing Systems - Software for Railway Control and Protection Systems
HVCA		**Heating Ventilation Contractors Associations**
	DW 144	Specification for Sheet Metal Ductwork, Low, Medium and High Pressure/Velocity Air Systems.
	DW151	Specification for Plastics Ductwork
IEC		**International Electro-technical Committee**
	34-1	Rotating electrical machines: rating and performance
	34-5	Rotating electrical machines: classification of degrees of protection provided by enclosures of rotating electrical machines
	34-6	Rotating electrical machines: methods of cooling (except traction engine)
	34-7	Rotating electrical machines: classification of types of constructions and mounting arrangements (except traction engine)
	34-8	Rotating electrical machines: Terminal markings and direction of rotation
	34-9	Rotating electrical machines: noise limits
	34-14	Rotating electrical machines: mechanical vibration of certain machines with shaft heights 56mm and higher. Measurement, evaluation and limits of vibration
	85	Thermal evaluation and classification of electrical insulation
	801-3	Radiated electromagnetic field requirements

Standard	Standard no	Description
	870-2-1	Operating conditions
	870-4	Performance requirements
	892	Effects of unbalanced voltages on the performance of three phase cage induction motors
	60034-1	Rotating Electrical Machines - Part 1: Rating and performance
	60034-12	Rotating electrical machines - Part 12: Starting performance of single-speed three-phase cage induction motors
	60335-2-104	Household and similar electrical appliances - Safety - Part 2-104: Particular requirements for appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment.
	60364-1	Electrical installations of buildings - Part 1: Fundamental principles, assessment of general characteristics, definitions
	60848	Preparation of function charts for control systems
	60947-2	Low-voltage switchgear and control gear – Part 2: Circuit-breakers
	60947-3	Low-voltage switchgear and control gear – Part 3: Switches, Disconnectors, Switch-disconnectors and fuse-combination units
	60947-4-1	Low-voltage switchgear and control gear – Part 4-1: Contactors and motor-starter – Electromechanical contactors and motor-starters
	60947-7	Low-voltage switchgear and control gear – Part 7: Ancillary equipment
	60228	Conductors of Insulated cables
	60502-1	Power cables with extruded insulation and their accessories for rated voltage from 1 kV – Part 1: Cables for rated voltage of 1 Kv
	60332	Tests on electric cables under fire conditions
	61034-2	Measurement of smoke density of cables burning under defined conditions – Part 2: Test Procedure and Requirements
	60754	Tests on gases evolved during combustion of electric cables
	61000	Electromagnetic compatibility
	61508	Functional safety of E/E/PE safety-related systems
IEEE		**Institute of Electrical and Electronic Engineers**
	85	Standard Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery
	112	Test Procedure for Polyphase Induction Motors and Generators
	519	Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
IP		**Ingress Protection**
	42	4 describes the level of Protected against solid objects over 1 mm (tools, wires, and small wires) and 2 describes the level of Protection against direct sprays of water up to 15º from the vertical.
	54	5 describe the level of protection from solid objects and 4 describe the level of protection from liquids.

Standard	Standard no	Description
	65	6 describes the level of totally protected against dust and 5 describes Protected against low pressure jets of water from all directions - limited ingress
IS		**Indian Standards**
	277: 2003	Specification for galvanized steel sheet (plain and corrugated)
	374 –1979	Electric ceiling type fans and regulators
	655: 1963	Specification for metal air ducts
	8623 : Part 1 : 1993	Specification for Low-Voltage Switchgear and Control gear Assemblies - Part 1 : Requirements for Type-Tested and Partially Type-Tested Assemblies
	13947 : Part 1 : 1993	Specification for Low-voltage Switchgear and Control gear - Part 1 : General Rules
	13947 :Part 2 : 1993	Specification for Low-voltage Switchgear and Control gear - Part 2 : Circuit Breakers
	13947 : Part 3 : 1993	Specification for Low-voltage Switchgear and Control gear - Part 3 : Switches, Disconnectors, Switch Disconnectors and Fuse Combination Units
	13947 : Part 4 : Sec 1	Specification for Low-Voltage Switchgear and Control gear - Part 4 : Contractors and Motor-Starters - Section 1 : Electromechanical Contactors and Motor Starters
	IS 1477-2	Code of practice for painting of ferrous metals in buildings, Part 2 Painting
	IS 14428	Guidelines for painting of structures in aggressive chemical environment.
ISO		**International Organization for Standardization**
	281	Rolling bearings: dynamic load ratings and rating life
	1680	Test code for the measurement of airborne noise emitted by rotating electrical machinery: Engineering method for free field conditions over a reflecting plane.
	5135	Noise: Air distribution and diffusion
	8821	Mechanical vibration: balance. Balancing shaft and fitment key convention
NBC		**National Building Code 2016**
NEMA		**National Electrical Manufacturer's Association**
	ICS-1	General Standards for Industrial Control and Systems
	ICS-1.1	Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control
	ICS-2	Industrial Control Devices, Controllers and Assemblies
	ICS-3	Industrial Systems
	MG-1	Motors and Generators
	MG-12.54	Efficiency
NFPA		**National Fire Protection Association**
	90A	Standard for the Installation of Air-Conditioning and Ventilating Systems
	90B	Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
	130	Standard for Fixed Guideway Transit and Passenger Rail

Standard	Standard no	Description
		Systems
SMACNA		**Sheet Metal and Air Conditioning Contractors National Association**
	68	Laboratory Method of Testing to Determine the Sound Power in a Duct (AMCA Standard 330) (ANSI approved)
	120	Method of Testing to Determine Flow Resistance of HVAC Ducts10 and Fittings (ANSI Approved)
	126	Method of Testing HVAC Air Ducts (ANSI approved)
	1286	Fire, Smoke & Radiation Damper Installation Guide for HECSs
SSPC		**Steel Structures Painting Council**
	PA-1	No. 1 Shop, Field and Maintenance Painting
	PA-2	Method for Measurement of Dry Paint Thickness with Magnetic Gauges.
	SP - 1	Solvent Cleaning
	SP - 2	Hand Tool Cleaning
	SP - 3	Power Tool Cleaning
	SP - 6	Commercial Blast Cleaning
	SP – 10	Near White Blast Cleaning
UL		**Underwriters Laboratories**
	94	Flammability of Plastic Materials for Parts in Devices and Appliances
	508	Industrial Control Equipment
	555	Fire Dampers
	555S	Leakage Rated Dampers for Use in Smoke Control Systems
	762	Power Roof Ventilators for Restaurant Exhaust Applications, (UL 762)
	793/705	Power Ventilators for Smoke
	900	Test Performance of Air Filter Units

1.5 Relevant Documents

1.5.1 This Technical Specifications should be read in conjunction with the General Conditions of Contract (GCC), the Special Conditions of Contract (SCC), the General Specification (GS), the Tender Drawings and any other document including standalone specifications of various sub-systems forming part of the Contract.

1.5.2 In the event of a conflict between the GS and this Specification, this Specification shall prevail.

1.5.3 In the event of a conflict between this Specification and any other standards or specifications quoted herein, the requirement of this Specification shall prevail.

1.5.4 The priority order of documents is as indicated (sorted from highest to lowest priority):

a. Technical Specification including appendices
b. General Specification including appendices
c. BIS standards
d. Other Indian Railway Standards
e. International Standards referenced herein
f. Other International Standards

1.5.5 Notwithstanding the precedence specified in Section 1.5.2, 1.5.3, and 1.5.4 the contractor shall always immediately seek advice from the Engineer in the event of conflicts between Specifications.

1.5.6 The prevailing latest relevant standards at the time of submission of design/documents shall be followed.

2 SCOPE OF WORK

2.1 General

2.1.1 The Ventilation and Air-Conditioning Work for Aarey Depot, OCC, PTR, Infrastructure, Maintenance, Auxiliary Sub Station & car park for Aarey station shall meet all performance, functional and technical requirements as defined in this Technical Specification.

2.1.2 The Contractor shall be responsible for the detailed design of Aarey Depot VAC which consist of Ventilation and Air Conditioning system (VAC) which includes but not limited to supply, installation, testing and commissioning of all VAC Equipment including Water Cooled Chillers and its associated pumps, Cooling Tower & its associated pump Air Handling Units, Fan coil units, VRF/VRV, PAC, duct works, pipe works, valves, brackets, fittings, sleeves, Fire sealants and insulation to complete the installation. The design shall include complete Depot rooms Environmental Control System, Electrical system for VAC, associated VAC Control and monitoring system including necessary cabling works through BMS.

2.1.3 The Contractor shall be responsible for system sizing and shall submit all calculations and basis adopted for consent of the Engineer. Where computer software are used for designing, complete print out of all steps involving detailed designing should be submitted to ensure complete understanding by the Engineer. The software shall be made available to the Engineer. The contractor shall also confirm the general adequacy of the space requirements within voids or service ducts, openings, main routes etc. with civil contractor.

2.1.4 Engineering studies and comparative evaluations shall be performed to ensure that the design incorporate features to achieve optimum performance. In addition, the VAC design shall be reliable, energy & cost efficient with due considerations to the local climate and operational conditions, safety, ease of operation and maintenance. Design documents shall be prepared and submitted to explain the rationale of the proposed designs. All basis, assumptions, norms and support documents used for designing should be detailed in the design procedure properly.

2.1.5 VAC shall be design to maintain specific temperature and humidity conditions in system rooms, office and equipment rooms.

2.1.6 The VAC should also be designed for efficient extraction of smoke from Depot OCC rooms in case of fire. Adequate smoke extraction arrangements from OCC shall be provided. The smoke extraction fans and other system components shall have suitable fire rating.

2.2 Scope of Work

2.2.1 The Works to be executed under the Contract includes the detailed design, procurement, manufacture, installation, testing, successful commissioning and technical / maintenance support for a complete, Depot VAC system, including associated automatic control & monitoring systems, associated electrical power supply and distribution system from the VAC low voltage main panel to the VAC equipment, with all applicable standards, Safety Integrity Levels, codes and regulations etc.

2.2.2 The scope of work for Depot, OCC, PTR, Infrastructure, Maintenance, Auxiliary Sub Station & car park for Aarey station shall include but not limited to the following:

a. Provision of Water Cooled Chillers, Cooling Towers and its associated pumps, water treatment system, including associated pipe works & insulation.
b. Provision of Air handling units, Smoke extraction fans for point of safety floor, Fan coil units, ventilation fans, Pressurization fans, Fresh air fans, dampers, ductworks including fire rated ducts & insulation of Ducts.
c. Provision of Associated Electrical power supply and distribution system including earthing from Main VAC Distribution panel to all VAC equipment including Main Distribution Panels, Motor control centre, VSD, Local control panel and smoke control panel.
d. Provision of all VAC equipment including provisions for local and remote control and monitoring to enable through the BMS.

2.2.3 The scope of work for other building rooms shall include but not limited to the following:

Provision of ventilation fans, Smoke extraction fans (OCC and Aarey Station Basement only), Pressurization fans for stair case and Lift well, dampers, ductworks.

2.2.4 The scope of work includes the quality checking and management for all the VAC equipment's & works.

2.2.5 The scope of work include training to the Employer's O&M staff & the OMC staff

2.2.6 The scope of work includes the supply of spares, special tools, and test equipments.

2.2.7 Services

The Services to be performed by the Contractor shall include, but not be limited to, the following:

a. Presentations, reviews and audit support.
b. System operations and maintenance support services.
c. Preparation of Operation, Maintenance and Training Manuals.
d. Decommissioning, removal and/or disposal of Temporary Works;
e. Mock ups, Prototypes and Samples. The Engineer shall advice the items for submission.
f. DLP after commissioning.
g. Supervised Maintenance.

2.2.8 Documentation

The documentation to be supplied by the Contractors are as follows.

- Programming General Requirements
- Progress Monitoring
- Works Programme
- Design Submission Programme
- Installation Programme
- Testing and Commissioning Programme
- Training Programme
- Three Month Rolling Programme
- Five Week Rolling Schedule
- Monthly Progress Report
- Project Management Plan
- Interface Management Plan
- Quality Plan
- System Safety Assurance plan:
- Construction Phase OHS & E Plan
- Software Quality Assurance Plan
- Design Plan
- Design Verification and Validation Plan
- Procurement, Manufacturing, Delivery and Manufacturing Testing Plan
- Construction & Installation Management Plans
- Inspection, Testing & Commissioning Plans
- Operation and Maintenance Manuals Plan
- Training Plan
- Spares Management Plan
- Defects Liability Management Plan
- Assistance for Maintenance Plan
- Documents Submission and Correspondence
- Contractor Supplied Documentation and Response
- Records
- Installation Documentation
- As-Built Status

- Structure of Handover Documentation
- Document titles and numbering
- Employer's Documentation Requirements

2.2.9 Signage:

The entire VAC and equipment premises shall be provided with suitable Signage as per relevant standards.

2.2.10 The Technical Specification and Tender drawings are to be taken as mutually explanatory to one another. Where Works is mentioned in one but not in the other, such Works are deemed to be included in the Contract where the context requires.

2.3 Key dates

The key dates applicable to this Technical Specification shall be as defined in Volume-1 and Volume- 2.

2.4 Works included in this contract

2.4.1 Liaison with others.

2.4.2 Interface and coordinate with other project contractors.

2.4.3 The Contractor shall provide necessary support (have experts with adequate knowledge and experience, qualification, and to submit such documentation as required) to assist MMRC for effective interaction with Indian authorities viz. Ministry of Railways, RDSO, Commissioner of Metro Railway Safety, EIG and Mumbai Fire Service department(MFS) and any other authorities as required.

The VAC Contractor shall co-ordinate with E&M contractor to obtain clearance and relevant certificates from local civic authorities, via completion certificates, EIG, fire clearance etc. MMRC may extend necessary assistance wherever possible. However, it will be the ultimate responsibility of the E&M contractor to obtain all the required clearance and relevant certificates as per the time schedule prescribed by contract.

2.4.4 Other Works:

All matters not explicitly mentioned but are necessary for the completion of the Works shall be deemed included. The Contractor shall provide all materials and fittings to perform any work, which are necessary for efficient functioning of the Works or required in accordance with good accepted trade practices even though such works/materials may not be explicitly mentioned or indicated in the Employer's Requirements / Specifications.

3 TECHNICAL REQUIREMENTS

3.1 General

3.1.1 The Ventilation and Air-Conditioning Scope of work for Aarey Depot, OCC, PTR, Infrastructure, Maintenance, Auxiliary Sub Station & car park for Aarey station shall meet all performance, functional and technical requirements as defined in this Technical Specification, BOQ and Drawings. The works shall include the design, coordination with all relevant parties, manufacture, supply, delivery, installation, testing and commissioning of the following systems:

- Ventilation and Air-Conditioning
- Electrical system for VAC
- Control and Monitoring System.
- All other works necessary to form a complete system as prescribed in the Employer's Requirements and specifications

The Contractor shall submit a list of all design review documents and drawings to the Engineer for notice of no objection.

3.1.2 **Quality Assurance**

The following items shall be considered in line with the whole Project QA/QC guidelines by the

successful Contractor for VAC works.

a. Labels and Listings
   VAC Equipment scheduled for delivery shall comply with the requirements of respective technical material submittals and shall meet the requirements of the Underwriter's Laboratories, Inc. (UL) and other standards if required.
b. All work provided under this Contract shall meet the requirements of the NFPA -92 & 92B and ASHRAE standards.
c. Current Models: All work shall be as follows:
   1. Manufactured items furnished shall be the current catalogued product of the manufacturer.
   2. Spare parts and consumable shall be available.
d. Compliance with International and Local Codes:
   Compliance with international and local regulations and codes for the prevention, control and abatement of air and water pollution is mandatory.

3.1.3 **Submittals**

Contractor shall submit the complete list of technical material submittals to the Engineer for obtaining Notice of no objection.

3.1.4 **Delivery, Storage and Protection**

a. Packing, storage, shipping and delivery for the requirements of materials and products to be delivered to the project site without extra cost by the contractor.
b. Materials stored at the project site which becomes soiled with construction dirt, concrete or earthwork shall be washed, cleaned and dried to the satisfaction of the Engineer or removed from the project site and replaced with new materials. Do not install soiled materials.
c. Protect and store material and equipment in such a manner as to effectively prevent damage from climatic conditions.

3.1.5 **Equipment Mounting**

a. Equipment to be mounted on the floor shall be placed on reinforced concrete equipment pads. Minimum pad height shall be 200 mm from finished floor level. The Contractor shall co-ordinate as necessary.
b. In cases where units are ceiling suspended, the support system shall be adequately braced to ensure stability during unit start up, operation and shut down.

3.1.6 **Labels & Name Plates**

a. Name plates shall conform to the requirements of the Underwriters Laboratories, Inc. (UL) and the American National Standards Institute, Inc. (ANSI).
b. Manufacturer's Nameplates: Nameplates on manufactured items shall be aluminium or type 304 stainless steel sheet, not less than 20 gauge, riveted or bolted to the manufactured item, with nameplate data legibly and permanently engraved or punched to form a non-erasable record of equipment data.
c. Field Installation: Field-installed nameplates shall be engraved melamine plastic laminate, 3.17mm thick, engraved in bold capital lettering to expose white lettering on black face. Secure labels with rivets, stainless steel bolts, stainless steel strap or with supporting angle. Adhesive attachment will not be permitted.
d. Submit a schedule of nameplates, abbreviations and equipment designations to the Engineer for Notice of No Objection.
e. Lettering Style: Comply with ANSI A13.1 for lettering size and style.

3.1.7 **Deviations**

If any deviation is necessary for equipment and material, capacity and ratings shall be furnished and get Notice of no objection by the Engineer. As a result of this deviation, feeders, circuit breakers, conduit, motors, bases shall be taken into consideration for the equipment spaces and if space is increased all additional works cost shall be borne by the Contractor.

3.1.8 Coordination

Coordinate VAC work with that of other interfacing contractors in sufficient detail to:

a Avoid interferences between VAC work with that of other mechanical, electrical, structural and other specialty trades.

b Maintain adequate clearances and advise other trades of clearance requirements for operation, repair, removal and testing of VAC equipment.

c Indicate aisle ways and access ways required on coordinated shop drawings for Chiller plants, mechanical equipment rooms.

3.1.9 Posted Operating Instructions

Furnish Notice of no objection operating instructions for systems and equipment indicated in the technical sections for use by the operation personnel. The operating instructions shall include manufacturer's wiring diagrams, control diagrams and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in laminated plastic that has received Notice of no objection from Engineer. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weather proof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

3.1.10 Manufacturer's Recommendations

3.1.11.1 Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation.
Installation of the item shall not proceed until recommendations are received Failure to furnish recommendations shall be cause for rejection of the equipment or material.

3.1.11.2 The contractor shall inspect the sub-contractor drawing for equipment requiring initial supply of consumables and provide one full supply prior to commissioning.

3.1.11 Execution

a **Procedures**

General Operating and Maintenance Instructions: The Contractor shall arrange their maintenance team to meet at site with Employer's personnel to provide necessary basic instructions in the proper required procedures, together with manufacturer instructions. As part of this instructions, provide details of the following items:

1. Replacement Products Procurement Manual
2. Operation & Maintenance Manual
3. Record Documents
4. Spare Parts and Materials
5. Tools
6. Lubricants
7. Fuel
8. Identification Systems

9. Control Sequences
10. Hazards
11. Cleaning
12. Warranties, Bonds, Maintenance Agreements and similar continuing commitments.

As part of those instructions for operating equipment, demonstrate the following procedures:

1. Start-up
2. Shutdown
3. Emergency Operations
4. Noise and Vibration Adjustments
5. Safety Procedures
6. Economy and Efficiency adjustments
7. Effective Energy Utilization

b Painting and Finishing

i. Damage and Touch-Up: Restore all marred or damaged factory painted finishes with materials and procedures to match original factory finish.

ii. Identification: Provide schedules for stencilling and identification markings. Submit stencilling and identification marking for issuance of Notice of no objection.

c Sizing

i. Capacity: Provide equipment and material of sizes, capacities, horse power, power ratings and dimensions indicated on the Construction drawings, Technical submittal and as specified.

ii. Fit and Clearance: All equipment, such as Chillers, pumps, cooling towers, VRV/VRF outdoor units, fans, storage tanks, air-handling equipment and filters etc. shall fit the space shown on the Construction drawings. Provide access for servicing, repairing and inspecting apparatus at least equal to that shown. Each item of equipment shall be installed without damage to the building, building equipment, or the equipment itself. Verify building access constraints before delivery of equipment to the project site.

3.1.12 Fire Stopping

a Fire stopping: Unused slots, sleeves and other penetrations in floors, walls or other general construction shall be closed and sealed with a fire stopping material that has been issued Notice of no objection from Engineer.

i. Fire stopping material shall be UL listed and tested silicone elastomer specifically formulated for use in horizontal and vertical applications. The material shall possess intumescent characteristics; upon exposure to heat above 121 degrees C shall expand to not less than five (5) times its original volume to form a fireproof envelope UL rated for 2 and 3-hour protection, when applied in accordance with the manufacturer's recommendation.

ii. Fire stop with a layer of silicone elastomer not less than 2.54 cm thick completely fills the opening. The top surface of the silicone elastomer shall be approximately 2.54 cm below the finished floor slab.

iii. Openings in walls shall be closed with 16 gauge galvanized steel sheet securely attached at the midpoint of the wall thickness and fire stopped on both sides of the steel sheet with not less than 0.32 mm thick layer of non-sagging silicone elastomer to fully cover the opening.

iv. Single or multiple pipes passing through walls and floors shall have the annular space between pipes or between pipes and structure filled with silicone elastomer to provide a 3-hour rated fire stop for floors and walls.

b Pipe and Ducts: The annulus between exposed pipe and ductwork and walls or floors in finished spaces shall be filled, sealed and painted to match adjacent surfaces.

c Future Slots: Identify unused sleeves and slots for future use by permanently anchored brass nameplates identifying size and purpose of the covered slot.

3.1.13 Start-up and Commissioning

The Contractor shall be responsible for cleaning all systems, including filters and strainers, verifying that new and existing equipment and systems are in a condition suitable for start-up in accordance with manufacturer's recommendations, and shall start systems up in a manner that shall cause no damage to new or existing equipment and systems.

3.1.14.1. General

The Contractor shall perform all testing and commissioning activities to satisfactorily demonstrate the performance of the Works within the framework of the Inspection, Testing and Commissioning Plan in accordance with the clause bellow.

3.1.14.1.1. The Contractor's activities shall include but are not limited to the following:

1) provision of all labour and experienced supervision to perform all inspections and tests required to demonstrate the performance of the Works;
2) preparation of the Testing &Commissioning Plans that applies to the Works to a level of detail acceptable to the PM;
3) Performance of all duties and responsibilities, as specified in the Testing and Commissioning Plans.
4) Performance of the Testing and Commissioning for all systems forming part of the Works in a manner which is fully co-ordinated with Interfacing Contractors, the Employer and the ENGINEER.
5) Provision of all required testing and specialised equipment and materials including consumables required to support the Testing and Commissioning pre-operations activities; and
6) Removal and appropriate disposal of any toxic or other spoil (e.g. cable drums, depleted filters, oils, and fluids) created as a result of the Contractor's construction, testing and commissioning activities.

3.1.14.1.2. The Contractor shall provide full access for the Employer, his representative including the Operation & Maintenance entity and ENGINEER to witness any test or inspection.

3.1.14.1.3. For unscheduled test and inspections the Employer shall be responsible for its own all costs associated with travel, accommodation, boarding, visa and permits.

3.1.14.2. Tests at factory

3.1.14.2.1 The Manufacturing Testing Plan is the Contractor's plan for carrying out the necessary procedures to ensure that the items presented for a Notice of no objection by the ENGINEER are in compliance with the requirements of the Specification.

3.1.14.2.2 During the process of procurement and manufacture of the system components the Contractor shall undertake such testing and inspection.

3.1.14.2.3 The Employer and the ENGINEER will not become involved in the Contractor's Manufacturing Tests except in respect of Factory Acceptance Tests, including:

1) Type tests;
2) Functional and operational tests;
3) Factory integration tests;
4) First Article Inspection (FAI), and
5) Other Factory Acceptance Tests.
6) Procedures for these tests are included in Factory Acceptance Test Plan.

3.1.14.2.4 Before shipment of any items to Site the Contractor shall present the items for the first stage of Acceptance according to the Testing & Commissioning Plan.

3.1.14.2.5 Inspection

The Contractor shall be wholly responsible for all inspection of items to be incorporated into the system as a whole.

3.1.14.2.6 **Type Tests**

1) Type tests will not be required in those cases where the Contractor can produce certified evidence within last 5 years, that the required Type tests have been performed successfully on identical equipment or equipment which is, for practical test purposes;
   (a) Of identical design;
   (b) Made using identical raw materials/components;
   (c) Made using identical software version under similar manufacturing conditions in the factory where the equipment offered is to be manufactured.
2) Evidence to this effect submitted during the Tender period shall be resubmitted. This and any further submissions for waiver of Type Testing shall be submitted for a Notice of no objection by the ENGINEER not later than 60 days before the scheduled date for shipment of the item to site.
3) Unless specified to the contrary, equipment type testing shall consist of performing the tests listed below on at least one sample of the design.
   (a) Mechanical Tests- Based on the function to be performed;
   (b) Environmental Tests - Based on the class of environment into which the item is to be installed;
   (c) Functional Tests-To comply with the requirements of the Technical Specification.
   (d) Electrical Tests- (where appropriate) To demonstrate compliance with electrical characteristics under conditions of interference and power supply disruption; and
   (e) Fatigue (Soak) Tests - To demonstrate the reliability or longevity of the item.
4) Type tests are not required if previously independently witnessed tests have been successfully carried out within the last five years. Where only some of the required tests have been carried out, the Engineer may agree to selected type tests being carried out individually rather than as part of a sequence.
5) The Contractor shall conduct the tests in accordance with test procedures which have been given a notice from the Engineer and shall enter the results in the result sheets. Full use shall be made during the tests of operator manuals and other documentation provided by the Contractor, to provide a series of tests of their accuracy. Type Tests shall be performed in accordance with the Employer's Requirements.
6) For each test, the Engineer will determine whether the item under test has passed or failed. In general, the test will be considered to have failed if either:
   (a) The result of the test is not in accordance with the expected result described in the test procedure, or
   (b) The result of the test is in accordance with the expected result described in the test procedure, but some other unexpected or unexplained event occurred which the Engineer considers to be a fault.
7) If during Type Tests, any failure occurs or the equipment design is changed, it shall be reported to the ENGINEER who may, at his discretion, require repetition of the previous tests at the Contractor's cost.

3.1.14.2.7 **First Article Inspection(FAI)**

1) FAI shall be performed by the Contractor and the Employer and the ENGINEER shall attend FAI on all major equipment items or sub-systems identified by the ENGINEER including wherever the Type Testing was considered incomplete or deficient in some minor respect.
2) Equipment shall be shipped from the point of manufacture only after a FAI has been completed or the requirement waived in writing by the ENGINEER.
3) Prior to any FAI, the Contractor shall inform the ENGINEER in writing a minimum of 14 working days in advance, if manufactured in India or 28 working days if sourced outside India. Other than the FAI, the Contractor shall give the ENGINEER notice of all Quality Control Points and Quality Hold Points involving inspections and/or tests by the Contractor.
4) At least 15 days prior to each jointly performed FAI, the latest drawings, inspection and test procedures, specifications and quality documentation required for adequate inspection of the equipment under inspection shall be submitted to the ENGINEER. The drawings shall be completed to the lowest level replaceable unit.
5) The Contractor shall ensure that his subcontractors are prepared for all FAIs. The Contractor shall not schedule more than one FAI on the same day without prior Notice of no objection by the Engineer.
6) The FAI shall evaluate component and system maintainability. The FAI shall enable the Employer and the ENGINEER and the Contractor to jointly establish the quality of workmanship for the balance of like components.
7) The FAI shall not be conducted until the design drawings of the equipment have been given a Notice of no objection by the ENGINEER. If drawings with outstanding comments are used, the ENGINEER's comments shall be satisfied at the FAI and represented by the inspected equipment.
8) FAI shall be performed on a component built using production processes, tooling and manpower having ENGINEER's Notice of No Objection. All test fixtures, programs and instruments used in FAI shall be those to be used in the routine production testing of subsequent identical items.
9) The Contractor shall be responsible for all the cost and scheduling of any repeat testing of items which failed FAI and these tests shall be repeated until they passed and accepted by the Employer and the ENGINEER's satisfaction.

3.1.14.2.8 **Functional and operational tests**

These tests are to check full compliance with each functional and operational requirements.

3.1.14.2.9 **Other Factory Acceptance Tests**

Before shipment all manufactured items or systems shall undergo Factory Acceptance Tests in accordance with the requirements of the Employer's Requirements and Technical Specification. Upon completion of the acceptance test, an acceptance report shall be signed and issued by the Contractor and a Notice of No Objection shall be obtained from the ENGINEER. The equipment shall be shipped upon receiving the notice of no objection from the ENGINEER.

3.1.14.3. Testing & Commissioning Plans

3.1.14.3.1 The Contractor's Testing & Commissioning Plans shall be developed by the Contractor to manage and coordinate the Testing and Commissioning, of the sub system covered with in the Contractor's scope as well as commissioning activities applying to the same sub-system functioning within the overall transit system.

3.1.14.3.2 Testing and Commissioning Phases

1) Testing and Commissioning activities shall be undertaken in accordance with the following phases:
   (a) Other Factory Acceptance Test
   (b) Installation Tests;

(c) Partial Acceptance Tests;
(d) System Acceptance Tests;
(e) Integration Testing & Commissioning
(f) Service Trial
(g) Blank operation
(h) Regular services verification performance checking period.

3.1.14.3.3 **Tests on site**

3.1.14.3.4 The Contractor shall prepare and submit Contractor's testing and Commissioning Plans for a Notice of no objection by the ENGINEER & shall detail and explain how the Contractor will plan, perform and document all tests and inspections that will be conducted to verify and validate the Works on Site. The Testing and Commissioning Plans shall consist of a narrative description supported by graphics, diagrams and tabulations as required.

3.1.14.3.5 The Testing and Commissioning Plans shall contain, but not be limited to, the following topics:

1) The Contractor's strategy for Testing and Commissioning all constituent parts of the Works and how this relates to the sequence of construction and installation;
2) The sequencing and interrelationships of the inspections and tests including:
3) All Quality Hold Points; and
4) All Quality Control Points;
5) The interdependency and interaction with Interfacing Contractors and their commissioning programmes;
6) The type and extent of Testing and Commissioning to be undertaken and the parts of the Works to be proven by that testing;
7) The objective of each test, what particular design and operating criteria the test or inspection will prove and how the success of the test will be demonstrated or measured;
8) Organisation chart and CVs of Key Staff in the testing and commissioning team;
9) The plan for the production and submission of the Testing and Commissioning procedures for the ENGINEER's Notice of no objection including the submission of the Testing and Commissioning reports and records; and
10) The Testing and Commissioning Plans shall be organised and submitted in the stages described.

3.1.14.3.6 Installation Tests

1) The Installation Tests phase is defined as being the final stage of assembly/installation before the start of commissioning itself. The Installation Tests are to be performed by the Contractor under the Contract and may be witnessed by the Employer, his representative including the Operation & Maintenance entity and the ENGINEER. During this phase, the Contractor shall perform static testing of components and/or systems in preparation for Partial Acceptance Testing.
2) The Contractor shall prepare three copies of a test report immediately after the completion of each test whether or not witnessed by the Employer and/or the ENGINEER. If the Employer and /or the ENGINEER has witnessed the test, he will countersign the report to indicate his Notice of No Objection to the information and conclusions (i.e. whether or not the equipment being tested has passed satisfactorily) contained therein. If the Employer and/or the ENGINEER has not witnessed the test (i.e. if a written waiver has been granted), the Contractor shall forward three copies of the test report without delay to the ENGINEER.
3) The ENGINEER will countersign the report to indicate his Notice to the information and conclusions (i.e. whether or not the equipment being tested has passed or failed) and return

one copy to the Contractor. Where the results of the test do not meet the requirements of the Specification, the Employer or the ENGINEER may call for a re-test at the Contractor's own expenses.

4) Test equipment and instrumentation shall be subject to calibration testing within a properly controlled calibration scheme, and signed calibration certificates shall be supplied to the ENGINEER in duplicate. Such calibration checks shall be undertaken prior to testing and, if required by the Employer or the Engineer shall be repeated afterwards.

5) The Contractor shall submit to the ENGINEER an Installation Test Plan including a comprehensive schedule of tests as required by the Employer's Requirements, General Specification & Technical Specification giving full details and procedures for each test to be carried out under the Contract and including the pass / fail criteria (i.e. the standards or limits to be achieved).

3.1.14.3.7 Partial Acceptance Tests

1) Partial Acceptance Tests are defined as the performance of functional tests of sections, areas, or stages of a system. The Partial Acceptance Tests are part of the Tests and Inspection to be performed by the Contractor under the Contract in order to achieve the Employer's Taking Over of the Works. During this phase, an energy source shall be introduced to enable functional testing to be performed. On satisfactory completion of the Partial Acceptance Tests, the tested items will be considered available for Systems Acceptance Testing.

2) The Contractor shall submit to the ENGINEER a comprehensive Partial Acceptance Tests Plan including all requirements. The plan shall be submitted on a logical section-by-section basis, using a "top-down" approach describing the testing and commissioning strategies and processes clearly showing how these serve to provide the full verification of the systems and equipment.

3) The Partial Acceptance Tests Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass/fail criteria, sample records, resources to be made available, drawings and records to be submitted to the ENGINEER, and a programme showing the dates for testing and for submission of each test procedure.

4) Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.

5) If any working equipment is relocated or altered by the Contractor during the execution of the Works, thorough re-testing shall be performed to verify that the equipment remains fully functional and operates safely according to its specification. The testing to be performed shall be no less rigorous than the procedures used for the original testing and commissioning of the equipment.

6) The Contractor shall during the execution of the Works prepare such reports and records of design, manufacture, installation, erection and testing as may be required in order that any relevant licences or approvals (including any statutory approvals) may be issued or granted. Such records shall be adequate to enable the system or its respective part to be commissioned and to meet the requirements of the licensing authority or statutory body.

7) Immediately following the successful Partial Acceptance Testing of the system or any constituent part, the Contractor shall complete the appropriate Partial Acceptance Tests records in the agreed format and submit 3 signed copies to the ENGINEER.

8) The Contractor shall include a complete schedule of all Partial Acceptance Tests records and their current status within the Monthly Progress Report.

3.1.14.3.8 System Acceptance Tests

1) System Acceptance Tests are defined as the tests undertaken to demonstrate that the Works in its entirety is capable of functioning in accordance with the specified requirements in the Contract in all respects, including internal interfaces. The System Acceptance Tests are part of the Tests and Inspection to be performed by the Contractor under the Contract in order to achieve the Employer's Taking Over of the Works. The System Acceptance Tests may commence before remote operations capability (if any) is fully functional. However, the remote operation capability must be in place before the System Acceptance Tests can be considered to be completed. On satisfactory completion of the System Acceptance Tests, the tested items will be considered available for Integration Testing & Commissioning.
2) System Acceptance Tests shall comprise comprehensive testing of the assembled installation to ensure that it operates in accordance with the requirements of the Employer's Requirements and Technical Specification.
3) The tests shall include, but not be limited to, the following:
   a. Tests of all functional and performance requirements for the system;
   b. Tests of behaviour under failure conditions, e.g. functioning of failsafe mechanisms, changeover to redundant hardware; initiation of re-configuration functions or reverse modes of operation; and recovery of the equipment and system from failure.
   c. The System Acceptance Test Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass / fail criteria, sample records, resources to be made available, drawings and records to be submitted to the ENGINEER for a Notice and programme showing the dates for testing and for submission of each test procedure.
   d. Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.
4) Immediately following the successful acceptance testing of the system, the Contractor shall complete the appropriate Testing & commissioning records in the agreed format and submit 3 signed copies to the ENGINEER.
5) The Contractor shall include a complete schedule of all System Acceptance Test records and their current status within the Monthly Progress Report.

3.1.14.3.9 Integration Testing & Commissioning

Integration Testing & Commissioning are defined as the final tests to be undertaken before the commencement of Service trial. The Integration Testing & Commissioning are part of the Tests and Inspection to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. The Integration Testing & Commissioning shall refer to all tests with Interfacing Contractors, including third parties, to demonstrate the full compatibility between all interfacing systems. These tests are managed by the interface leader Contractor, in accordance with contractor's Interface Management Plan. On satisfactory completion of the Integration Testing & Commissioning, the tested items will be considered available for Service trial.

1) The Contractor shall submit to the ENGINEER a comprehensive Integration Testing & Commissioning Plan as required by the Employer's Requirements and Technical Specification. The plan shall be submitted on a logical section-by-section basis, using a "top-down" approach describing the testing and commissioning strategies and processes clearly showing how these serve to provide the full verification of the systems and equipment in context of the complete railway system.

2) The Contractor shall co-ordinate with the ENGINEER and with all Interfacing Contractors to ensure that the proposed test programme and schedule truly demonstrates that the full specified performance requirements are achieved.
3) The tests shall include, but shall not be limited to the following:-
   a) Test of all functional and performance requirements for the system;
   b) Test of behaviour under failure conditions (e.g. functioning of failsafe mechanisms, changeover to redundant hardware, initiation of re-configuration functions or reversionary modes of operation, recovery of systems and equipment from failure, demonstrations of planned emergency procedures, etc.).
   c) The Integration Testing & Commissioning Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass/fail criteria, sample records, resources to be made available, drawings and records to be submitted to the ENGINEER for a notice and a programme showing the dates for testing and for submission of each test procedure.
   d) Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.
4) Immediately following the successful Integration Testing & Commissioning of the system or any constituent part, the Contractor shall complete the appropriate commissioning records in the agreed format and submit 3 signed copies to the ENGINEER.
5) The Contractor shall include a complete schedule of all Integration Testing & Commissioning records and their current status within the Monthly Progress Report.

3.1.14.3.10 Performance Testing

1) The Contractor will demonstrate by measurement and recording that an installation, or part of an installation, functions correctly without need of adjustment and is capable of maintaining internal environmental conditions within specified limits under varying plant loading. All tests will be witnessed by the Engineer
2) The Contractor will submit his proposal for the performance tests to the Employer for approval 6 weeks before start of commissioning. For the duration of performance tests, the Contractor will ensure that all qualified commissioning and other specialist personnel are present and available at all times to make any necessary immediate adjustments and repairs.
3) Specialised installations including technical rooms, switch rooms and safety critical equipment rooms and computer rooms and other close- control applications, will be required to achieve satisfactory system performance when subjected to artificial internal and external loads in accordance with the procedure laid down.
4) Comfort and process air conditioning installations will be required to achieve satisfactory system performance in accordance with the procedure indicated.
5) The plant will be continuously operated for a minimum period of 24 hours before tests are witnessed. The Contractor will confirm to the Employer, giving a minimum period of 24 hours' notice, that the installation is ready for witness of performance testing.
6) The Contractor will be responsible for the supply, fixing, connection and safe operation of sufficient temporary artificial heat load equipment and any instrumentation necessary to demonstrate system performance and for subsequent disconnection and removal from site when the Employer is satisfied that tests are complete.
7) The Contractor will subject the entire plant to a total continuous run of the duration agreed with the Engineer to ensure that all apparatus, materials and systems are working properly. During the run tests will be carried out to ensure, that all controls, safety devices, operating

services and all units are properly adjusted and operating correctly, that design temperatures in the piping system and throughout the air system are established and that the system provide the required internal conditions. The Contractor will assure himself that the design intent is achieved before demonstration to the Engineer. The performance will be evaluated during environmental conditions prevailing at that time.

8) The Contractor will provide a temporary installation of portable recorders where indicated and simultaneously record temperatures and humidifies for summer and winter design conditions. The location of test instruments shall be approved by the Engineer. The corresponding external conditions will also be recorded whilst tests are in progress. The capacity of refrigeration plant, (including components thereof such as condensers, evaporators, cooling towers), and other air handling plant will also be demonstrated and recorded.
9) Individual room temperatures shall be measured by mercury-in-glass thermometers located 1.5m above floor level at points unaffected by the influence or draughts or direct radiation from hot or cold surfaces.
10) Measurements and records of performance test results will be entered on the Commissioning formats and handed over to the Employer within a reasonable time after the tests are completed. Copies of the results will be retained on site by the Contractor and be available to other official representative as required.

3.1.14.3.11 Service Trial

1) Service Trial is defined as the final test of the fixed equipment, the rolling stock, and the operational procedures including the final elements of the Tests and Inspection to demonstrate that the system in its entirety can operate satisfactorily. The Service trial is performed by the Employer and his appointed Operator with attendance by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. During this phase, the system will be run to the published timetable but without fare-paying passengers. Prior to the trial, the Contractor shall ensure that it has all the necessary licence to operate and if it is the train, the license to operate needs to be authorised. This phase also allows for Validation of the training procedures in a real time environment.
2) The Commissioning Team as specified in conjunction with the Employer will develop the Service Trial Plan. Representatives of the Contractor as well as the O&M company to be appointed by the Employer in the Commissioning Team will serve to organise and co-ordinate all on-Site activities.
3) The Contractor shall provide special and general attendance to the Employer, the nominated Operation and Maintenance entity and the ENGINEER during the Service Trial period.
4) The Contractor shall co-operate with the Employer and the ENGINEER and with all Interfacing Contractors to ensure that the proposed Service Trial programme and schedule truly demonstrates that the full, specified performance requirements and operating parameters are achieved.
5) The Contractor shall review and comment on the ENGINEER's Service Trial Plan and shall identify specifications, standards, method statements, procedures, pass / fail criteria, to the ENGINEER for inclusion in the Plan.
6) The Contractor shall not interfere with the Service Trial tests and Validations in any manner. Any need for remedial works required to be performed by the Contractor shall be co-ordinated with the Employer, the nominated Operation and Maintenance entity and the ENGINEER in advance.
7) Immediately following the successful tests of the system or any constituent part during Service Trials the Contractor shall complete the appropriate Testing & commissioning

records in the agreed format, submit 3 signed copies to the ENGINEER and may then apply for the Completion Certificate in accordance with the requirements of the GCC.

8) The Contractor shall include a complete schedule of all Service Trial records and their current status within the Monthly Progress Report.

3.1.14.3.12 Regular Service Verification

1) During each Regular Verification period each contractor shall provide personnel with the necessary skills and shall be proactive and responsive so as to:
   a) Submit a proper methodology and efficient tools to be used by Site observers to ensure a close follow-up of the operational performances of its sub-subsystem under contract scope
   b) Actively attend meetings to follow up overall performances follow up and promptly propose preventive/corrective measures to improve such performance
   c) Actively attend sites to promptly analysis and correct defect of its own sub-system and ensure availability for others.
   d) Submit a detailed defect analysis report within 12 hours for any observed unreliability events of its sub-system under contract scope
   e) Actively support preliminary investigation of any defect affecting O&M and helping determine the possible causes of malfunctioning
   f) Provide necessary back office support for establishing contingency plans, whenever appropriate.
   g) At the end of this period submit an operational acceptance note summarizing the measurement of operational performances of its various sub-systems under contract scope, including measurement tools used, analysis perform, observed results, actions undertaken and overall proof of compliance with operation performance contractual requirement.
2) At the end each Regular Service Verification period, operational acceptance note will be submitted to the Employer:
   a) If observed performances confirmed to be compliant with contract requirements, then Contractor will pass operational acceptance
   b) If some observed performances are not compliant with contract requirements, then contract will fail operational acceptance and Regular Service Verification will be extended at Contractors own costs until necessary corrections/improvements are implemented so as subsequent observed performances comply with required performances
   c) Resolution of observed poor performance level will be processed as a non-compliance and may lead to a contingency plan subject to formal agreement by the Employer.

3.1.14 **Commissioning Team**

3.1.15.1 The Employer and the ENGINEER will establish a Commissioning Team at service trial stage of the Project. This team will comprise representatives of all interested parties including not more than two representatives of the Contractor, subject to Notice of No Objection by the Employer and the ENGINEER. In accordance with the Testing and Commissioning Plans, the Commissioning Team shall advise and plan to co-ordinate the activities of the Contractor to ensure the Employer and the ENGINEER's requirements are met.

3.1.15.2 The Contractor shall participate in the activities of the Commissioning Team in addition to its own testing and commissioning or as directed by the Employer or the ENGINEER.

3.1.15 **Records and Reports**

3.1.16.1 The Contractor shall submit to the ENGINEER for Notice of No Objection not less than six (6) months before commissioning activities commence his proposed format for the

commissioning records. The records shall be appropriately sub-divided to make provision for the various parts of the Permanent Works covered by the Contract.

3.1.16.2 The format of the records shall cover all mechanical and electrical tests, provide positive identification by serial number for assemblies and sub-assemblies of the Permanent Works and show modifications to Employer's Drawings and diagrams or "as built" data to be certified by the Employer or the ENGINEER in the course of installation, testing and setting to work of the Works.

3.1.16.3 The Contractor shall, during the execution of the Works, prepare such reports and records of design, manufacture, installation and testing as may be required in order that :

1) A licence may be issued or
2) Statutory requirements may be met or
3) A Notice of No Objection given by ENGINEER. Such reports or records shall be adequate to enable each part of the Permanent Works to be commissioned and to meet the requirements of the licensing authority or any standing statutory regulations for the Notice of no objection to be issued by the ENGINEER.

3.1.16.4 The Contractor shall obtain reports of each inspection and/or test. Such reports shall show the results of all the inspections and/or tests carried out and shall certify that the work has been inspected and/or tested in accordance with the requirements of the Contract and that the work complies with the requirements of the Contract.

3.1.16.5 A representative of the Contractor who has been allocated the required authority under the relevant quality plans shall sign each report of inspection and/or test, with an official company stamp.

3.1.16.6 Each report of inspection and/or test shall include the appropriate details of:

1) The description of the item or goods subjected to the test or inspection;
2) If applicable, the batch from which the samples were taken for test, the size and description of samples and the method of sampling;
3) The place of testing;
4) The date and time of tests;
5) The environmental conditions;
6) The technical personnel supervising or carrying out the test or inspection;
7) The properties tested or inspected;
8) The method of testing or inspection;
9) All relevant checklists and work sheets used during the inspection and/or test, including the readings and measurements taken during the tests; and
10) The test results, including any calculations and graphs.

3.1.16.7 After Commissioning of a part of the Works, the Contractor shall complete each commissioning record in the agreed format and shall forward copies of the records to the ENGINEER for a Notice of no objection.

3.1.16.8 The Contractor shall submit within his Monthly Progress Report a complete schedule of his commissioning records showing completion dates, target completion dates and status.

3.1.16.9 Timing for Reports of Inspection and/or Test

The Contractor shall ensure that a signed copy of each report of inspection and test is filed in his filing system within 3 (three) working days of the date of inspection and test and within 7 (Seven) working days of the date of the date of completion of the test.

3.1.16.10 Quality Control Register

The Contractor shall provide and maintain at all stages of the work a quality control register or registers to identify the status of inspections, sampling and testing of the work and all certificates.

3.1.16 **Test Equipment and Facilities.**

3.1.17.1 The Contractor shall provide all equipment and services required for testing, including, but not limited to:

1) Laboratory test instruments.
2) Special test equipment, emulators, simulators and test software, to permit full testing of System functions and performance.
3) Other items of the System, specified elsewhere as being part of the Contractor's supply, even if not part of the Subsystem under test.
4) Consumables.

3.1.17.2 All test instruments shall be subject to regular routine inspections, testing and calibration by the Contractor as when required by the manufacturer's instructions / recommendations.

3.1.17.3 Details of all test instruments shall be submitted for a Notice of no objection by the ENGINEER and, if required by the ENGINEER, he may order re-calibration of equipment at the expense of the Contractor by an independent standards laboratory.

3.1.17.4 All test equipment must be capable of operating from the mains supply (230V AC 50Hz).

3.1.17.5 All test software shall be subject to formal quality assurance requirements stipulated.

3.1.17.6 The Contractor shall ensure that all inspection and test equipment is calibrated in accordance with the specified standards or, if such standards are not applicable to certain test and inspection equipment, with systems and programmes of calibration which have been given a Notice by the ENGINEER.

3.1.17.7 The Contractor shall ensure that documented evidence of instrument calibration is maintained and made available to the ENGINEER on request.

3.1.17 **Witnessing by the Engineer**

3.1.18.1 The Contractor shall give the ENGINEER notice for Trial, Inspection and/or Test when there is Quality Control Points and Quality Hold Points involved.

1) In the absence of any such statement or notice, the period shall be as follows, unless otherwise agreed by ENGINEER:

a) In the case of on-site work, such notice shall be given not less than 72 hours of normal working time before the work is to be inspected and / or tested.
b) In the case of work carried off-site in Mumbai, such notice shall be given not less than 5 days before the work is to be inspected and/or tested; and
c) In the case of work carried out outside Mumbai, but within India, such notice shall be given not less than 14 days before the work is to be inspected and/or tested.
d) In the case of work carried out outside of India, such notice shall be given not less than 21 days before the work is to be inspected and / or tested.

3.1.18.2 If the Contractor is in any doubt whether any inspection and/or test is required by the ENGINEER as a Quality Hold Point, the Contractor shall request that the ENGINEER clarifies his requirements prior to submitting the relevant prior to commencement of any tests inspection and Testing Plan for Notice of No Objection, and in any event not later than 30 days prior to commencement of any tests,

3.1.18.3 Timing for Inspection and/or Test by ENGINEER.

1) The Contractor shall allow the Employer and the ENGINEER a reasonable time to carry out any inspection and/or testing and to assess the result of any inspection and/or test before proceeding with the Works.
2) Unless the ENGINEER's prior Notice of No Objection has been obtained, all inspections and/or tests to be carried out or witnessed by between week the Employer and the shall be carried out between 0800 and 1800 hours between Monday to Friday.

3.1.18.4 Failure to Notify the ENGINEER.

The Employer or the ENGINEER may reject the test and test results in question, and require the test to be repeated in the event of any failure by the Contractor to notify the ENGINEER.

3.1.18 **Failures**

3.1.19.1 The Contractor shall correct all faults found during testing, and shall arrange for the relevant tests to be repeated. The relevant tests shall only be repeated when the fault has been remedied and the equipment confirmed and determined to function correctly.

3.1.19.2 Where remedial measures involve significant modifications that might, in the opinion, affect the validity of earlier tests, the Contractor shall repeat any earlier tests and obtain results satisfactory to the before repeating the test in which the fault was first identified.

3.1.19.3 The ENGINEER has the right to order the repeat or abandonment of any test in the event that results demonstrate that the equipment is significantly non-compliant with the Contract.

3.1.19.4 The have the right to suspend any test in the event that errors or failures have become unacceptable. They also have the right to suspend any test if a fault was detected by the Contractor but not reported to the 24 hours of the detection. In this event, the suspension shall remain in effect until reporting has been brought up to date to the satisfaction of the ENGINEER.

3.1.19 **Repeat Tests**

3.1.20.1 The Contractor shall correct and re-test every fault detected during the tests.

3.1.20.2 If the test results in a failure of the item under test the provisions of GCC clause 23 shall apply.

3.1.20 **Fault Log**

3.1.21.1 The Contractor shall maintain a fault log throughout each series of tests. Every fault detected during the tests will be entered in the log, together with the actions taken to clear and re-test the fault.

3.1.21.2 The fault log will be retained as part of the permanent Quality Assurance records for the system and shall be subject to regular inspection by the ENGINEER.

3.1.21 **Hardware Failure Reports**

3.1.22.1 For each hardware failure that occurs at any stage of testing, the Contractor shall investigate the failure and prepare a report on its cause(s) and design implications, if any, resulting from such failure. The report shall clearly show:

1) The observed symptoms;
2) The most likely cause of the failure;
3) The fault category
4) An analysis of any stress that may have been caused to other components of the equipment being tested as a result of the failure;
5) Whether the failure is a result of any component operating outside its design range; and
6) Whether any design changes should be made to avoid further failures.

3.1.22.2 All such reports will be retained as part of the permanent quality assurance record for the system, which shall be subject to inspection by the ENGINEER.

3.1.22 Software Failure Reports

3.1.23.1 For each software failure that occurs, once the software has been given a Notice by the Engineer inclusion into the system and is subject to configuration control, the Contractor shall generate a software failure report.

3.1.23.2 All such reports will be retained as part of the permanent Quality Assurance records for the system, which shall be subject to inspection by the ENGINEER.

3.1.23.3 The report shall clearly show:

1) The observed symptoms;

2) The likely cause;
3) The fault category and
4) The operator input.

3.1.23.4 The report shall also clearly show the following information which shall be entered when the failure has been investigated and solved:

1) The actual cause of the failure;
2) The corrective action taken; and
3) All software modules affected.
4) Declaration the problem has been solved and the software is working correctly.

3.2 Technical Specifications

3.2.1 Design criteria – Ventilation and Air-Conditioning

3.2.1.1 General.

This technical Specification describes the requirement of the VAC to provide a comfort and Pollution-free environment requirement for the Depot of the proposed MML3.

3.2.1.2 Design Parameters for the VAC

The VAC design parameters are mentioned in below table.

A	**Outside ambient conditions based on ASHRAE recommended design conditions for 2% criteria as under :**		
	Summer		
	Dry Bulb Temperature	:	33.9° C
	Wet Bulb Temperature	:	24° C
	Monsoon		
	Dry Bulb Temperature	:	30.9° C
	Wet Bulb Temperature	:	27.1° C
B	**Duct sizing**		
	Pressure loss	:	0.8 -1.2 Pa/m for Equal Friction Method.
	Velocity	:	Refer ASHRAE Application handbook, Chapter Sound and Vibration control.
C	**Pipe sizing**		
	Velocity	:	≤ 2.5 m/s

Note: Latest ASHRAE Standards shall be followed.

3.2.1.3 Design Criteria of Air Conditioning System

a System Description

The overall aim of the Air conditioning system is to create:

- A safe and pleasant environment for staff, visitors and equipment rooms.
- A minimum adverse impact on the local environment.
- Heat removal from the equipment.

b System Design

The design parameters for Depot auxiliary rooms, office spaces, (where applicable) are as described hereunder:

Heat gains in Depot rooms and other areas are attributable to the following sources:

- Staff
- Lighting

- Equipment
- Outdoor air
- Solar Load
- Heat Transmission through walls

c Equipment shall include items such as Signalling & Telecommunication equipment, Lifts & escalators, Electrical panels, and other similar equipment.

d Air conditioning loads shall be based on the actual occupancy, lighting, equipment and any other internal loads. The DDC shall ascertain the data during co-ordination with the respective system-wide contractors.

e **Lighting Load**

The following lighting load values shall be used in the calculation of the cooling loads requirements, which shall be coordinated and checked with the respective contractors.

Equipment Room : 15 W/m²
Offices : 20 W/m²

f **Equipment Load**

Shall be coordinated with respective contractor.

g **Fresh Air Supply**

Fresh air supply of 5 L/s per person or based on ASHRAE, whichever is higher shall be used.

h **Peak Cooling Load**

The peak cooling load shall be used in the cooling load design calculations.

Table 3.1: Rooms with air-conditioning facility :

3.1.A OCC BUILDING

	Room Name	Design Temp °C	Relative Humidity %	A/C	Standby unit
GROUND FLOOR					
1	Administration	24	55	●	
2	Pay way Office	24	55	●	
3	Telecom Hub - 1	22	55	●	●
4	Telecom Hub - 2	22	55	●	●
5	BMS (Building Management System)	24	55	●	●
6	Security	24	55	●	
FIRST FLOOR					
1	Admin	24	55	●	
2	Depot Signalling Maintenance Office	24	55	●	
3	Depot Telecom Maintenance Office	24	55	●	-
4	Conference	24	55	●	
5	Telecom Hub 1	22	55	●	●
6	Telecom Hub 2	22	55	●	●
7	AFC CCU	22	55	●	●
8	RS office	24	55	●	-
9	PSD Office	24	55	●	-
10	Spare Office	24	55	●	-
11	Office	24	55	●	-
12	RS Simulator	24	55	●	-
13	PTR,ATS,M.E,SCADA, Simulator	24	55	●	-
14	PSD Equipment store	24	55	●	
15	Telecom electronic store	24	55	●	
16	Signalling Equipment Store	24	55	●	
17	Library	24	55	●	
18	Principal	24	55	●	
19	Admin	24	55	-	-
20	Staff Office	24	55	●	-
23	Training Room – I	24	55	●	-
24	Training Room – II	24	55	●	-
25	Training Room – III	24	55	●	
26	Training Room – IV	24	55	●	

	Room Name	Design Temp °C	Relative Humidity %	A/C	Standby unit	
SECOND FLOOR						
1	Head of Security	24	55	●		
2	Dy. Head of Security	24	55	●		
3	Security Room	24	55	●		
4	OCC Theatre	24	55	●		
5	NMS Room	24	55	●	-	
6	Incident Management	24	55	●	-	
7	Operation Manager			-	-	
8	OCC Theater Lobby	24	55	●		
9	Tele Hub-1	22	55	●	●	
10	Tele Hub-2	22	55	●	●	
11	Central Equipment Room	24	55	●	●	
12	S&T UPS	24	55	●	●	
13	S&T UPS Lab	24	55	●		
14	UPS Data Room OA/IT	22	55	●	●	
15	Server OA/IT Room	24	55	●	●	
16	Meeting Room	24	55	●		
	UPS Room - 1	24	55	●	●	
17	UPS Room - 2	24	55	●	●	
18	Signalling Equipment Room	24	55			
19	ATP/ATO	24	55	●		
20	Telecom Lab	24	55	●		
21	SSL Lab	24	55	●		
22	PSD Lab	24	55	●		
23	Signalling Lab	24	55	●		
24	STPT Staff	24	55	●		
25	SSI(Solid State Interlocking) Testing	24	55	●		
THIRD FLOOR						
1	Visitors Gallery	24	55	●	-	
2	Training Room	24	55	●	-	
3	Tele Hub	22	55	●	●	
4	AFC PTR	24	55	●	●	
5	AFC workshop	24	55	●	-	
6	Ticket Printing Room	24	55	●	-	
7	Electronic Card Repair	24	55	●		
8	Operation Staff	24	55	●		
9	Maintenance Simulator - 1	24	55	●		
10	Maintenance Simulator -2	24	55	●		
11	Maintenance Simulator - 3	24	55	●		
	Room Name	Design Temp. °C	Relative Humidity %	A/C	Standby Unit	

12	Maintenance Simulator -4	24	55	●	
13	Maintenance Simulator -5	24	55	●	
14	Maintenance Simulator - 6	24	55	●	

3.1.B WORKSHOP BUILDING

	ROOM NAME	Design Temp °C	Relative Humidity%	A/C	Standby unit
GROUND FLOOR					
1	Telecom Equipment Room	24	55	●	●
2	Signalling Equipment Room	24	55	●	●
3	First Aid Room	24	55	●	
4	Supervisor Room	24	55	●	
5	First Aid Room	24	55	●	
6	Security Room	24	55	●	
7	Daily Meeting Room	24	55	●	
8	Supervisor Room	24	55	●	
FIRST FLOOR					
1	Depot Control Room	24	55	●	●
2	UPS	24	55	●	●
3	Electronic Card Workshop	24	55	●	
4	Train Bound Signalling Workshop	24	55	●	
5	Records Office	24	55	●	
6	Chief Workshop Manager	24	55	●	
7	Asst Manager	24	55	●	
8	Office	24	55	●	
9	RS Maintenance	24	55	●	
10	Engineer Office	24	55	●	
11	Depot Mechanical Engineer	24	55	●	
12	Depot Electrical Engineer	24	55	●	
13	Technical Staff	24	55	●	
14	Manual Library	24	55	●	
15	Dining Hall	24	55	●	
16	Meeting Room	24	55	●	
17	Meeting Room	24	55	●	
18	Dormitory	24	55	●	

Note: Quantity of rooms shall be as per approved architectural layout.

3.2.1.4 Design Criteria of Ventilation System

a Mechanical ventilation loads shall be based on the actual occupancy, lighting, equipment and any other internal loads. The designers shall determine the remaining data during co-ordination with the appropriate system-wide contractors.

3.2.1.4.1 Auxiliary Rooms Ventilation System

a The rooms located in depot building shall be provided negative air pressure when the room temperature reaches more than 5°C of the ambient temperature. The exhaust fan shall be energised by temperature sensors accordingly. The purpose of auxiliary Ventilation system is to

maintain the pressurization in the room, indoor air quality that will be acceptable to human occupants and equipment reliability. Auxiliary ventilation system design parameters are mentioned in Table 3.2 below.

b Toilet, Pantry, Store & Other room Mechanical Ventilation System

The above Auxiliary rooms in Depot building shall be provided with exhaust mode ventilation. Replacement air shall be induced through louvers at the doors. The design parameters are mentioned in Table 3.2 below.

Table 3.2: Rooms with Ventilation

3.2.A: OCC Building

S.no	Room Name	No. Of Air changes Per hour (ACPH)	Natural Ventilation Supply	Mechanical Ventilation Supply	Mechanical Ventilation Exhaust	Pressurization
Ground Floor						
1	Dining (Canteen)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
2	ASS 1&2(Auxilary Sub Station)	-	•	-	•	-Ve
3	Toilets (Gents)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
4	Toilets (Ladies)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
5	Toilets (Handicapped)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
6	Kitchen	As per ASHRAE standard	•	-	•	-Ve
7	Toilets (Gents)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
8	Toilets (Ladies)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
9	Toilets (Handicapped)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
10	Track Workshop & Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
11	Electrical	-	•	-	•	-Ve
12	PSS, OCS Workshop & store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
13	TVS & ECS Workshop & store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve

S.no	Room Name	No. Of Air changes Per hour (ACPH)	Natural Ventilation Supply	Mechanical Ventilation Supply	Mechanical Ventilation Exhaust	Pressurization
14	E&M Pumps & store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
15	L&E Workshop & store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
16	PSD Workshop & store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
17	Light Electrical workshop & Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
18	STPT workshop & Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
19	Electrical Room	-	•	-	•	-Ve
First Floor						
1	Document Control	-	•	-	•	-Ve
2	Gents Toilet	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
3	Ladies Toilet	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
4	Toilets (Handicapped)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
5	Store/Pantry	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
6	Electrical Panel	-	•	-	•	
6	MEP L&E Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
7	Toilets (Gents)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
8	Toilets (Ladies)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
9	Toilets (Handicapped)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
10	Tool Room	-	•	-	•	-Ve

S.no	Room Name	No. Of Air changes Per hour (ACPH)	Natural Ventilation Supply	Mechanical Ventilation Supply	Mechanical Ventilation Exhaust	Press urizati on
Second Floor						
1	Spare 2	-	•	-	•	-Ve
2	Emergency PSI Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
3	Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
4	Electrical Panel	As per ASHRAE standard	•	-	•	-Ve
5	Toilets (Gents)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
6	Toilets (Ladies)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
7	Toilets (Handicapped)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
8	UPS Testing	-	•	-	•	-Ve
9	Heavy Equipment	-	•	-	•	-Ve
10	Spare1	-	•	-	•	-Ve
11	Toilets (Gents)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
12	Toilets (Ladies)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
13	Toilets (Handicapped)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
14	Pantry	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
15	Pantry	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
Third Floor						
1	Electronic Card Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve

S.no	Room Name	No. Of Air changes Per hour (ACPH)	Natural Ventilation Supply	Mechanical Ventilation Supply	Mechanical Ventilation Exhaust	Press urizati on
2	AFC Indoor store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
3	Electrical Panel	-	•	-	•	-Ve
4	Toilets (Gents)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
5	Toilets (Ladies)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
6	Toilets (Handicapped)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
7	Toilets (Gents)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
8	Toilets (Ladies)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
9	Toilets (Handicapped)	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
10	ECS Plant Room	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve

3.2.B :Workshop Building

	Room Name	No. Of Air changes Per hour (ACPH)	Natural Ventilation Supply	Mechanical Ventilation Supply	Mechanical Ventilation Exhaust	Pressurization
GROUND FLOOR						
1	Battery Shop	As per ASHRAE standard	•	-	•	-Ve
2	Tool Room	As per ASHRAE standard	•	-	•	-Ve
3	House Keeping	As per ASHRAE standard	•	-	•	-Ve
4	Electric Module	As per ASHRAE standard	•	-	•	-Ve
5	IBL Store	As per ASHRAE standard	•	-	•	-Ve
6	Toilet-1	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
7	Electric Panel Room	As per ASHRAE standard	•	-	•	-Ve
8	Compressor Room	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
9	Paint Booth	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
10	Brake Cylinder Section	As per ASHRAE standard	•	-	•	-Ve
11	Bogie Wash	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
12	Manual Wash	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
13	Toilet-2	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
14	R.B. Section	As per ASHRAE standard	•	-	•	-Ve
15	Central Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve

S.no	Room Name	No. Of Air changes Per hour (ACPH)	Natural Ventilation Supply	Mechanical Ventilation Supply	Mechanical Ventilation Exhaust	Press urizati on
FIRST FLOOR						
1	Spare Room	As per ASHRAE standard	•	-	•	-Ve
2	Electronic Store	As per ASHRAE standard	•	-	•	-Ve
3	Spare Room	As per ASHRAE standard	•	-	•	-Ve
4	Toilet	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
5	Toilet	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
6	Locker Room	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
7	Dinning Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve
8	Central Store	As per NBC 2016 Clause No. 5.2.2.1	•	-	•	-Ve

Note: Wherever natural ventilation is not feasible due to location of room, mechanical ventilation shall be provided.

Mechanical ventilation loads calculated based on lighting, equipment and any other internal loads shall be checked with the above table and the higher capacity shall be considered in the design of ventilation system.

Staircase pressurization shall be as per ASHRAE, NFPA and local fire department standard.

3.2.1.5 Depot Smoke Extraction System

In case of fire, the smoke extraction is done by Smoke exhaust fans through the fire rated duct of the individual rooms. The discharge ducts of the smoke extraction fans shall be terminated to the ventilation shafts of the depot or to the atmosphere depending on the fans' location.

3.2.1.6 Control and Monitoring of Smoke Control System

The smoke control system shall be controlled and monitored by the BMS through PLCs in the depot building.

The status of smoke dampers, motorized fire damper, Pressurisation fans and smoke extraction fans shall be monitored.

In addition, a Smoke Control Panel (SCP) shall be provided next to the Main Alarm Panel for monitoring and activation of the smoke exhaust/control/purging system, firemen stairs, exit passageways, service corridors and fire pump rooms fans.

3.2.2 Air Handling Units

3.2.2.1. General

This section specifies the requirements for providing Air Handling Units (AHU) and appurtenances as specified herein.

3.2.2.2. Quality control

a Reference Standards:

Standard	Standard no.	Description

AFBMA		Anti-Friction Bearings Manufacturers Association
	AFBMA 9	Load Rating and fatigue Life for Ball Bearing
	AFBMA 11	Load Ratings and Fatigue Life for Roller Bearings.
ANSI		American National Standards Institute
	S 12.34	Survey Methods for Determination of Sound Power Levels of Noise Sources.
ARI		American Refrigeration Institute
	ANSI/ARI 430-89	Central Station Air-Handling Units
	ANSI/ARI 410	Coils
ASTM		American Society For Testing and Materials
	A 123	Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.
	A 239	Locating the Thinnest Spot in Zinc (Galvanized) Coating on Iron or Steel Articles by the Peerce Test (Copper Sulphate Dip).
	A 525	Steel Sheet, Zinc Coated (Hot Galvanized) by the Hot-Dip Process.
	A 588	High Strength Low Alloy Structural Steel with 345 MPa Minimum Yield Point to 100 mm Thick.
	B 247	Certification for Aluminium Alloy Die Forgings, Hand Forgings and Rolled Ring Footing.
	B 686	Aluminium Alloy Castings, High Strength
	E 94	Radiographic Testing.
	E 155	Reference Radiographs for Inspection of Aluminium Magnesium Castings.
AWS		American Welding Society
	D1.1	Structural Welding Code - Steel.
	D1.3	Structural Welding Code - Sheet Steel.
EN		European Standards
	EN 1886	Unit Performance, coil performance and Mechanical Strength
EUROVENT		Eurovent Certified Performance

b Manufacturer's Qualifications

The AHU manufacturer shall show at least five years of continuous and current experience in the design, manufacture, assembly, and testing of AHU's. Unit Performance, coil performance and Mechanical Strength shall be certified with EUROVENT.

c Submittals

i Before providing the AHU manufacturer with Notice to Proceed, the Contractor shall submit the technical submittal to the Engineer for his review and consent, evidence of the manufacturer's qualifications including, but not limited to the following data:

- Theoretical fan-motor composite performance curves of the AHUs proposed to be furnished under this Contract.
- Fan sound power levels in decibels shall be submitted as hereinafter specified. Sound power levels at design airflow capacity shall not exceed the listed values on the fan schedule shown at each octave band.
- Manufacturer's quality assurance program.
- List of components proposed to be purchased from other manufacturers, giving name of manufacturer, type and characteristic of each item and applicable data requested.

- List of projects on which similar equipment have been supplied shall be furnished. List shall include:
- Name of owner or user
- Contract number
- Original installation date
- Current condition of equipment
- A list of all known failures for the past two years, including their apparent causes, corrective work effected (including design change), and a description of equipment service operating conditions.

ii On receipt of Notice of no objection from the Engineer the Contractor shall submit the following for the Engineer Review and consent:

- Certified shop drawings for AHUs, fans, motors, fan-motor unit bases, installation drawings, installation instructions, dimensioned drawings for anchor bolt locations, and any additional data required to demonstrate compliance with Contract documents.
- Certificate of Compliance signifying that equipment to be furnished under this Contract meets the requirements specified herein. Shop drawings shall indicate weight of each component.
- Data on motor bearing lubricant.
- Factory and field-test procedures.
- List of technical support items specified and list of any additional support items required.
- AHU disassembly and reassembly instructions.
- Procedures for separately removing and replacing motor coil and filter, as well as procedures for removing a complete fan-motor unit without disassembly.

iii After successful completion of tests specified herein and of any additional tests conducted at the Contractor's own option, Contractor shall submit the following:

- Certified test results for all factory tests conducted. All test data shall be bound in one report. The test report shall be indexed and cross-referenced in an easily understood manner.
- All records and results of non-destructive examinations made at completion of each examination.
- Field test results

3.2.2.3. Technical and installation requirements

a General

The air handling units shall be of double skin construction, draw through type and shall include filter section, fan and coil section.

The units shall be insulated to prevent heat loss, to eliminate panel sweating and to provide a moisture free unit with thermal break profile.

The units shall be provided with the access doors with lookout glass for filter removal and to facilitate easy access to internal components for maintenance and repairs or replacement.

The units shall be provided with drain pan of heavy gauge Stainless steel (SS-316) completely rust and corrosion proof and thermally insulated.

The units shall be of a panelised construction fabricated with heavy gauge steel suitably welded and reinforced to provide a rigid assembly. The complete units shall be absolutely rust free.

Unit's ships in sections shall have a minimum of four points of lift. These lift points shall be designed to accept standard rigging devices.

b Fan and Accessories

The fan shall be Plug/Plenum type with backward inclined aerofoil centrifugal fan. Fans shall be of non-overloading design. The wheel shall be fabricated from heavy gauge galvanised steel. The fan impeller shall be mounted on a solid shaft supported on angle iron heavy-duty ball bearing. The fan shall be selected for a speed not exceeding 1800 rpm. The impeller & fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not exceed 12.7 m/s. Fan with motor shall be mounted on a common extruded aluminium base frame mounted on anti-vibration springs mounts. The fan outlet shall be connected to casing with fire retardant double canvass. The opening for the access of the fan section shall be provided with micro-switch and galvanised iron mesh. The AHU air outlet shall be provided with a motor operated damper (MOD).

Coils shall be supplied by the supplier of the AHU. Coils shall be removable by unbolting the panels in the coils section. The cooling coil shall be of seamless copper tubes, not less than 0.5 mm thick and minimum 12 mm O.D. The bends shall be ready made with solder rings on both ends. The coil shall have continuous aluminium dual sine wave fins. Having minimum thickness of 0.15 mm and having hydrophilic coating. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of airflow. The fins shall be uniformly bonded to the tubes by mechanical expansion of the tubes. The coils shall be designed to operate at 17.5 kg/cm² working pressure and 150°C temperature and shall be tested against leaks at a pressure not less than 23 kg/cm² compressed air under water. This pressure shall be maintained for a period of 2 hours. No drop should be observed indicating any leaks. The water headers shall be of copper pipes, to connect all the tubes. The headers shall be complete with water In/Out connections, vent plug on top and drain at the bottom. Drainpipe should be of GI and insulated with minimum 20mm thick closed cell Nitrile rubber insulation. Coil tube water velocity shall not exceed 2.5 m/s. The coil size shall be designed at an operating air velocity not more than 2.5 m/s. The coil frames should be of SS-304.

The AHU shall be provided with twin fan design (working and standby arrangement) which allows the standby fan to be activated upon failure of the working fan.

c Filtration

Each AHU shall have two types of filters conforming to the specifications given under:

i. High Efficiency washable Pre filters of 90% efficiency down to 10 micron particle size with aluminium frame.

ii. Washable Bag filter shall be provided with 85% efficiency down to 3 micron particle size. Both filter cartridge and frame shall be fabricated by one manufacturer. Air filter holding frame shall be constructed of light weight, durable extruded aluminium frame. The framing members shall be permanently gasket to prevent the bypass of unfiltered air. The percentage of open area of the full size cartridge face shall not be less than 90% of the total face area. Air filter cartridge shall be constructed in a configuration to provide uniform dust loading throughout the full net effective media area. Air flow velocity across filter shall be uniform as measured at any point of the cartridge. Face velocity for all bag filters shall not be greater than 2.5 m/s. Initial resistance at 2.5 m/s face velocity shall not exceed 80 Pa. It shall be designed such that no sagging and flipping of filter is allowed.

iii. For detailed specification of filters see annexure-A to specifications

d Drain pan

The drain pan shall be construction of 18 Gauge stainless steel (SS-316) sheets, externally insulated with 12 mm thick closed cell polyethylene foam insulation with necessary slope to allow for proper condensate removal.

e Coil and filter housing

The cooling coils, special and standard filters, etc., shall all be housed in a separate enclosure of suitable size and length. The inspection doors shall have neoprene rubber T-section, rubber seals, hinges and locking arrangements. The gaps between filter frames and housing shall have synthetic rubber/EPDM packing, to eliminate any air leakage. All filter frame shall of SS-304 and be epoxy painted. The flat filter section shall be suitable for mounting filters vertically.

f Heat pipe heat exchanger

Heat pipe shall be included within the AHU and wrapped around the chilled water coil.

i A minimum 200mm gap shall be allowed between the leaving face of the cooling coil and the entering face of the heat pipe reheat section

ii The external fins shall be aluminium with a minimum thickness of 0.15mm.

iii Tubes shall be refrigerant standard seamless copper C106 for heat exchanger use. Tube diameter shall be minimum 12 mm with a grooved inner surface.

iv Casings shall be from galvanized sheet steel with a minimum thickness of 1.6mm. Casing shall incorporate tube plates and top and bottom plates around both the pre cool and reheat pipe blocks.

v The working fluid shall be refrigerant type classified as ASHRAE safety group AI. The refrigerant shall be R134A.

vi

g AHU enclosure/housing

The AHU enclosure shall be double skin design with the mainframe work made of extruded aluminium thermal break structural section.

Casing shall be of panel construction; double wall type packed with pressure injected CFC free foam insulation minimum 50mm thick between the walls. Outer skin shall be minimum 1.0 mm galvanized steel sheet while inner skin shall be minimum 1.2 mm galvanized steel sheet. The sheet should have a minimum galvanisation of 275 GSM and should be pre coated on the exposed side. The inner skin is required to be epoxy painted on the exposed side.

Each section shall be provided with separate access panel of suitable size. The access panel shall be hinged type with heavy-duty stainless steel hinges and handles made of nylon. The handles shall be self-tightening type to ensure leak proof closing. The access door should have provision of look out glass.

The opening for access doors and gaps between sections shall be provided with the neoprene rubber double ripped/T-gaskets fixed in grooves in the extruded sections.

The sandwich panels shall be bolted from inside on to the framework with soft rubber gaskets in between to make the joints airtight. All fasteners used should be of stainless steel.

Details of AHU Access Door, Air Vent, Drain Plug for Coil Header, and door guard to be provided in the submittal.

h Fan motor & starter

The fan shall be provided with a totally enclosed fan cooled squirrel cage motor. The starter rating shall match the motor rating and will conform to specifications under "motor and switch gears. The motor shall be of high efficiency class i.e. EFF-1.

Motors shall be mounted on the fan shaft.

Motor shall comply with NEMA MG-1

Motor bearing L10 life shall be of 40,000 hours.

i Accessories

Each air-handling unit shall be complete with the following accessories:

- Stem type thermometers at coil inlet and outlet, with thermo well.
- Pressure gauge with cock at inlet & outlet of the coil, with tubing and gauge cocks.
- Butterfly valves at inlet & Outlet of the coil and balancing valve at outlet of coil.

- Two way motorised valve
- Y type strainer
- GI Drain line with trap seal from the unit up to floor trap.
- Automatic air vent and drain valves on pipes.
- Fire retardant Flexible connection between the fan outlet and duct.
- Vibration isolators of 90% efficiency between AHU and foundation.

j Unit paint

Units supplied with casing exterior factory painted shall able to withstand a salt water spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours.

Unit casing exterior shall be provided with standard colour as approved by the Engineer.

k Limitations

- The air velocity across the cooing coil shall not exceed 2.5 m/sec.
- The fan outlet velocity shall not exceed 15 m/sec.
- The air velocity across the filters shall not exceed 2.5 m/sec.
- Fin spacing shall be 11 to 13 fins per inch.
- Coils shall not have more than 8 rows deep.
- Air pressure drop through the coil shall not be more than 250Pa.

3.2.2.4. Testing

a Testing of AHU shall be done based on BS-EN for the AHU, AMCA for the fans and ARI for the coils.

b Cooling coils testing

- Identification of materials. The physical & chemical test certificates shall be submitted for consent of the Engineer.
- Checking of mechanical bonding of fins to tubes. The detailed procedure as per governing international standards shall be submitted to the Engineer for consent.
- Pneumatic pressure test on coil as per latest governing International Standards.
- Dimensional check.

c Inspection during assembly of components for quality of workmanship, painting etc. and final check of AHU and performance test at factory shall be witnessed by the Engineer.

d Cooling capacity shall be computed from measurements of air flow and dry and wet bulb temperature of air entering and leaving the coil. Flow measurements shall be by accurate digital anemometer and temperature measurements by accurately calibrated digital thermometer / Sling psychometer. Cross checks will be carried out by measurement of water flow rate and temperature differential across the coil with designed full water flow through the coil. The design should be verified by the computed results.

3.2.2.5. UVC Emitters

a General requirements

Supply, Installation, Testing and Commissioning of Emitters System suitable for mounting in AHUs to reduce mold and fungus growth on the coil and keep the coil surface clean eliminating need for coil cleaning programme.

Shall be double ended type. Each component and product is to be inbound and outbound tested before shipment under Mil Standard 105E and ANSI.

Tested in accordance with the general provisions of IES Lighting Handbook, 1981 Applications Volume, total output per one inch are length shall not be less than 10µW/cm² , at one meter, in a 400 fpm air stream of 45 Deg. F.

b Design requirements

Irradiation – Emitters and fixtures are to be installed in sufficient quantity and in such an arrangement so as to provide an equal distribution of UVC energy on the coil and in the drain

pan. To maintain energy efficiency, the UVC energy produced shall be of the lowest possible reflected and shadowed losses.

Intensity – shall be measured by a Solid State Photodiode UV Sensor at the coil. Calibration wavelength is 254 mm. Accuracy is to be ± 10%. Operating range shall be 0°C - 70**°C**. Read by a display module with a 3.5 digit LCD screen / panel. Irradiance range shall be 0-1999 (x10) W/ cm^2 with a resolution of 10µW/ cm^2.

Installation – Emitters and fixtures shall be installed downstream of the cooling coil at right angles to the coil fins, such that UVC energy bathes all surfaces of the coil and drain pan. The wiring kit for emitters shall be supplied by manufacturer / strategic business partner / authorized dealers of manufacturer / business partners only.

c Equipment

Units shall be high output, HVAC type, and germicidal UVC light sources, factory assembled and tested. Components shall include a housing, reflector, high efficiency electronic power source, Emitter sockets and Emitter tube, all constructed to withstand HVAC environments.

Double ended Unit housings shall be made of 304 stainless steel with Units having electrical connectors on both ends to simplify gang wiring and wiring to power. They shall include mounting holes to assist in securing the fixtures.

DE reflectors shall be constructed of high spectral finished aluminium alloy with a minimum 85% reflectance of 254 mm UVC energy.

The Emitters shall be designed to operate at 230 V ac/ 50 Hz with a high p.f. They shall be UL listed to comply with UL Standard 1995 and capable of igniting each Emitter at temperatures from 35 – 170 Def. F in airflow velocities to 1000 fpm. They shall be equipped with RF and line noise suppression.

Emitter tube shall be of the high output, hot cathode, T5 (15mm) diameter, and medium bi-pin type. They shall produce 95% of their energy at 254 mm and be capable of producing the specified output at airflow velocities to 1000 fpm at temperatures of 0°C - 77**°C**. UVC Emitters shall not produce ozone or other secondary contamination.

d Installation of UVC Emitters

Sufficient No. of Emitters shall be installed on each coil.

An interlock switch shall be provided on each access door to the UVC Emitters to turn the lights off when the access is opened.

Proper Caution Labels shall be installed on all accesses to the Emitters when installed.

The transformer rectifier must be protected against weather when installed outdoor and its housing shall meet at least IP54 standard.

Power input to the transformer rectifier shall be single phase 230 V, 50 Hz AC. Supply whereas the continuous DC Output from the transformer rectifier must have the maximum capacity of 30 Volt, 3 Amp. For safety reason, DC voltage higher than 30 Volt is not acceptable. However, the transformer rectifier rating must be capable of withstanding the continuous maximum current output of 3 amps.

3.2.3 Fan Coil Units

3.2.3.1 General

This section specifies the requirements for furnishing fan coil units and appurtenances as specified herein. Fan coil units shall be the product of a single Manufacturer whose name shall appear on all the submittals.

3.2.3.2 Quality control

a Reference standards:

Standard	Standard no	Description
ACGIH		**American Conference of Governmental Industrial Hygienists**
		Industrial ventilation: a manual of recommended practice, 23rd edition (1998) – Installing fan coil units.
ARI		**American Refrigeration Institute**
	ARI 440-97	Room fan coils and unit ventilators
ASHRAE		**American Society of heating, refrigeration and air-conditioning Engineers**
	Method of testing for rating room fan coil air conditioners ASHRAE 52.1-1992	Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
BS		**British Standards**
	BS 476: Part 6	Fire Tests on Building Materials and Structures
	BS 4856	Methods of Testing and Rating Fan Coil Units; Unit Heaters and Unit Coolers
NFPA		**National Fire Protection Association**
	NFPA 90A	Installation of Air-Conditioning and Ventilating System
UL		**Underwriter's Laboratories**
	UL 883	Fan-Coil Units and Room Fan-Heater Units

b Manufacturer's qualifications

The fan coil units Manufacturer shall show at least Five years of continuous and current experience in the design, assembly and testing of fan coil units.

c Submittals

Submit the following to the Engineer for review and obtain notice of no objection:

i. Dimensioned shop drawings of FCU showing material of construction of each component
ii. Technical data sheet of FCU giving the sound level, air quantity and power consumed at all the three speed at the stated static pressure and the cooling capacity at the rated conditions indicated.
iii. Manufacturer's quality assurance program
iv. Certificate of compliance that the design and fabrication of the FCU to be furnished under this Contract meets the requirements specified herein
v. Include data substantiating that materials comply with the requirements of the various standards as specified

vi. After successful completion of factory tests specified herein and of any additional tests conducted at the Contractor own option, the Contractor shall submit the following:

- Certified test results for all factory tests conducted. All test data shall be bound in one report. The test report shall be indexed and cross-referenced in an easily understood manner.
- All records and results of non-destructive examinations made at completion of each examination.
- Field test results

3.2.3.3 Technical and installation requirements

3.2.3.3.1 General

a The FCU shall be complete in all respects and shall generally comply with the specifications as given hereunder.

b The FCU casing shall be of double skin construction concealed ceiling mounting type complete with finned coil, fan section with motor, drain pans, air filters, filter box, etc. Inner skin & Outer skin thickness should be 1.2 mm & 1 mm of Powder coated sheet steel.

c All fan coil units shall be demountable from the ceiling void for maintenance purposes without causing damage to the associated ductwork and insulation

d All fan coil units shall be selected to suit the limited space within the false ceiling with due considerations to access for maintenance and servicing. Coordinate with all involved parties on Site for the provision of maintenance access panels for the units mounting inside false ceiling.

e The drain pan details, control details, installation details, operation & maintenance manual shall be submitted along with the proposal.

3.2.3.3.2 Cooling coil

a The coil shall be 4 or 6 rows deep, of seamless copper tubes not less than 10mm O.D. and 0.5 mm thick encased in SS-304 frame and having copper headers.

b The coil shall have continuous aluminium fins having minimum thickness of 0.15 mm.

c The fins shall be spaced by collars forming integral part of the fins. The fins shall be uniformly bonded to the tubes by hydraulic expansion of the tubes.

d The tubes shall be staggered in the direction of air flow.

e The coil circuit shall be sized for adequate water velocity but not exceeding 1.8m/s. The coils shall be tested against leaks at a hydraulic pressure of 21.0kg/cm². This pressure shall be maintained for a period of 2 hours. No drops shall be observed indicating any leaks.

3.2.3.3.3 Fan and motor

a This shall consist of aluminium impeller of forward curved type, both statically and dynamically balanced, along with properly designed GI casing.

b Maximum noise level acceptable shall be 50 dB at a distance of 1.5 m from fan.

c The two impeller shall be directly mounted on to a double shaft, single phase, and multiple winding motor, capable of running at three speeds.

d Motor shall be capable of providing at least 3 fan speeds ('LOW-MEDIUM- HIGH') and shall be of adequate capacity to prevent over-loading at any speed and duty of the fans. Each fan coil unit shall be equipped with a three-speed fan switch ('LOW-MEDIUM-HIGH') and ON/OFF switch for the fan control.

e Motor shall be of the permanent split-capacitor type for direct-on-line starting, and factory wired to a terminal block inside a factory installed junction box. Motor shall be provided with UL listed thermal overload protection. Motor windings and electrical components shall be impregnated or protected to avoid trouble from condensation.

f Connection unit or socket outlet shall be provided near each fan coil unit. Location of these electrical power points shall be coordinated so that the connection unit or socket outlet shall be positioned within 1 m from the fan coil unit.
g Electrical wiring connection including cables and wiring accessories between the connection unit or socket outlet and the fan coil unit shall be provided.
h Electrical cables or wiring installed outside the casing and inside the air stream shall be protected by metallic flexible conduit.

3.2.3.3.4 Drain pan

a Every fan coil unit shall be provided with a drain pan that shall be situated beneath the coil and arranged so that all moisture will be collected in the pan. The pan shall project under the entire length and width of the coil including all headers and bends.
b The drain pan shall be of double skin construction with 15mm nitrile foam/PUF insulation sandwitched between 22 G outer and 18 G inner pans of SS-316 accommodating coil connections, valves, and shall be complete with drain connections.
c The FCU shall also be provided with an additional secondary drain pan of 18 G SS (SS-316) sheet duly epoxy coated/FRP lined from inside.
d Each drain pan shall be fitted with an insulated drain pipe which shall be connected via suitable runs correctly laid to fall to the drainage system. Drain pans shall have copper male connectors for connection to the condensate drainpipes. The frame and drain pipe should be of SS-316.
e The drain pipe should connect to the nearest drain point in the room to be provided by other contractor.
f Drain pans shall be large enough to collect all condensate from the coils, return bends and pipe work connections. For units catering for load including a high proportion of latent heat, the size of the drain connection shall be adequate to deal with the condensate.

3.2.3.3.5 Air filter

a The filters shall be washable fibre glass/polypropylene air filters with anodised extruded aluminium frames mounted behind the fans in a filter box made of GI sheets.
b The efficiency of filters shall be 90% down to 10 microns

3.2.3.3.6 Water connections

a The water lines shall be finally connected to the coil of the fan coil unit by at least 300 mm long type L, seamless, solid drawn copper tubing, with flare fittings and connections
b The water connections shall be made so that all the valves installed are accommodated within the extension of the drain pan of the unit. So that, in case of any leak in the valves, the water shall fall into the drain pan and not onto the false ceiling.
c The copper piping shall be insulated with polyethylene tubes of suitable size, and all joints shall be sealed with aluminium tapes.

3.2.3.3.7 Noise control

FCU shall be selected for the lowest operating noise level of the equipment. Maximum noise level acceptable shall be 50dB in the room.

3.2.3.3.8 Valves

a The valves on inlet line shall be of gunmetal ball type integral water strainer, having internal tread (FPT) inlet and flare type external (MPT) outlet connection.
b Return line shall be provided with, motorised two way valve, balancing valves and Ball valve.
c Fan coil unit valve set shall be factory fitted and tested with all accessories.

3.2.3.3.9 Installation

a The FCU shall be installed as per good practice and as per the standard referred.

b The power outlet to the FCU shall be provided with an isolator and its location shall be co-ordinated so that it is located with 1 to 1.5m of the FCU.

c Each FCU shall be provided with a thermostat positioned in an approved location. The thermostat shall have switches to provide Low-Medium-High fan speeds and a rotating temperature set point selector.

d The thermostat shall have an aesthetically made housing/cover.

e The cabling and wiring between the thermostat, the FCU and the power point shall be provided in fully concealed metal conduits of approved quality. Free hanging of cabling and wiring shall be kept to the minimum distance possible, and such cables shall be provided with metallic flexible conduits of approved quality.

f The end of the flexible conduit shall be properly terminated in the junction box of the FCU and the pipe conduit/switch box at the other end.

3.2.3.3.10 Field tests

a After each FCU is installed and ready for pipe connection, the coil shall be tested against leaks at a hydraulic pressure of 10kg/m². The pressure shall be maintained at least one hour, and no drop or leak shall be observed. Repair of coil shall not be permitted.

b After the installation work is completed, the following minimum characteristics shall be measured:

- Air quantity at all of the three speeds
- Sound level inside the conditioned space
- Flow measurement
- DBT and WBT of return air and supply air
- The FCU shall be tested as per relevant ASHRAE standards.

3.2.4 Water cooled Chillers

3.2.4.1 General

a. This section specifies the requirements for furnishing water cooled variable speed drive screw chillers with appurtenances as specified herein, including but not limited to:
    - Chiller package
    - Charge of refrigerant and lubrication oil
    - Controls and control connections
    - Chilled water connections
    - Condenser water connections

b. The performance curves and other data submitted for the water chilling units proposed to be furnished shall be certified by the Air Conditioning, Heating and Refrigeration Institute (AHRI 551/591 latest version with addendum). The water chilling units shall be the product of a single manufacturer whose name shall appear on all the technical submittals and it shall be manufactured in a facility whose products are certified by AHRI.

c. The Chillers shall be suitable for operation with 415±10% Volts, 3 Phase, 50 Hz power supply.

3.2.4.2 Quality control

a) Reference standards

Materials and workmanship shall be in accordance with the latest edition of the following standards and codes to the extent specified herein.

Standards	Standard no	Description
AHRI		**Air-Conditioning, Heating, and Refrigeration Institute**
	551/591	Water chilling packages using the vapour compression cycle
ASHRAE		**American Society of Heating, Refrigerating and Air-Conditioning Engineers**
	ASHRAE 30-1995	Methods of testing liquid chilling packages
	ANSI/ASHRAE 24-1989	Methods of testing for rating liquid coolers
	ANSI/ASHRAE 22-1992	Methods of testing for rating water cooled refrigerant condensers
	ANSI/ASHRAE 15-1992	Safety code for mechanical refrigeration
	ASHRAE 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings

b) Manufacturer's qualifications and experience

The water chilling units Manufacturer shall show at least ten years of continuous and current experience in the design, assembly and testing of such units.

c) Submittals

i Before giving the Manufacturer notice to proceed, the Contractor shall submit to the Employer for review and approval, the name and qualifications of the Manufacturer of water chilling units. Qualification statement shall include but need not to be limited to the following data:

- Manufacturer's selection software print out for the model of the chilling units proposed to be furnished under this contract as certified with AHRI.
- Manufacturer's computer software print out for performance at part load in steps of 100%, 75%, 50% and 25% as certified with AHRI
- Data sheet showing computation of IPLV as per AHRI
- Data sheet showing computation of NPLV as per AHRI
- The following data shall be imprinted on each data sheet:
  - Project title
  - Chilling unit designation number
  - Chilling unit rated capacity as per AHRI
  - Manufacturer's quality assurance program
  - Installation and operation manuals

ii The Contractor shall submit to the Employer a certificate of compliance signifying that equipment to be furnished under this Contract meets the requirements specified herein.

iii After successful completion of all factory tests specified herein and of any additional tests conducted at the Contractor's own option, the Contractor shall submit the following:

- Certified results for all factory tests conducted. All test data shall be bound in one report. The test report shall be indexed and cross-referenced in an easily understood manner.
- All records and results of non-destructive examinations made at completion of each examination.
- Installation, commissioning, maintenance and field test procedures.

3.2.4.3 Technical and installation requirements

3.2.4.3.1 Water cooled variable speed drive screw Chillers

a General

i. Each water-cooled chilling unit shall be a standard cooling model and shall comprise but not limited to:
   - Screw compressor
   - Shell and Tube Condenser with accessories and supports.
   - Shell and Tube Chiller with accessories, support and insulation.
   - Steel structure as required for assembling/mounting the above.
   - Microprocessor based colour control panel with automatic controls and display module with BMS compatible features.
   - Accessories as specified/required.
   - Interconnecting refrigerant piping.
   - Full charge of Refrigerant and oil.
   - VFD Starter for the motor.

ii. Contractor shall provide Chiller Manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer and as required for a complete Chiller installation as specified herein. The Chiller shall be designed, selected, and constructed to use refrigerant HFC-134a (not subject to the Montreal Protocol). Chillers shall meet the capacity requirements specified herein. Refrigerants containing chorine (HCFC's) are not acceptable.

iii. The Chillers shall fit into the space provided and shall be made readily serviceable including the provision of marine water boxes and other necessary accessories, etc., to complete the system.

iv. Efficiency of the chiller (IPLV, NPLV and FL performance) shall meet or exceed the requirements of ASHRAE 90.1 (latest edition).

b Compressor

i Each unit shall have a rotary twin-screw compressor serviceable bolted semi-hermetic type.

ii The twin rotary screw shall be manufactured from forged steel with precision cast male and female profiles, which are asymmetrical. The profile of screws shall permit safe operation upto a speed of 3000 RPM for 50 Hz operation.

iii The compressor housing shall be of high grade cast iron, machined with precision, to provide a very close tolerance between the rotors and the housing.

iv The rotors shall be mounted on antifriction bearings designed to reduce friction and power input. There shall be multiple cylindrical bearings to handle the radial and axial loads.

v There shall be built in oil reservoir to ensure full supply of lubricants to all bearings and a check valve to prevent backspin during shut down.

vi There shall be oil pump or other means of differential pressure inside the compressor for forced lubrication of all parts during start-up, running and coasting for shut down. An oil sump header shall be provided in the casing.

vii The units shall be complete with automatic capacity control mechanism, to permit modulation between 20% and 100% of capacity range. The Compressor will be designed to operate both on full capacity as well as part capacity without affecting the operating efficiency. The chiller units should be able to modulate cooling capacity to precisely match the load and minimise energy consumption. Chilled water temperature control setting capability will be to 0.1 °F or less

c Compressor motor

i The driving motor shall be double squirrel cage type or suitable hermetic type as required, protected against damage by means of built in protection devices.

ii In case of hermetic type, motor shall be liquid refrigerant cooled with internal thermal overload protection devices embedded in the winding of each phase.

iii If open type motors are used, the Contractor shall ensure that the motor heat loss will not result in excessive increases in temperature of the plant rooms affecting the operation and performance of the Chillers and other equipment. The Contractor shall provide at his own expense any additional ventilation/cooling equipment. In addition, the Contractor shall also bear all direct, indirect and associated costs to provide a mechanical room safety alarm, wiring and Chiller emergency shutdown shall be included to prevent Chiller operation if the room temperature exceeds 40°C.

iv Motor shall be compatible with the specified starting method.

d Condenser

i Each unit shall have one horizontal shell and tube, water-cooled, multipass condenser, fitted with safety valve, purge valve, and other safety devices.

ii The shell shall be of welded steel construction fitted with machined steel tube sheets on either ends. The water boxes/end covers shall be marine type of steel or cast iron so that tubes are accessible without dismantling of pipes. The water boxes/end covers shall be removable and plant components shall be arranged so that the space for tube removal is not obstructed.

iii The tubes shall be at least 12 mm O.D. of seamless copper with integral fins. The tubes shall be supported in the shell to avoid noise and vibrations and the ends shall be properly expanded in the tube sheets to prevent leakage of refrigerant gas.

iv The water heads shall be of fabricated steel, easy to remove, with suitable baffles for multipass water flow, Inlet and Outlet connections and gasket to prevent water leakage.

v The condenser shall be tested against leaks with a pressure of 24.5 Kg/Cm^2 on both the shell side and the waterside.

vi The condenser shall be complete in all respects and shall also include:

- Support for mounting.
- Refrigerant In and Out connections.
- Water In, Out and drain connections.
- Relief valve and purge valve on refrigerant side.
- Refrigerant Isolation Valve and Safety valve
- Oil Separator
- Water flow Switch.

e Chiller

i Each unit shall have one horizontal shell and tube, flooded type cooler complete with accessories.

ii The shell shall be of welded steel construction fitted with machined steel tube sheets on either ends. End water boxes shall be designed to provide adequate space for water movement such that there is no erosion of the tube ends. In general, this requires the water box end to be domed rather than flat. End box covers shall be removable, and allow easy access for cleaning the tubes.

iii The Chiller shall either have internally finned copper tubes or tubes with other means for increasing heat transfer surface. The tube shall be supported in the shell by adequate, stiff supports to eliminate vibration and noise. The tube ends shall be mechanically bonded to the tube sheets to prevent leakage of refrigerant gas.

iv The water heads shall be made of fabricated steel and the faces ground to a close tolerance to prevent leakage and permit 2, 3 or 4 pass operation.

v The Chiller shall be tested against leaks with a pressure as recommended by the manufacturer for both on the shell and the waterside.

vi The Chiller shall be insulated with factory-installed insulation.

vii The Chiller shall be complete in all respects and also include: -

- Supports for mounting.
- In and Out connections both for the refrigerant and the water circuit and drain connections.
- Anti fouling device for condenser unit.
- Freeze up protection and capacity control sensors.
- Water flow switch.

f Oil recovery unit

An efficient oil separator shall be included to remove oil from the refrigerant and there shall be suitable heat exchanger for oil separation, if required. Compressor shall be fully field serviceable with full acoustical alteration as per AHRI standard (Latest) and early serviceable type. Discharge oil separation shall be accomplished external to the compressor casing, oil separator and return system. Seal shall be designed to ensure that oil is adequately returned to the compressor and does not collect in the heat exchangers.

g Control panel

The unit shall be complete with a Microprocessor Based Interactive Control Panel having multi-colour display mounted directly on the unit and prewired with all operating and safety controls. The exposed control wiring should be provided in suitable conduits. The control panel shall have the following extended capabilities but not limited to:

i Remote indication of:

- Chiller operating status
- Shutdown codes
- Key operating parameters including but not limited to:
  - Entering and leaving chilled water temperatures
  - Entering and leaving condenser water temperatures
  - Oil feed and sump temperatures
  - Oil pump discharge and oil differential pressure
  - Motors amps and amps as a percent of rated load amps
  - Hours of operation and number of starts, time of last start and stop
  - Fault history for last 8 failures.
- Self-diagnostics.

ii Programming capabilities of:

- Leaving chilled water temperature
- Reset of chilled water temperature from:
  - Return chilled water temperature (to maintain constant return chilled water temperature)
  - Reset of supply water temperature
  - Load on Chiller
- Power demand limit
- Lead-lag operation and control

iii The control panel should include but not to be limited to the items listed below:

- Start/Stop switch (for both local/remote operation) and micro-processor module for capacity control system with overload limit control point adjustment, oil pump and purge unit controls, etc.

- Indicating lights
- Suction, oil and discharge pressure indications
- Necessary motor protection devices
- Other time delays, relays, etc as required

iv As a minimum, the following safeties shall be incorporated in the control panel:

- High and low discharge pressure
- High discharge temperature
- Chilled or condenser water pumps failure
- High or low oil feed temperature
- Low oil differential pressure
- High motor temperature, low motor current
- Starter fault.

v The display shall have a minimum of 160-characters liquid crystal having multi-colour display and be backlit with a light emitting diode. Messages shall be in plain English. Coded two or three character displays are not acceptable.

vi A time clock shall be incorporated to allow daily time starts and stops

vii The control system shall have automatic restart after a power failure and not require a battery backup for memory continuity.

viii The microprocessor shall be capable of communicating to BMS system, other units or a PC using a twisted pair communication interface RJ-45 or RS-485. The protocol shall be BACNet/ Modbus compatible. In case of any translator being required for communication between the Chiller panel & BMS system the same would be required to be provided by the ECS contractor.

h Refrigerant piping

i Necessary steel/copper refrigerant pipe lines as per approved manufacturer's standard of heavy class shall be provided for the flow of suction and hot gases and liquid refrigerant. All control cables of the Chiller should be provided in the metal conduits.

ii The pipe lines shall be insulated, as required.

iii The chilling units shall be delivered with pre-charged refrigerant from the manufacturing premises. The refrigerant shall not be charged at site.

i Lubrication system

The lubrication system shall be complete with accessories such as oil Chiller with thermostatic control, oil heaters, oil strainer, and relief valve etc. Necessary pipe lines for lubricants and cooling system with valves, shall be included.

j Accessories

i Each unit shall include the following as part of unit price:

- Spring type vibration isolators to eliminate transmission of vibrations upto 90%.
- Full charge of refrigerant gas and required quantity of lubrication oil.
- Other valves as required for cleaning of condenser and draining of water.

ii Each unit shall include the following:

- Water flow switches at the outlet of the condenser and the Chiller
- Stem type thermometers and dial type water pressure gauges at the inlet and outlet of the condenser and the Chiller
- Suitable size motorised butterfly valves at the outlet of the condenser and Chiller
- Suitable size balancing valve at the outlet of condenser and Chiller
- Automatic air vent at the inlet and outlet of Chiller

iii Each unit shall include, but not be limited to, all the items listed in the foregoing paragraphs. In addition, all such items, as may require, shall include whether specifically mentioned or not, if considered or found necessary to fulfil the intent and meaning for the purpose of maintaining design operations under all extreme weather conditions.

iv All exposed surfaces and insulation shall be painted using the Manufacturer's standard paint system and colours.

k Variable Speed Drive

i A variable speed drive shall be factory installed on the Chiller. It will vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The capacity control logic shall automatically adjust motor speed and compressor capacity for maximum part-load efficiency by analysing information fed to it by sensors located throughout the Chiller.

ii Drive shall be PWM type utilizing IGBT's with a power factor of 0.97 or better at all loads and speeds.

iii The variable speed drive shall be unit mounted in a NEMA 1 enclosure with all power and control wiring between the drive and Chiller factory installed. Field power wiring shall be a single point connection and electrical lugs for incoming power wiring shall be provided.

iv The following features shall be provided but not limited to:

- Door interlocked circuit breaker capable of being padlocked.
- Ground fault protection.
- Over voltage and under voltage protection.
- 3-phase sensing motor over current protection.
- 3-phase sensing input over current protection.
- Single phase protection.
- Phase reverse rotation protection.
- Over temperature protection. Active Harmonic filters to restrict total current demand distortion, current harmonics < 5% at source.
- Digital readout at the Chiller unit control panel of output frequency, output voltage, and 3-phase output, current, input Kilowatts and Kilowatt-hours, self-diagnostic service parameters. Separate meters for this information will not be acceptable.
- KW Meter - The unit's input power consumption will be measured and displayed digitally via the unit's control panel. The KW meter accuracy is typically +/- 3% of reading.
- KWh Meter – The unit's cumulative input power consumption is measured and displayed digitally via the unit's control panel. The KWh meter is resettable and its accuracy is typically +/- 3% of reading.
- Ammeter – Simultaneous three-phase true RMS digital readout via the unit control panel. Three current transformers provide isolated sensing. The ammeter accuracy is typically +/- 3% of reading.
- Voltmeter – Simultaneous three-phase true RMS digital readout via the unit control panel. The voltmeter accuracy is typically +/- 3% of reading.
- Elapsed Time Meter – Digital readout of the unit's elapsed running time (0 – 876,600 hours, resettable) is displayed via the unit control panel.

3.2.4.3.2 Chiller Plant Manager (CPM)

General

A. The Chiller Plant Optimizer system shall be as indicated in the BOQ and described in the specifications. CPM has been indicated in BOQ as an optional item, and shall be provided subject to approval by Employer.

B. Network Automation/Control Engine and Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.

C. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any work-station
on the control system and have access to all appropriate data. The system shall be fully web enabled as shown on the drawings and as specified in this specification.

D. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

E. Communication between the control panels and all work-stations shall be over a high speed TCP/IP network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.

F. The equipment to be monitored and controlled include the following:

a. Control of Chillers with Primary Chilled Water Pumps, Condenser Water Pumps, Cooling Towers and Motorized Butterfly Valves.
b. Measurement and monitoring of the chilled water temperatures and flows.
c. IkW/TR measurement of each chiller.
d. Energy metering using special Energy Software with dashboard and customized reporting tools for MMRC Depot
e. Automatic Alarm routing through e-mail and SMS to user.

Work Included

A. Provide a Chiller Plant Optimizer incorporating Network Automation/Control Engine and Direct Digital Control (DDC),equipment monitoring, and control; Advanced DDC Controllers (DDCs) interfacing directly with sensors, actuators and environmental delivery systems (i.e. chilled water distribution, etc) and mechanical devices for all items indicated on drawings, BOQ and specification including motorized butterfly valves, VFDs, panels; a primary communication network to allow data exchange from DDC to DDC; terminal equipment, DDC Controllers interfacing with sensors, actuators, terminal equipment devices; a secondary BACnet MS/TP communication network interfacing DDCs to network automation controllers ; hardware and software interfaces to third-party control equipment.

B. The Chiller Plant Optimizer System (CPO) shall be a state of the art technology, freely expandable for any future expansion plans. The system (CPO) shall have a minimum controlling capacity of 10,000 physical points without upgrading the data server software
or related hardware. In general the system shall support "Open Architecture Concept" with capability to Dynamic Data Exchange (DDE) Link. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

The CPO as provided shall incorporate, at minimum, the following integrated features, functions and services:
1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.

3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Seamless integration of third party system protocol such a MODBus-RTU, BACnet IP
5. Diagnostic monitoring and reporting of CPO functions.
6. Offsite monitoring and management access.
7. Energy management / Reports / Dashboards.

CPO System Architecture

The system architecture shall be as follows:

The Chiller Plant Optimizer (CPO) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the CPO shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
The system shall be designed into three tiers and contain a field tier (the tier that contains all of the field level controllers, and application specific controllers), an automation tier (this is the tier that connects all of the field tiers), and an enterprise tier (this is the tier that connects all of the automation tiers). No two-tier design is acceptable.

The CPO shall consist of the following hardware and software:

1. Standalone Network Automation/Control Engine(s)
2. DDC Field Equipment Controller(s) and Input/Output Module(s)
3. Workstation and Energy Management Software

1. Standalone Network Automation/Control Engine

A. Controller shall provide supervisory control over the control network and shall support all three (3) of the following communication protocols:
1. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
2. The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
3. The NAE shall be tested and certified as a BACnet Building Controller (B-BC).

B. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications.

C. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.

D. Network engine shall have Unlimited number of user license without any additional cost of license on the OWS.

E. Network engine shall be able to access by 4 simultaneous user.

F. Network engine shall l be browsed by Microsoft Internet Explorer and Netscape Navigator.

G. Network engine processor should be of 32 bit configuration.

H. Network engine should have inbuilt display and keys to operate in absence of PC.

I. Network engine should have inbuilt IO points , functionally able to act as a DDC controller as well as a Supervisory controller.

J. Network engine should support AHARAE standard BACnet MS/TP protocol , Proprietary Protocol shall not be accepted.

K. Network engine should support integration of third party protocol (eg MODbus-RTU) seamlessly without adding additional hardware.

L. For BACnet MS/TP or IP integration, the Network engine should be support auto discovery to discover the field devices and field points.

M. Network engine should support DHCP function for IP addressing.

2. Workstation and Energy Management Software.

A. The system shall provide a real-time database incorporating data from analog, logical or pulse inputs.

B. It should be support up to 1000 TCP/IP addresses for the supervisory controllers in the Enterprise network.

C. Historian of point data shall be configurable as part of the point definition. Historian shall be provided for both snapshots and averages with intervals ranging from 5 seconds to 24 hours.

D. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility.

E. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format.

F. The system shall be able to store all the events.

G. The operator interface shall be flexible in its connection to the CPO server. Both serial wireless, 3G and LAN connection shall be possible. The operator interface shall provide standard dial-up modem support. Using other packages such as Microsoft Terminal to make the modem connection shall not be acceptable.

H. CPO management level software shall have Unlimited number of user license without any additional cost of license on the OWS.

I. CPO software shall be web based software shall allow 5 simultaneous user access.

J. Server software shall be able to browsed by Microsoft Internet Explorer and Netscape Navigator.

K. Energy Management software capable of fetching the energy data from the BMS and store the data into separate application database (SQL) for analysis. This Software should have the following Key features:

• Segmentation Of Energy Information At A Glance.
• Customisable Energy Dash-Board.
• Energy Report Generation Against Selection Of Time And Frequency.
• Co2 Emission Calculation And Reporting.
• Web Based Tool. No Additional Software Required.
• Automatic Alarm Email / Sms Option Available

L. The software shall have Ready Access Portal Architecture, graphics and management software shall be accessible thru smart phones.

M. A minimum of 100 unique passwords shall be supported. Provide a minimum of 100 categories of systems to which individual operators may be assigned.

N. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of 5 years in advance.

O. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers.

P. The system shall provide flexible trending allowing real-time, historical or archived data to be trended in a variety of formats. In addition, trend data types shall be able to be combined to allow for comparisons between data e.g. current real-time data versus archived data.

Q. The system shall support a flexible reporting package to allow easy generation of report data. The reports provided should include preconfigured standard reports for common requirements such as Alarm Event reports and custom report generation.

R. The system shall provide up to six levels of security providing varying degrees of access to system operation and configuration functions.

3. DDC Field Equipment Controller(s) and Input/ Output Module(s)

A. General purpose DDC controllers shall be minimum 32 bit microprocessor based with FLASH base of operating system.

B. The devices shall be programmable and capable of extensive measuring, control and monitoring functions.

C. All DDCs shall support modular architecture with the following:
1. A CPU with Power Supply Module
2. Distributed I/O modules to accommodate Input/Output points.

D. Energy management programs such as optimum start/stop, load reset, duty cycling, night purge, distributed demand control and others must be resident on each DDC.

E. As a back up, DDCs shall store DDC programs and data files on non-volatile EPROM or flash memory to allow simple and reliable additions and changes. Each DDC shall have a 72 hours battery backed real-time clock.

F. Each panel shall be provided with a socket for a Portable Operators Terminal (POT) which can be connected via Bluetooth communication for easy access for testing & trouble shooting and no need to open the panel, and a port for network communications In max. speed of 76Kbps.

G.The DDC I/O modules should communication within the CPO network by ASHARE BACnet MS/TP protocol, no other proprietary protocol is accepted protocol

H. All the DDC should be BTL listed.

I. DDC shall support PRAC and PID logic

J. The DDC software configuration tool shall use be GUI based logics.

Immersion Temperature Sensors:

a. Immersion sensors shall be provided with a separable stainless steel/brass well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
b. Operating range shall be -20 to 70 deg C; pressure rating shall be min. PN 16, IP 54 protection, 1000 ohms platinum at 0 deg. C, . To meet UL 1995 plenum requirements if necessary. Accuracy to ±0.73F° at 70°F (±0.41C° at 21°C),DIN Class B
c. Standard of Acceptance: Johnson Controls TE-6300 series or approved equal.

Outside Air Temperature Sensors:

Chilled Water Flow Meters:

1. Flow meter shall be a single paddle/ electro-magnetic / insertion flow meter.

2. The wetted material shall be constructed of stainless steel or brass.

3 . Provide output to CPO.

4. Install flow meters according to manufacturer's instructions paying particular attention to the upstream and downstream piping requirements.

5. Standard of Acceptance: Kele/ABB/Sanitech.

Local Control Panels:
1. The control panel should be lockable and IP 55 rating
2. Standard of Acceptance: BCH / equivalent

3.2.5 Water Circulating Pumps

3.2.5.1 General

This section specifies the requirements for furnishing water circulating pump sets complete with all accessories specified herein.
The pump sets shall be the product of one single Manufacturer whose name shall appear on all submittals.

3.2.5.2 Quality control

a The following codes, regulations, references, standards and specifications apply to the work of this section.

Standard	Standard No	Description
ASME		**American Society of Mechanical Engineers**
	ASME PTC 8.2 – 1990	Centrifugal pumps
HI		**Hydraulic Institute**
	ANSI/HI 1.1 – 1.5 (1994)	Centrifugal pumps
	ANSI/HI 1.3.4 (1997)	Centrifugal pumps – Horizontal base Plate design
	ANSI/HI 9.1.9.1 (1994)	General guidelines
	ANSI/HI 9.6.3 (1994)	Allowable operating regime

b Submittals

As the pump parameters in BOQ are indicative Before providing the pump Manufacturer with Notice to Proceed, the Contractor shall submit to the Employer for his review and consent the following data (not limited to):

i. Theoretical pump performance curves for equipment proposed to be furnished under the contract.
The pump performance curves form shut off to free delivery shall have the following data plotted as ordinate versus flow in cubic meters per hour as abscissa:
- Head in m
- Efficiency

- Kilowatt input to the pump
- NPSH required in m

The curve shall be for the recommended operating speed of the pump

ii. Pump technical data sheet.

iii. Pump flow and head calculations, meeting the requirements of Chilled water and condenser water systems, with due consideration to selection of Chilling equipment and cooling tower.

iv. A motor data sheet for each pump giving the following information at the operating point of the pump.
- Current in ampere
- Speed in revolutions per minute
- Efficiency in percent
- Power factor in percent
- Torque in Nm

v. Manufacturer's Quality Assurance Program

vi. Total head to be overcome by the pump including but not limited to the following:
- Pressure loss in the connected equipment at the operating/duty conditions
- Pressure loss in the piping with piping length measured from working drawing to be performed during final design stage
- Pressure loss in all pipe fittings like elbows, reducers and tees
- Pressure loss in piping accessories like regulating and controlling valves, flexible connections, sensor wells and probes
- Head due to change in elevation

3.2.5.3 Technical and installation requirements

a The pump sets shall be split case type with flanged connections directly mounted on TEFC squirrel cage induction motor and suitable starter as specified. The pumps should have anti-corrosion coating/ investment casting on the inside of the casing and exterior (colour) finish should be same as that of the Chillers.

b The impeller shall single entry shrouded design. The pump efficiency shall be 80% minimum.

c The pump set shall be of back pull out type.

d The pump casing shall be high-density cast iron or cast steel volute design machined to a close tolerance.

e The shaft shall be of high tensile SS mounted in generously sized bearings.

f The impeller shall be of Bronze and should be properly balanced.

g The shafts seal shall be of mechanical type to withstand leakage at high working pressure of 12 kg/cm² and should be easily serviceable in the field.

h A suitable flexible coupling shall be provided to connect the pump and the motor

i The base plate shall be suitable for mounting the motors and the pumps.

3.2.6 Variable Speed drive (VSD)

a The adjustable speed drive(s) shall be pulse width modulation (PWM) type, microprocessor controlled design.

b Test the VSD, including all factory-installed options, to UL Standard 508. The VSD shall also meet C-UL and be CE marked and built to ISO 9001 standards.

c The VSD shall be housed in a NEMA 1 enclosure. VSD's with plastic enclosures shall not be acceptable.

d The VSD shall employ an advanced sine wave approximation and voltage vector control to allow operation at rated motor shaft output speed with no derating. This voltage vector control shall

minimize harmonics to the motor to increase motor efficiency and life. Power factor shall be near unity regardless of speed or load.

e The VSD shall have balanced DC link reactors to minimize power line harmonics. VSD's without a DC link reactor shall provide a 3% impedance line reactor.

f Automatic motor adaptation (AMA) algorithm shall be utilized. This feature shall allow for automatically optimized drive performance and efficiency leading to additional energy savings.

g Input and output power circuit switching shall be done without interlocks or damage to the VSD.

h The following customer modifiable adjustments shall be provided but not limited to:
   i Accel. time
   ii Decel. time
   iii Minimum frequency
   iv Maximum frequency

i An automatic energy optimization selection feature shall be provided. This feature shall reduce voltages when lightly loaded and provide a 3% to 10% additional energy savings.

j The VSD shall be suitable for elevations to 3300 feet above sea level without derating. Maximum operating ambient temperature shall not be less than 45°C. VSD shall be suitable for operation in environments up to 95% non-condensing humidity.

k The VSD shall be capable of displaying the following information in plain English via a 40 character alphanumeric display but not limited to:
   i Frequency
   ii Voltage
   iii Current
   iv Kilowatts per hour
   v Fault identification
   vi Percent torque
   vii Percent power
   viii RPM

l The VSD shall be compatible to interface with RJ 45,RS 485 utilizing Modbus/ BACNet Protocol

3.2.6.1 Sensor / transmitters

Provide field mounted differential pressure sensor transmitter(s) as indicated on the plans. Unit shall transmit an isolated 4-20mA dc signal indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall have stainless steel wetted parts with two 0.25" male NPT process connections. It shall be protected against radio frequency interference and shall have a watertight, NEMA 4 electrical enclosure capable of withstanding 2000 PSI static pressure with a 0.5" NPT conduit connection. Accuracy shall be within 0.25% of full span.

3.2.6.2 Sequence of operation

a The system shall consist of a pump logic controller, multiple pump sets, with manual and automatic alternation.

b The pumping system shall start upon the closure of contact when the pump logic controller Mode of Operation selector switch is in the REMOTE position.

c When the pump logic controller selector switch is in the LOCAL position, and start command is given via operator interface, the pumping system shall operate automatically.

d Sensor / transmitters shall be provided as recommended by the manufacturer.

e Each sensor/transmitter shall send a 4-20mA signal to the pump logic controller, indicative of process variable condition.

f The pump logic controller shall compare each signal to the independent, user determined set points.

g When all set points are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.

h The pump logic controller shall continuously scan and compare each process variable to its individual set point and control to the least satisfied zone.

i If the set point cannot be satisfied by the designated lead pump, the pump logic controller shall initiate a timed sequence of operation to stage a lag pump [wherever applicable].

j The lag pump shall accelerate resulting in the lead pump(s) decelerating until they equalize in speed [wherever applicable].

k Further change in process variable shall cause the pumps to change speed together [wherever applicable].

l When the set point criteria can be safely satisfied with fewer pumps, the Technologic pump logic controller shall initiate a timed staged sequence and continue variable speed operation [wherever applicable].

m As the worst case zone deviates from set point, the pump logic controller shall send the appropriate analog signal to the VSD to speed up or slow down the pump/motor.

n In the event of a VSD fault, the pump logic controller automatically initiates a times sequence of events to start the redundant pump/VSD set in the variable speed mode. The redundant variable speed system shall be started through the pump logic controller.

o Upon VSD fault(s), the pump controller shall display an alarm condition through a plain English message.

p VSD fault indication shall be continuously displayed on the operator interface of the pump until the fault has been corrected and the controller has been corrected and the controller has been manually reset.

q In the event of the failure of a zone sensor/transmitter, its process variable signal shall be removed from the scan/compare program. Alternative zone sensor/transmitters, shall remain in the scan/compare program for control.

r Upon sensor failure, a plain English warning message shall be displayed on the operator interface of the pump logic controller.

s In the event of failure to receive all zone process variable signals, a user selectable number of VSDs shall maintain a user adjustable speed, reset shall be automatic upon correction of the zone failure.

3.2.6.3 Quality assurance

a The pumping package shall be assembled by the pump manufacturer. An assembler of pumping systems not actively engaged in the design and construction of centrifugal pumps shall not be considered a pump manufacturer. The manufacturer shall assume "Unit responsibility" for the complete pumping package. Unit responsibility for interface and successful operation of all system components supplied by the pumping system manufacturer.

b The manufacturer shall have a minimum of 5 years' experience in the design and construction of variable speed pumping systems.

c All functions of the variable speed pump control system shall be tested at the factory prior to shipment. This test shall be conducted with motors connected to VSD output and it shall test all inputs and program execution specific to this application.

d The manufacturer shall be fully certified by the International Standards Organisation per ISO 9001. Proof of this certification shall be furnished at time of submittal.

e Manufacturer shall be listed by Underwriter's Laboratories as manufacturer of packaged pumping systems.

3.2.6.4 Painting

All variable pumping system, pumps, motors and bases shall be supplied with approved finish. Shop coat of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the adjoining areas.

3.2.7 Cooling Tower

3.2.7.1 General

This section specifies the requirements for furnishing cooling towers complete with all accessories as specified herein.

The cooling towers shall be the product of a single Manufacturer whose name shall appear on all submittals.

3.2.7.2 Quality control

a The following codes, regulations, reference standards and specifications apply to the work of this section.

Standard	Standard No.	Description
NFPA		**National Fire Protection Association**
	NFPA 214-1992	Water cooling towers
ASTM		**American Society of Testing & Materials**
	ASTM-568 & ASTM E84	
ISO 9001:2000		**International Organizations for Standardization**
CTI		**Cooling Tower Institute**
	Cooling Towers should be CTI certified. As per latest CTI STD 201 – 1991 Certification standard for cooling towers and shall demonstrate the performance test on selected sample in factory.	
	CTI ATC 133	Acceptance test code for spray cooling system
	CTI ATC 105	Acceptance test code for water cooling towers: mechanical draft, Natural draft, fan assisted types, evaluation of results, and thermal testing of wet/dry cooling towers
	CTI STD 201	Certification standard for commercial water cooling towers CTI ATC 128.....Code
	CTI STD 131	Fiberglass-reinforced plastic panels for application on industrial water cooling towers
	CTI NFL 109	Nomenclature for industrial water cooling towers
	CTI PFM 143	Recommended practice for airflow testing of cooling towers
ASME		**American Society of Mechanical Engineers**
	PTC 23	Atmosphere water cooling equipment
OSHA		**Operation Safety and Health Administration**

b Submittals

i. Submit certificate of compliance that the design and fabrication of various components of the cooling towers to meet the requirement of the Contract.

ii. Include data substantiating that materials comply with the requirements of the various standards as specified.

iii. Submit complete selection sheet, sound datasheet, performance curve, detailed unit drawing, load point analysis as supporting documents to comply on various standards.

3.2.7.3 Technical and installation requirements

a General

The cooling towers shall be induced draft, Cross flow type with vertical discharge complete with FRP basin, FRP body, fan and motor assembly, fill media, distribution pipes, etc.

The Cooling tower shall be constructed with a sturdy structural Hot dipped Galvanized frame designed to transmit all wind, seismic and mechanical Load to the equipment anchorage. The body shall be made of FRP sections of equal segments, all bolted together. The surface on both inside and outside shall be smooth, for minimum air resistance. The fan deck shall form an integral part of the body. The Casing panels shall be constructed of corrosion resistant and UV resistant fibreglass reinforced Plastic (FRP) with smooth finish to minimize air resistance and ensure prolong equipment life as per CTI Standard.

The water basin shall be constructed of minimum 4 mm thick Fibreglass reinforced plastic (FRP), having an auxiliary cylindrical suction tank, wherever required. The basin shall be completed with connections for drain, overflow, make up-water, quick fill and float valve, and hot dipped galvanised suction strainer.

The support structure for the tower shall be of mild steel duly sturdy structural hot dipped galvanised frame (750GSM).

The water diffusion deck shall be of rigid PVC fill as per manufacturer's standard, arranged in a suitable pattern for ease of replacement. The fill shall be rated and certified by the cooling tower manufacturer.

b Water distribution system

The hot water distribution basin shall be open gravity type for easy cleaning, constructed with FRP, and shall be distributed through a sprinkler system consisting of PVC sprinkler pipes, which shall be mounted on top of the main supply standpipe. Alternately, the water distribution could be with a water diffusion deck.

c Fan assembly

The Fans shall be heavy duty, axial flow with aluminium alloy blades selected to provide optimum cooling tower thermal performance with minimum sound levels. The fan blades shall be of aerofoil design and adjustable pitch. The fan assembly shall be statically and dynamically balanced.

The fan outlet velocity shall not be less than 10 m/s and the fan speed RPM shall be as per manufacturer recommendations.

The Fans shall be driven either by speed reduction gears or direct driven. Fans and shafts shall be supported by heavy duty, self-aligned, grease–packed ball bearings with moisture proof seals and integral slinger collars.

The fan motor shall be shall be of high efficiency class EFF-1 totally enclosed fan cooled squirrel cage type conforming to IP 55 protection for outdoor operation designed specifically for cooling tower services. The motor shall be furnished with moisture protection on the windings, shafts and bearings and have watertight terminal box.

The fan guard shall be hot dipped galvanised (min 750 GSM) with wire mesh screen to prevent bird nesting during idling period.

All fasteners shall be of Stainless steel (SS-316).

d Ladder

All towers shall be provided with a ladder, made out of hot dipped galvanised M.S. tubes (min. 750 GSM) to access the fan Deck. Handrails shall be provided along the perimeter of the cooling tower cells. The ladder design shall be submitted for approval by the Project Manager.

e Noise level

The noise emanating from the Cooling towers, Chiller plant etc shall meet the requirements of Maharashtra Pollution Control Board. Sound data sheet showing complete octave band should be submitted by the manufacturer. Acoustic Louvers, discharge silencer, acoustic lining etc shall be provided accordingly, to limit the sound level with in the requirement.

f Installation

Installation shall be carried out in a manner, which shall fully comply with the Manufacturer's recommendations.

g Field tests

i General requirements are the following:
- Perform all tests in the presence of the Project Manager
- Furnish all field test instruments. The Contractor may remove test instruments only after testing is completed.
- Provide labour, materials and appurtenances required to complete the specified field tests.
- Submit all testing standards and procedures for approval prior to proceeding with any of the tests.

ii The acceptance testing shall be conducted in accordance with the procedure specified in CTI publication ATC 105.

iii The noise level testing for the cooling tower shall be conducted in accordance with the procedure specified in CTI publication ATC 128.

h Access Door

Suitable access door should be provided as standard for access into the plenum section.

3.2.8 Pipe Work

3.2.8.1 General

This section specifies the requirements for furnishing of pipe work related to VAC, complete with all required accessories.

3.2.8.2 Quality control

a Material and workmanship shall be in accordance with the latest edition of the following standards and codes, and the materials shall be certified by the standard organisation.

Standard	Standard no.	Description
ANSI		**American National Standard Institute**
	ANSI B16.9	Factory-Made Wrought Steel Butt-welding Fittings
	ANSI B16.21	Non-metallic Gaskets for Pipe Flanges
	ANSI B31.1	Power Piping
ASME		**American Society Of Mechanical Engineers**
	ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings
	ASME B16.5	Pipe Flanges and Flanged Fittings
ASTM		**American Society For Testing and Material**
	ASTM A234	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Services

Standard	Standard no.	Description
	ASTM A181	Standard Specification for Carbon Steel Forgings, for General – Purpose Piping
	ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
	ASTM B16	Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for use in Screw Machines
	ASTM B88	Standard Specification for Seamless Copper Water Tube
	ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
BS		**British Standard**
	BS 143 & 1256	Malleable Cast Iron and Cast Copper Alloy Threaded Pipe Fittings
	BS 476	Fire Tests on Building Materials and Structures
	BS 864	Capillary and Compression Tube Fittings of Copper and Copper Alloy
	BS 1387	Screwed and Socketed Steel Tubes and Tubulars and for Plained End Steel Tubes Suitable for Welding or for Screwing to BS21 Pipe Threads
	BS 1965	Butt Welding Pipe Fittings for Pressure Purposes
	BS 2494	Elastomeric Seals for Joints in Pipework and Pipelines
	BS 2871 Part 2	Copper and Copper Alloys, Tubes Part 2: Tubes for General Purposes
	BS 3600	Specification for Dimensions and Masses per Unit Length of Welded and Seamless Steel Pipes and Tubes for Pressure Purposes
	BS 3601	Carbon Steel Pipes and Tubes with Specified Room Temperature Properties for Pressure Purposes
	BS 3974	Pipe Supports
	BS 4504	Circular Flanges for Pipes, Valves and Fittings (PN Designated)
	BS 4865	Dimension of Gaskets for Flanges to BS 4504
	BS 5422	Method for Specifying Thermal Insulating Materials on Pipes, Ductwork and Equipment (In Temperature Range 40°C to +700°C)
	BS CP 2010	Codes of Practice for Pipelines
	BS EN 287 Part 1:	Approval Testing of Welders for Fusion Welding: steels
	BS EN 545	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Water Pipelines - Requirements and Test Methods

b Submittals

Certificate of the standards organisation testifying that the material furnished under this Contract comply with these standards.

Details of all supports, hangers and accessories

Manufacturer's quality assurance programme

Test results: The Contractor shall submit certified test results conducted at the factory for the material being furnished, which shall include but not limited to the following:

- Material test certificates giving the physical and chemical properties of the material used in the manufacture
- Hydraulic tests
- Non-destructive examinations
- Radiographic film

3.2.8.3 Technical and installation requirements

3.2.13.3.1 Pipe material

a Chilled water piping shall be black steel and condenser water piping shall be GI.

b Chilled and Condenser water piping

- Nominal bore 50-150mm: black steel/GI to BS 1387 or IS 1239 heavy grade
- Nominal bore 200 mm and above: Black carbon steel/GI manufactured by electric resistance welded using 350 Mpa grade steel to BS 3600 and BS 3601 or IS 3589 for 200mm to 500mm diameter; manufactured by submerged arc welded for 600mm diameter and above.

- Minimum wall thickness for pipes to BS 3600/3601 or IS 3589 shall be:

Diameter (mm)	Wall thickness(mm)
200-300	6.3
350-400	8.0
450-600	9.5
700-800	12.5

c Condenser water piping shall be of GI as per IS 1239 heavy grade for pipe NB 50-150mm.

d Condensate drain and vent piping system: Nominal bore 15-150: Galvanised steel to BS 1387 or IS 1239 medium grade

e For fan unit connections: Copper tubes to ASTM B88 type L

3.2.13.3.2 Pipe fittings – Materials

a Black malleable iron heavy weight screwed or weld able fittings for chilled water piping and GI heavy weight screwed or weld able fittings for condenser water piping to IS 1239 part II. Thickness and outside diameter of the pipe fittings shall match with the straight pipe.

b Condensate drain and vent piping system: Galvanised malleable iron screwed fittings to IS 1239 part II.

c For FCU connections: wrought copper to ASTM B16.22

3.2.13.3.3 Flanges

a Welded piping: Steel, welding neck pattern, 150 (1035 kPa) or 300 (2070 kPa) WSP class, complying with BS 4504 shall be used.

b Screwed piping: Galvanised steel screwed boss flanges complying with BS 4504: Part 1 Table 16/4 or galvanised malleable cast iron screwed boss flanges complying BS 4504 Part 1 Table16/13.

c Copper tubing: Copper slip-on flanges for brazing, complying with BS 4504 shall be used. Galvanised iron bolts and nuts shall not be used for fixing copper flanges.

3.2.13.3.4 Gaskets

a Gaskets shall be suitable for the temperature, service and pressure of the system and shall be installed in accordance with the Manufacturer's recommendations. Made-up flanged joints shall be fabricated from one-piece ring gaskets, 3mm thick, and neoprene rubber.
b For flanged joints between dissimilar metals or insulating flange joints: insulating gaskets, sleeves and washers between flanges, bolts and nuts respectively shall be used. Insulating material shall be "Teflon" or approved equal.
c Joint rings and gaskets shall comply with the requirements of BS 2494 or BS 4865 but other materials may be used if they have been proved to be more suitable for their duty as recommended by the Manufacturer, and approved by the Engineer.

3.2.13.3.5 Jointing

a Chilled water/Condenser water systems: screwed sockets or welded joints for sizes up to 50mm; butt-welded joints for sizes 65 mm and above.
b Condensate drain and vent piping systems: screwed sockets joints for sizes up to 50mm; screwed flanges for pipe work 65mm and above.
c Chilled water/Condenser water systems: black malleable iron, bronze to iron spherical seat unions for pipework up to 50 mm diameter. Black mid steel welding flanges to BS 4504 in accordance with the specified working pressure for pipework above 65mm diameter.
d For condensate drain and vent piping systems: Galvanised malleable iron, bronze to iron spherical seat unions for pipework up to 50 mm diameter. For pipes of 65 mm diameter and above, galvanised malleable iron, bronze to iron spherical seat unions or galvanised steel screwed boss flanges to BS 4504 Part 1.
e For fan coil unit connections: Union or flange joints

3.2.13.3.6 Supports and hangers

a Pipework supports and hangers shall be to BS 3974 Part 1 and 2.
b Supports for insulated piping: high density phenolic/PUF insulation extending on either side of the support.
c Unless specified otherwise, hangers shall be of the following sizes:

Pipe diameter (mm)	Single rod diameter (mm)	Double rod diameter (mm)
15 to 50	10	10
65 and 80	13	10
100 and 125	15	13
150	20	15
200;250 and 300	22	20
Above 300	Hanger rod shall be designed with a safety factor of 5, based on the ultimate strength of the material used	

d Buried galvanised/steel pipes shall be protected from rusting with approved good quality bituminous paint and protective tapes.

3.2.13.3.7 Installation

a Construction of pipeline shall be in accordance with BS CP 2010: Part 2, 3 and 4.
b The installation shall be neat and tidy, with accurate spacing between pipes, valves and joints, whether running in straight routes or turning through bends.
c Particular care shall be taken that all pipework is erected and secured truly parallel with the building structure, clear of obstructions, preserving headroom and keeping passageways clear and that all vertical drops are plumb.

d No bends or curves in any pipe shall be made to diminish the waterway or alter the internal diameter of the pipe.

e Wherever possible, horizontal pipes shall be fixed to 'fall' to aid venting and draining down of the pipework. Eccentric reducing sockets shall be used on horizontal runs of pipe to prevent the formation of air pockets. On vertical pipes, concentric reducing sockets shall be used.

f Drain outlets shall be provided at all low points of the system to enable emptying and to facilitate maintenance of the pipework.

g Automatic/manual air vents shall be placed at each high point of each water line and discharge pipe shall be terminated at 50 mm above floor drain.

h Pipe runs, where exposed, shall be positioned at least 25 mm from the finished wall surfaces to enable subsequent cleaning and painting of all surfaces. Where pipe runs are installed at an angle, they shall be positioned 40 mm from the finished surfaces.

i All pipes shall be fitted clear of the floor to permit cleaning beneath the pipes. Where possible, a 125 mm clearance shall be provided between the underside of the pipe and the finished level of the floor and in no case shall the pipe be less than 100 mm clear of the floor.

j All pipe runs when not buried underground shall be concealed as far as possible by careful positioning or shall be chased into walls, or laid in screeds except inside plant rooms. All pipes which are to be concealed shall be tested and Approved before being covered.

k Where it is not possible to install the pipework with setting out dimensions as shown on the Drawings, minor deviations will be allowed, subject to prior Approval.

l Where pipes pass through walls and floors, steel pipe sleeves shall be provided to allow free axial movement of the pipes and shall be sealed with fire sealant. Sleeves passing through walls shall be of sufficient length to fully enclose the pipe, from one side of the finished wall to the other side. Sleeves passing through floors shall protrude at least 50 mm above and below the finished floor and soffit to enclose the pipe.

m All pipes passing through the roof shall be provided with at least mm lead flashing sandwiched between the layers of waterproofing roofing membrane, and secured to the pipe with a galvanized spring clip.

n Where pipes pass through water-containing chambers, puddle flanges of Approved design shall be provided.

o Accessible pipes shall be flanged or union connected in sections of three nominal lengths for dismantling. Embedded pipework shall be in straight lengths as far as possible. Pipes with screwed joints shall be installed with hexagon unions at suitable positions for easy removal of equipment.

p All pipe installations shall be provided with removable sections to facilitate pipe-cleaning operations.

q Pipework shall rest freely upon supports and be carefully aligned prior to final connection.

r All pipes on straight runs shall be lined up with facilities for pipes to be rotated for the process of welding joints to avoid welding from the bottom as far as possible.

s During storage, all pipes shall have end covers fitted to prevent the ingress of any unwanted particles or waste.

t During installation, all open ends of pipes shall be blanked off with blank flanges or pipe caps. These shall be removed only immediately prior to connecting to adjacent sections. As soon as pipes have been installed, all open ends shall be covered to prevent entrance of materials that would obstruct the pipes. Covers shall be left in place until removal is necessary for completion of the installation.

u Damage to coatings or linings during material transport or handling on Site shall be repaired to the Project Manager's satisfaction before installation of the pipework and fittings commences.

v The Engineer reserves the right to reject any material deemed to be unsuitable for installation and such material shall be removed from the Site and be replaced with approved material at no extra cost to the Employer.

w Steel welded fittings shall be of the same weight as the piping with which they are to be used complying with ANSI B 16.9 and ASTM A234. Long radius welded elbows shall be used at changes in the direction of the pipe work. Welded tees shall be used for branches of the same size as the main pipe. Long radius reducing elbows shall be used at pumps. Reducing outlet tees shall be used for branches of smaller size than main pipe. Where the branch size is three or more pipe sizes smaller than the main pipe, steel gussets to provide full pipe strength shall be used. Where a branch is connected to screw piping, a steel welded threaded socket shall be used. Eccentric welding reducing fittings shall be used at changes in pipe size for horizontal piping, with top level for water piping.

x All pipes shall be colour coded, symbolled and direction of arrows shall be provided. The location of symbols and arrows indicating directions shall be as follows.
   i. Every 6 meters internal of straight line pipe.
   ii. Near all valves
   iii. Every change of directions and or separation
   iv. Where pipe pass through wall or floors
   v. Near service pipe

   The identifications previously mentioned shall have colour as required by NBC and IS standard.

3.2.13.3.8 Supports

Unless otherwise specified or indicated, all brackets, stays, frames, fixed and roller supports and hangers necessary to carry and support all pipes and valves shall be provided as below.

Steel pipe Nominal Bore (mm)	Maximum intervals for vertical runs (m)	Maximum intervals for horizontal runs (m)
15-40	2.4	1.8
50	2.7	1.8
65-80	3.5	3.5
100	4.0	4
150 and above	4.5	4.5

Where hangers and/or supports are provided for insulated chilled water pipes, high density phenolic insulation approximately 100 mm long shall be inserted, the outer diameter being identical to that of the insulated pipe and the ends thereof facing tight the pipe.

3.2.13.3.9 Hangers

a Hanger's rods of steel, threaded and fitted with two removable nuts at each ends for positioning rod and hanger and locking each in place shall be provided.

b Secure hangers from metallic inserts cast into concrete. When these inserts are not available, attachment by anchor bolts to be placed with fast setting high strength grout shall be used.

c Supports and hangers shall be placed as close as possible to joints. When hangers or supports are not within 300 mm of branch line fitting, additional hangers or supports shall be provided at the fitting.

3.2.13.3.10 Welding

a Steel piping shall be mill-bevelled on both ends before welding, bevelled to 37.5°. Weld spacing on all butt welds shall comply with the following table.

Nominal pipe wall thickness (mm)	Spacing (mm)	Bevel angle (°)
6.35 or less	3	37.5

6.35 to 19.5	5	37.5

b Backing rings shall be used on all butt-welded joints

c Before starting any welding, all corrosion product and other foreign material from surfaces to be welded shall be removed by scraping, brushing, chipping and swabbing.

d Welding process: welding shall be carried out by either manual shielded metallic arc process or automatic submerged arc process using direct current. All pipeline welding shall conform to Chapter 4, Section VI, "Welding of pipe joints", of ANSI code for pressure piping, ANSI B31.1, and in accordance with latest accepted practice applicable to the particular service. Welding procedure specifications shall be submitted for Approval.

e Welding operation: Electrodes, voltage, current, thickness and number of passes or beads, shall be as previously specified. After deposition, each layer of weld metal shall be cleaned to remove all slag and scale by wire brushing and grinding and chipped where necessary to prepare for deposition of the next layer. Welded reinforcement shall be not less than 1.6 mm nor more than 3.18 mm above the normal surface of sections being welded. Reinforcement shall be crowned at centre and tapered on each side of surfaces being jointed. Exposed surfaces of weld shall present workman like appearance and be free of depressions below surface of jointed members.

f Weld metal shall be thoroughly fused with base metal at all sections of weld. Penetration of weld shall include unbevelled portion and extend to inside walls of pipe.

g Inspection: All welds shall be inspected visually and non-destructively by the Engineer. The Engineer reserves the right to order at random the examination of 2 % of the number of the welded joints for ultrasonic test by an independent firm nominated and paid by the Contractor. Should any one of the above welds prove faulty in materials or workmanship, further test of welds will be ordered up to a total of 4 % of the welded joints. If the number of welds failing the tests within the above 4 %, it is sufficient to suggest that an operative is not consistent in standard, the Engineer may order any number of that welds to be removed and rectified at no extra cost to the Employer.

h Certification on the qualification of each welder in accordance with BS EN 287: Part 1 shall be submitted.

3.2.13.3.11 Jointing

a Pipes shall be cut in a neat manner without damaging the pipe. Unless otherwise approved by the Engineer cutting shall be done with an approved type of mechanical cutter. Wheel cutters shall be used only when practicable. Pipe ends shall be reamed to remove burrs.

b Flanges and unions shall be face true. Flanges shall be provided with approved gaskets and made square and tight.

c Screw joints shall be made with tapered threads properly cut. Joints shall be made tight with Teflon tape. Not more than three threads shall show after the joint is made up.

d Flanges and unions shall be faced true. Flanges with approved gaskets shall be provided and made square and tight. Union or flange joints shall be provided in each line immediately preceding the connection to each place of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items.

3.2.13.3.12 Protective coating

a Buried steel pipes shall be protected against corrosion by treating with two coats of good quality bituminous paint and fully wrapped with an Approved weatherproof tape before laying.

b Under special circumstances, such as in ground containing industrial wastes, refuse, ashes, clinker, or in aggressive water-logged clays, additional external protection shall be provided.

c Where buried metallic pipes cross the route of the railway, the pipework shall be electrically continuous and double half-wrapped with an approved electrical insulating tape.

d Piping near and around Cooling towers shall be FRP coated.

3.2.13.3.13 Testing

a At Manufacturer's factory, samples of pipes and fittings shall be tested and certified to the relevant IS/BS. Test certificates shall be submitted for each type of pipe and fitting to the Employer.

b All pipework including valves and fittings shall be hydrostatically pressure tested to 1.5 times the duty head of the system or 1.5 times the closed delivery valve pressure of the pump, whichever is the highest. The pressure shall be held for a minimum period of 24 hours.

c The Contractor shall perform hydrostatic testing of all piping. Preliminary tests shall be carried out to demonstrate that the work is satisfactory. The Engineer and all authorities having jurisdiction shall be notified in ample time to be present for final testing of all piping. Testing shall be carried out before insulating or concealing any piping takes place. Defects disclosed by tests shall be repaired and the complete test repeated. Tests shall be carried out in stages if so ordered by the Engineer to facilitate work of others. Use of wick in tightening leaking joints is not permitted.

d Refrigerant pipework when completed shall be pressure tested by nitrogen gas in two or more steps as recommended by manufacturer and maintained for at least 24 hours. Prior to charging any additional refrigerant as necessary into the system, it shall be vacuum dried. A vacuum test of 1 mm of mercury shall be applied to the pipework and held for 8 hours. The vacuum shall not rise beyond 2 mm of mercury during the 8 hour test.

3.2.9 Pipe line Fittings

3.2.9.1 General

a This Section specifies the furnishing of globe valves, gate valves, check valves, butterfly valves, motorized valves, gauge cocks, automatic air valves, strainers, dirt pockets, stopcocks, pressure reducing valves, double regulation valves, safety and relief valves, thermostatic mixing valves, UPVC valves for flushing water, drain cocks, ball float valves, safety and pressure relief valves, escutcheons, thermometer, pressure gauges, flow measuring elements, vortex inhibitors, pipe sleeves, expansion loops, expansion joints, pipe anchors, pipe guides, gaskets for pipe separation, access pipes, traps, water – closet connectors and fresh air inlets.

b All valves, taps and cocks shall be of the types and working pressures suitable for the systems to which they are connected. Valves shall be rated to withstand the system hydraulic test pressure.

c All Brass, bronze or cast iron valves shall generally be of 16 bar pressure rating (working pressure) type. In addition, all valves at discharge side of transfer water pumps shall be of minimum 16 bar pressure rating.

d Where valves are provided at the discharge side of 2 or more pumps, each valve shall be so selected to withstand effectively the anticipated system pressure under the worst case scenario.

e All valves shall comply with British Standards in respect of tests and working pressures, dimensions and materials of construction.

f Wheel head valves shall be arranged for clockwise operation of the handle to close the valve.

g Screwed valves shall have taper threads to BS 21. Flanged valves shall have dimensions and bolting in accordance with BS 4504.

h Connections shall be made between each valve and the adjoining pipework or equipment with flanges for 65mm size pipework and above. Flanges shall be selected to suit working pressure and temperature.

i Screwed connections shall be made between each valve and the adjoining pipework or equipment for 50 mm size pipework and below. A union/flange joint shall be fitted on each side of all screwed valves.

j All valves shall be suitably located in accessible positions for operation and maintenance purposes.

k All drain outlets and manual air vents shall have connection pipes leading to the nearest drain.

l Valve packing shall be suitable for the service intended. Valve packing consists of asbestos or asbestos based materials shall not be used.

m Valves of identical make, size, type and duty shall be fully interchangeable.

n Inverted mounting of valves shall not be permitted without prior Approval.

o All valves provided for manual operation shall have a hand wheel or other suitable device which shall be fixed to the valve. Hand wheels shall be rotated clock-wise to close the valves and shall be clearly marked with the words "OPEN" and "CLOSE" and arrows pointing in the appropriate directions. The rims of hand wheels shall be machined to a smooth finish. All hand wheels which may be dangerously hot to touch when the system is in use shall be provided with an Approved heat insulation on the rim and spokes.

p Chain-operated hand wheels shall be provided including rustproof chain and chain guide for valves installed two metres or more above finished floor.

3.2.9.2 Quality control

Material and workmanship shall be in accordance with the latest edition of the following standards and codes, and the materials shall be certified by the standard organisation.

Standard	Standard no.	Description
ASTM		**American Society For Testing and Material**
	ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium – Nickel Steel Plate, Sheet and Strip
BS		**British Standard**
	BS 21	Pipe Threads for Tubes and Fittings where Pressure-Tight Joints are made on the Threads (Metric Dimensions)
	BS 699	Copper Direct Cylinders for Domestic Purposes
	BS 759	Valves, Gauges and other Safety Fittings for Application to Boilers and to Piping Installations for and in Connection with Boilers
	BS 853	Clarifiers and storage Vessels for Central Heating and Hot Water Supply
	BS 1010	Draw off Taps and Stop valves for Water Services (Screw down Pattern)
	BS 1212	Float Operated Valves (Excluding Floats)
	BS 1400	Copper Alloy ingots and Copper alloy and High Conductivity Copper Castings.
	BS 1452	Flake Graphite Cast Iron
	BS 2456	Floats (Plastics) for Floated Operated Valves for Cold Water Services
	BS 2879	Draining Traps (Screw – Down Pattern)
	BS 3456	Safety of Household and Similar Electrical Appliances
	BS 4346	Joints and Fittings for Use with Unplasticized PVC Pressure Pipes

Standard	Standard no.	Description
	BS 4504	Circular Flanges for Pipes, Valves and Fittings (PN Designated)
	BS 4514	Unplasticized PVC Soil and Ventilating Pipes, Fittings and Accessories
	BS 4994	Design and Construction of Vessels and Tanks in Reinforced Plastics
	BS 5150	Cast Iron Gate Valves
	BS 5152	Cast Iron Globe and Globe Stop and Check Valves for General Purposes
	BS 5154	Copper Alloy Globe, Globe Stop and Check, Check and Gate Valves
	BS 5155	Butterfly Valves
	BS 5163	Predominantly Key–Operated Cast Iron Gate Valves for Waterworks Purposes
	BS 7350	Double Regulating Globe Valves and Flow Measurement Devices for Heating and Chilled Water Systems

3.2.9.3 Technical and installation requirements

3.2.9.3.1 Globe Valves

a. Generally, globe valves shall be used on service pipelines where regulation is required, and shall be supplied and fitted in positions indicated on the Definitive Design Drawings.
b. The bodies shall be of an even thickness throughout, clean and free from scale and flaws. Valves up to and including 50 mm nominal bore shall have bronze body and valves of 65 mm bore and larger shall have cast iron body. No material used shall be susceptible to dezincification.
c. Globe valves are used for circuit regulation and shall have characterised plug discs. The discs shall be free to rotate, readily removable from the valve stem and renewable. Discs may be manufactured proprietary composition type materials if approved by the Engineer.
d. Valves may have packed stuffing boxes or be fitted with 'O' rings.
e. Valves up to and including 50 mm nominal bore shall have taper screwed ends, valves of 65 mm nominal bore and larger shall have flanged connections.
f. Regulating valves shall be fitted with a lockable spindle to limit the proportion open once regulation is complete.
g. Bronze globe valves shall be rising stem pattern. Cast iron globe valves shall be outside screw rising stem type.

3.2.9.3.2 Gate Valves

a. Generally, gate valves shall be used on service pipelines where isolation of plant, equipment and system circuits is required and shall be fitted in the locations indicated on the Definitive Design Drawings.
b. The bodies shall be of an even thickness throughout, clean and free from scale and flaws. Valves up to and including 50 mm bore shall be bronze, 65 mm bore and larger shall be cast iron. No material used shall be susceptible to dezincification.
c. Valve wedges may be of cast iron, bronze, nickel alloy or stainless steel. Cast iron wedges shall have bronze trims and seating. Wedges shall be renewable and free to rotate on the valve spindle.
d. Valves may have packed stuffing boxes or alternatively may be fitted with 'O' rings.
e. Bronze gate valves shall have non-rising spindles. Cast iron body gate valves shall be outside screw rising stem type.

3.2.9.3.3 Balancing Valves

a. The balancing valves shall be capable of measuring, regulating and isolating the flow.
b. The balancing valves up to 40 mm dia shall be of gunmetal screwed type and 50 mm dia and above shall be C.I double-flanged type confirming to B.S. 1452 or equivalent specifications.
c. The balancing valve pressure measuring nipples shall be made of stainless steel AISI 410. All other internals shall be non-corrosive material preferably of forged brass.
d. The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.
e. The valve shall be complete with two ports for connections to a mercury manometer, to measure the pressure drop, as well as drain port.
f. The spindle shall have a shielded/concealed locking screw to avoid the tempering of the setting after balancing.
g. The valves must have easily accessible pressure drop measuring facility.
h. The balancing valve shall have indication of number of turns on hand wheel preferably digital type.

3.2.9.3.4 Flow Measurement Valves

a. Flow measurement valve sets shall comprise a screwed or flanged gate valve close-coupled to a flow measurement device.
b. Sets up to DN50 size shall be screwed end valves and threaded nipple type carrier with integral orifice ring. Sets DN65 size and above shall be flanged and include an orifice plate and carrier with mating flange. Sets shall be used for measurement and isolation in conjunction with a double regulating valve.

3.2.9.3.5 Flow Measurement Variable Orifice Double Regulating Valve

a. Double regulating valves as described shall additionally be provided with 2 No. double seated pressure test valves for flow measurement in conjunction with a double regulating valve used in a balancing application.
b. Flow Measurement Fixed Orifice Double Regulating Valves (FODR Valves)
c. FODR valves up to DN50 shall be as for double regulating valves to BS 7350 or other equivalent standard directly coupled to a flow measurement device comprising male/female threaded nipple type carrier with integral orifice ring and 2 No. double seal pressure test valves.
d. FODR valves DN65 and above shall be cast-iron double regulating valves to BS 7350, or other equivalent standard with flanged connections.
e. The flow measurement device shall comprise a single piece stainless steel square edged orifice plate carrier with 2 No. double seal pressure test valves, integral orifice to fit between the valve outlet flange and mating flange.
f. Low flow rate commissioning sets shall comprise bronze double regulating globe valve with bronze stem, slotted parabolic disc and screwed ends, close-coupled to a bronze carrier with integral fixed orifice and 2 No. double seal pressure test points.
g. Butterfly valve commissioning sets DN65 to DN300 shall comprise cast-iron wafer semi-lugged valves with stainless steel shaft, aluminium bronze disc, nitrile liner and gear operated double regulating properties close-coupled to fixed orifice nickel-plated cast-iron measuring station, with 2 No. double seal pressure test points.

3.2.9.3.6 Check Valves

a. Check valves shall be of double door type, supplied and fitted in the locations indicated on approved Drawings. Care shall be taken to ensure that the valves supplied are suitable for installation in the plane required as per data sheets. Check valves shall be installed in vertical pipes.

b. Check valves up to DN50 shall be bronze with renewable nitrile rubber faced disc and screwed-in cap with ends screwed taper thread.
c. Check valves DN65 to DN150 shall be cast iron with bronze seat and trim and nitrile rubber faced disc with flanged connection.
d. Check valves DN200 and above shall be with metal faced disc, bronze trim with flanged to connection to PN16.

3.2.9.3.7 Butterfly Valves

a. Valves of DN40 and larger shall be of cast iron body and arranged to be fixed between pairs of mating flanges (wafer body) with interconnecting long bolts except for 'end of line' service or equipment isolation. Valves shall be fully lugged type.
b. Valve stems shall be of stainless steel.
c. Compound rubber seat rings shall have excellent elasticity as well as wear resistance to ensure positive water shut-off under the designed working pressure. Moulded in O rings shall provide positive flange sealing to eliminate need for gaskets.
d. All isolation valves shown on pipe schematic for all major branches and risers shall be lugged butterfly valves.
e. Valve discs shall be either stainless steel or aluminium bronze and shall be machined to give tight shut off against the valve seat.
f. Valves shall be supplied with graduated indicator plates to show disc position.
g. Generally valves up to and including DN150 shall be lever operated and valves in excess of DN150 shall be provided with gear operation.
h. Motorized butterfly valve for Chillers, cooling towers shall be 2 positions ON/OFF type Butterfly valve with standard train. The valve shall be controlled by an electric actuator mounted directly on the valve. The actuator shall have a reversible synchronous motor and generate the desired stoke by gear train. It shall be suitable for interfacing with BMS.
i. Actuator
   - Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
   - Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required flow.
   - Two-position or open/closed actuators shall accept 24 or 230 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or Chiller

3.2.9.3.8 Ball Float Valves

a. Level controllers size 15mm shall be brass bodied float operated valves of the diaphragm type with discharge component to effectively prevent back-siphoning of water, all in accordance with BS 1212 Part 2. Copper floats shall be to BS 1968, and plastic floats to BS 2456 or equivalent.
b. Valves DN20 to DN30 shall be gunmetal bodies double seat balanced equilibrium type of full bore pattern with inlet screwed end.
c. A stopcock shall be fitted on the inlet to all ball float valves.
d. Ball float valves of the delayed action type shall incorporate an equilibrium type ball valve with the float operating in an auxiliary chamber within the storage tank, cooling tower, etc. A second float below the base of the chamber shall operate a quick-operating valve, which shall provide open/shut control. Such ball valves shall be fitted where indicated on the Definitive Design Drawings.
e. Ball float valve installations shall be complete with water stilling pipes to minimize the effect of the water inflow on the operation of the floats and the level controllers.

3.2.9.3.9 Ball Valves

a. Ball valves up to DN50 shall be copper alloy bodies confirming to BS 2872 or equivalent, have an inhibited brass body with chrome coated ball plug and valve stem, and PTFE seat and seals.
b. Valves shall be 1/4 turn lever handle operated.
c. Valves DN65 and above shall be cast iron.

3.2.9.3.10 Strainers

a. Strainers shall be 'Y' pattern, unless otherwise indicated, suitable for the working pressures and service of the piping system and of the same nominal bore as the pipeline in which they are to be installed.
b. Strainers shall be screw or flanged connected to suit the isolating valves adjacent to, and on the 'dead' side of which they shall be installed.
c. Strainers 15-300mm for use up to 120°C shall have upstream and downstream self-sealing test points incorporated and two blank tapped points.
d. Baskets/screens shall be readily accessible for removal with adequate clearances for inspection and clearing.
e. Baskets/screens shall be of specified sheet material with perforations recommended by the manufacturer for the service application.
f. Baskets/screens shall be cleaned with solvent after pipeline pre-operational cleaning and shall be again thoroughly cleaned before issue of a Completion Certificate.
g. Strainers for cold service up to 17 bar and size DN15 to DN40 shall be gunmetal body, screwed ends, with stainless steel screen, non-ferrous cap and non-asbestos cap gasket.
h. Strainers DN50 to DN200 shall be cast iron flanged body, with stainless steel strainer screen, cast iron cap, and asbestos-free reinforced non-stick cap gasket. The cap shall be complete with 20mm drain valve fitted with hose union.
i. Strainers DN250 and above shall be cast steel flanged pot-type with scantlings as for DN200.

3.2.9.3.11 Drain Valves

a. Drain valves shall be provided at the bottom of every riser and at all low points within the water systems to enable full draining down of the entire system.
b. Drain valves shall comply with BS 2879, be screwed end, solid wedge disc, inside screw, non-rising stem, screwed in bonnet lock shield type bronze gate valves with hose union connection.
c. Extended drain lines shall be of the same size as the drain valves.
d. Drain valves shall be of sizes indicated below:

Main Pipe Size (DN)	Drain Valve Size (DN)
Up to 25	15
32-100	20
100-300	32
300-600	50

3.2.9.3.12 Gauge/Test Cocks

a. Gauges and other instruments shall be fitted with a gauge cock between the instrument and the service pipe.
b. Gauge cock bodies shall be bronze construction with polished finish and parallel threads.
c. Gauge cocks for use with chilled water; condenser cooling water and cold water shall be of the straight pattern, ground plug type with lever handle.

3.2.9.3.13 Automatic Air Eliminator Valves

a. Connections to the service pipe shall be made at the highest point to ensure complete venting. Valves shall be mounted so that the inlet connection is in an exact vertical plane. A lock shield valve shall be provided between service pipe and automatic air release valve. The highest point shall include both ends of Station pipework and also Auxiliary Building pipework.
b. Valves for water systems may have bodies of brass, gunmetal or malleable iron, non-ferrous or stainless steel floats and guides, and non-corrodible valves and seats.

3.2.10 Expansion Tank

The Chiller system shall include for a pressurised closed type expansion tank of suitable capacity. The tank shall be rated for a pressure 16 bar and a temperature range between 5°C to 50°C. The tank shall be fitted with a safety valve. The tank shell shall be heavy gauge carbon steel and the replaceable membrane shall be of butyl/EPDM material.

3.2.11 Ductworks, Dampers, Diffusers and Accessories

3.2.11.1 General

a. This Section specifies furnishing of ductwork, diffusers, registers, grilles, dampers, guide vanes, cleaning of air system, access panels and accessories.
b. All ductwork and distribution accessories delivered to Site shall be new and indelibly stamped to identify different grades, materials and manufacturers.
c. Provide all ductwork, diffusers, registers, dampers and grilles generally in accordance with the GFC Drawings to be performed during final design stage.
d. Diffusers, registers and grilles shall be selected to meet the requirements of noise control as described elsewhere in this Specification.

3.2.11.2 Quality control

Relevant Codes and Standards

Standard	Standard no	Description
HVCA		**Heating and Ventilation Contractors Association**
	DW/144	Specification for Sheet Metal Ductwork, Low, Medium and High Pressure/Velocity Air Systems
BS		**British Standards**
	BS 476	Fire Tests on Building Materials and Structures
	BS 729	Hot Dip Galvanized Coatings on Iron and Steel Articles
	BS 5669: Part 1	Methods of Sampling, Conditioning and Test
UL		**Underwriters Laboratories**
	UL 555	Fire Dampers
	UL 555S	Leakage Rated Dampers for Use in Smoke Control Systems
SMACNA		**Sheet Metal and Air-conditioning Contractors National Association Inc.**
		HVAC Duct Construction Standards, metal and Flexible and Rectangular Industrial Dust Construction Standards
IS		**Indian Standard**
	IS 277	Galvanized steel sheet.
	IS 513	Cold rolled carbon steel sheets.

	IS 655	Metal air ducts.

3.2.11.3 Technical and installation requirements

3.2.11.3.1 Sheet Metal Ductwork

a. All sheet metal and stainless steel ducting shall be constructed to the recommendations of referred standards above. The pressure class rating shall also be in accordance with referred standard.
b. Ductwork shall be constructed of galvanised steel sheets of coating type as specified in and of minimum thickness complying with standards as listed above.
c. Provide splitter dampers, complete with adjusting handle or similar device to all branches of the supply air ducts to regulate air flows along the main duct and the branch ducts. Provide opposed blade type volume control dampers to all branch.
d. Provide flexible connectors of not less than 100 mm long between primary air handling units/air handling units/fans and related ductwork to prevent transmission of vibration to adjacent elements. Flexible connectors shall also be provided at building/station expansion and movement joints.
e. The material used for the flexible connections shall withstand the specified conditions of temperature and air pressure, and shall comply with the standards of air-tightness. The material shall be fire resistant.
f. Provide access doors in ducts where required to gain access to fans, silencers, dampers, filters or controls for cleaning and future maintenance.
g. Access doors and panels in ductwork shall be quick release type with handles. Multiple screw fixings will not be accepted. The doors shall be of air-tight construction with gasket mounted on the periphery of door frame.
h. Provide flanged joints to plant and elsewhere as necessary to facilitate maintenance.
i. All flanged joints in ductworks shall be made up with rubber gaskets or suitable mastic material. These joints should also be connected with suitable material for earthing. Proper sized electrical continuity jumpers (min. 2 per joint) is required to be provided for making the duct work continuous. The gaskets provided should be fire retardant and should not emit toxic gases in case of fire.
j. Apply sealant, adhesives, and tapes to joints for sealing. All such material shall comply with the requirements as per standard.
k. Balancing dampers of appropriate types shall be provided for air balancing.
l. Short radius rectangular and square elbows in air ducts shall be equipped with double thickness turning vanes. Long radius elbows shall be used wherever possible.
m. The transition ductwork between silencers and fans shall be constructed of not less than 1.2mm thick galvanised steel sheet. The transition shall be aligned with the fans and shall be connected with angle flanges.
n. The ducts and supports in the stations must be adequate for minimum 100 mm wg static pressure or the system pressure whichever is the higher.

3.2.11.3.2 Flexible Ducts

a. Flexible ducts shall be neatly fixed and adequately supported.
b. Flexible ducting used to connect the air distribution accessories and main ductworks shall comply with referred standard.
c. Flexible duct length shall not exceed 3.7m in length. Sheet metal duct branch off shall be provided in case the maximum length of flexible duct permitted is not long enough to reach the air terminal.
d. Bending radius shall be sufficient to prevent undue tensioning of the outside of the bend and restriction of the throat likely to cause deformation and/or leakage. The ratio between the bending

radius and the duct diameter shall be less than 2. In no case shall flexible ductwork be used to connect misaligned ducts.

e. Flexible duct shall consist of flexible corrugated metal tubing of stainless steel, aluminium, tin plated or aluminium coated steel and suitable for an operating temperature range of –5 to 35°C.
f. The frictional resistance to air flow per unit length of flexible duct shall not exceed 150% of the frictional resistance per unit length of galvanised steel duct of similar diameter.
g. Flexible duct shall be insulated and wrapped with a minimum 25mm thick 24kg/m^3 density fibre glass blanket.
h. Flexible duct shall not be used for any system which is designed for handling smoke or being part of a smoke control system.

3.2.11.3.3 Fusible link Fire Dampers

a. Provide fire dampers in air ducts where ducts penetrate fire compartments.
b. Fire dampers shall be constructed to the same standards of air tightness as the rest of the system.
c. Fire damper casings and blades shall be constructed of galvanised sheet (275 GSM) and provided with a galvanised steel angle frame to each side of wall or floor.
d. Fire damper casings shall be flanged to suit the ductwork which they are fitted and the cross-sectional area shall not be less than that of the ductwork.
e. Blade and fusible link shall be accessible for servicing through air-tight inspection doors placed upstream or downstream of the air path whichever provides the better access.
f. Provide Approved fusible link set at 68°C or else as approved to all fire dampers unless otherwise specified. Fusible link shall be arranged in an exposed position and at upstream of the damper.
g. Details and position of all fire damper and associated access doors shall be submitted for Approval prior to installation on Site.
h. Provide all necessary fixing framework for the installation of fire dampers.
i. Provide fire rated material to seal off the clearance between the fire dampers and wall.

3.2.11.3.4 Fire Rated Ductwork

a. Where shown on the Drawings, fire rated ductwork or equipment enclosure shall be fabricated from fire rated material to the requirements of BS 476 Part 24 or ISO 6944.
b. The fire rated ductwork shall follow the latest Code of Practice of Fire Resisting Construction BS 9999 and BS 7346 Part-2.
c. The construction of the ductwork or enclosure shall take into account the structural strength, noise isolation as required.
d. All necessary supports, and other accessories required for the complete installation of fire rated ductwork, Sealant, Gasket, including additional material for fire stopping at wall/ceiling penetration, shall be supplied by the same manufacturer as the fire rated duct material and shall be assembled in accordance with all the manufacturer's recommendation regarding all aspects of construction and installation shall be certified by the manufacturer.
e. The applicable smoke temperature shall be 250°C. The ductwork system shall be fire-rated for two hours and shall maintain mechanical stability, fire resistant integrity, and thermal insulation criteria to BS 476: Part 24 as per the ISO Cellulosic Fire Curve at temperature of 1029°C, for both vertical and horizontal duct arrangements, for both inside and outside fire exposures. Restriction of the duct due to twisting or buckling after the fire test shall not cause 25% or more reduction in cross-sectional duct area.
f. The performance shall not be affected by moisture absorption. Mechanical strength shall be maintained and the fire resistance material shall not de-laminate or the fire resisting properties shall not deteriorate even under water saturation. The material shall also be "Class-One" surface

spread of flame as defined in BS 476: Part 7. Additional insulation, if required, shall be used as per the manufacturer's recommendation.

g. Fire rated air-conditioning supply, return, and exhaust ductwork shall be complete with thermal insulation and vapour barrier.
h. The fire resistant material shall not attract pests and shall not rot or support the growth of mould.
i. All fire resistant ductwork or enclosure, apart from its fire resisting quality, shall be capable of resisting accidental damage and shall require to pass the hard body impact test section of BS 5669: Part 1 with the weight being dropped through not less than 1m.
j. Smoke extraction system ductwork shall be made from suitable material with adequate thickness. Rivets or self-sealing screws used shall not be of aluminium. Where ductwork (including sealant, flexible connection, gasket and accessories) for smoke extraction / purge systems penetrate the fire compartment walls or floors of the room which they serve, the portion of the ductwork that traverses outside of the compartment wall or floor shall have a fire rating equal to the fire rating of the compartment wall or floor which it traverses through or of not less than two hours whichever is the higher.
k. Fire resistant and acoustically sealed access panels shall be provided in the above-mentioned enclosures for the access and maintenance of equipment and fire dampers.

3.2.11.3.5 Motor Operated Dampers (MOD)

a. All motor operated dampers shall be suitable for installation in either a vertical plane or a horizontal plane.
b. The dampers shall be operated by electric actuators and shall be readily assembled on Site from modular panels. Each motor operated damper panel shall be of the multiple-parallel-blade type, with an independent channel frame; and shall be factory-assembled complete with frames, blades, shafts, bearings, seals, linkage, and all accessories required to erect the panels into composite dampers. Motor operated dampers shall be provided with all structural support members and hardware required for installation with additional framing or trims as required to complete the installation.
c. Motor operated damper actuator shall be mounted outside of the damper frame.
d. Spring-return type damper actuator shall be provided either to open or close damper as required in the event of power failure.
e. All motor operated dampers shall be the product of a single manufacturer; and all like components shall be provided by a single supplier.
f. Motor operated damper module assembly shall have a net free face area of not less than 80% measured to the inside of the frames.
g. Dampers shall be based on standard air having a density of 1.20 kg/m³. This shall apply to MOD and MSFD/MFD.
h. The motor operated damper manufacturer shall carry out factory tests to verify that when the dampers are fully-closed and holding against a differential pressure of 1000 Pa, air leakage through the damper will not exceed 0.1 m^3/s per square metre of net damper face area.
i. When the dampers are in the fully-open position and air is flowing across the damper at a uniform velocity of 10 m/s and the static-pressure drop across the damper shall not exceed 38 Pa.
j. The motor operated dampers and their associated structural-supporting systems shall, when the dampers are in the fully - closed position, be capable of withstanding a differential pressure across the dampers of not less than 1.5 kPa.
k. The motor operated damper blade and shaft assemblies shall be supported at each end by means of heavy duty, permanent self-lubricating bronze or stainless steel bearings.
l. All motor operated damper-blade seals and damper-frame seals shall be fabricated of a flexible material suitable for the specified operating conditions as Approved. The seals shall be factory-

installed in dovetail grooves incorporated for this purpose in the design of the blade and frames to facilitate a tight closure between the blades, and between the blades and frame. All seals shall sit securely in the closed damper position. Alternative design of the seals will be subject to the Approval of the Engineer. Noise due to resonance of spring-type seals or any other source shall be rejected.

m. Each module of damper with only two operating positions should have one limit switch with two contacts to monitor its open/closed status. If anyone module of the damper fails to operate, the damper shall be considered not functioning properly. For each module of damper with three operating positions, two or more limit switches shall be provided.
n. Motor operated damper linkage shall consist of stainless steel (SS-316), extending through bearings inserted in brackets fabricated of stainless steel. The linkage bearings shall be fabricated from bronze or other material suitable for the specified operating conditions as Approved. The linkage brackets shall either be attached to the damper-blade shafts or be side-mounted and mechanically inter-connected with the shafts. Set screws shall not be used in the linkage assembly.
o. Motor operated damper frames shall be a channel cross-section with not less than a 100 mm web and 50 mm flanges, and shall be fabricated of hot-dipped galvanised steel plate (min. 275 GSM) to BS EN 10142. Reinforcing bosses and dove-tail grooves for mounting frame seals shall be integral parts of the channel configuration. The corners of the frames shall be either welded or reinforced by means of riveted gusset plates.
p. All screws, bolts, nuts, washers, expansion anchors, and/or other hardware required to complete the installation shall be fabricated from stainless steel grade 316, and all intermediate supports, framing members, and hardware required for assembly/installation of the damper shall be fabricated of hot-dipped galvanised steel to BS 729.
q. The motor operated dampers shall be installed using fastening devices and structural support elements herein specified, and in accordance with the published instructions of the damper manufacturer.
r. Motor operated damper blades shall have an aerofoil cross-section, and shall be fabricated of hot-dipped galvanised steel plate (min. 275 GSM) to BS EN 10142 extruded to a minimum thickness of 2 mm. The width of the blades, measured in the direction of airflow shall not be less than 100 mm and shall not be greater than 200 mm.
s. Motor operated damper-blade shafts shall be fabricated of stainless steel SS-316. The design of the shafts shall incorporate the devices required for securely locking the blades onto the shafts.
t. All VCDs, and MDs shall comply with above specifications. VCDs shall have provision to set & lock the damper at any desired position, whereas, MDs shall have a two position set and lock facility only. These would be made of GSS (275 GSM) with 2 mm frame and blades.

3.2.11.3.6 Motorised Smoke and Fire Dampers (MSFD/MFD)

a. MSFD/MFD shall comply with the following requirements.
b. MSFD/MFD frames and other components made of steel shall be hot-dipped galvanised to BS EN 10142 and shall not be painted. Damper blades shall be fabricated of galvanised steel to BS EN 10142. All unprotected edges shall be touched up with an Approved paint-on type zinc-based protective coating.
c. MSFD/MFD design and construction materials shall be submitted for Approval before manufacturing.
d. MSFD/MFD shall comply with BS 476: Part 20 and UL 555, UL 555S. MSFD/MFD shall be tested in accordance with the procedure specified in UL 555S with respect to the requirements of elevated temperature and air leakage of the MSFD/MFD.
e. MSFD/MFD shall have a minimum fire rating to match with the building structural elements where the MSFD/MFD is mounted.

f. All materials used for the construction of the MSFD/MFD shall be so selected and all components and accessories of the dampers shall be so designed that the dampers will be fully operational in accordance with the performance requirements specified when fully exposed in an air stream temperature of up to 250°C for not less than one hour. Accessories shall include electric actuators, limit switches and any other damper status sensing devices.
g. Actuator shall be of sufficient torque to ensure tight closure of the damper, and shall be capable of being detached with ease to allow manual operation of the damper. The actuator shall be provided with spring return to close or open as required by the design in case of power failure.
h. The actuator linkage shall be capable of being adjusted so as to allow the damper to function as a volume control damper.

3.2.11.3.7 Guide Vanes

Guide vanes shall be provided as required to maintain an acceptable system pressure loss.
All blanking plates and sealing plates shall be provided for a complete installation.
Vanes, supports, stiffeners, flanges, washers, bolts and welding filler shall be of galvanised steel (275 GSM) and constructed to the recommendations of DW/144.
Vanes shall be of continuous seam welded construction, except for stiffening ribs, which may be stitch welded. Welding shall be in accordance with relevant British Standards.
Curved sections shall be rolled or alternatively formed by a series of creases in a break press as long as the creases are closely spaced, not obstructive and form a smooth profile of air flow. If a break press is to be used, a sample of a section of vane shall be submitted for Approval.

3.2.11.3.8 Ductwork Installation

a. Provide complete ductwork systems and ensure that the installation can be adjusted to the designed flow rates to the satisfaction of the Engineer.
b. Check all the Drawings provided in regard to structural requirements and other finishes before detailing the ducting system. Allowance shall be made for the detailed development and on Site co-ordination.
c. Submit all drawings to indicate the fabrication and installation of ductwork for Approval before fabrication commences.
d. Replace damaged ductwork and other appurtenances at no additional cost to the Employer.
e. Provide hangers and supports (Slotted rail), fabricated of hot-dipped galvanised steel, for the proper installation of ducts in accordance with referred above standards. Hanger rods shall be 10 mm or 13 mm in diameter, depending on size of duct. All such hangers shall be provided with screwed lengths on lower end for adjustment of ducting runs to level. All nuts shall be provided with washers and with lock-nuts, and projecting ends of bolts shall be cut off.
f. Supports shall not be riveted or bolted to the air ducts.
g. Install dampers and splitters in a manner so that they can be adjusted at any time after completion of the work.
h. Install dampers without strain or distortion of any part of the dampers.
i. Adjust moving parts to move freely without binding.
j. Caulk dampers airtight around frames.
k. Adjust dampers and splitter adjusting rods to operate freely, between the open and closed position.
l. All ductwork shall be manufactured according to the dimensions taken on Site. Provision shall be allowed to accommodate any discrepancies between the Drawings and the Site dimensions.
m. All branches and openings in ducts shall be purpose made prior to erection of the ductwork.
n. Cross-breaking will be permitted on low velocity ductwork only and in no case where rigid external insulation shall be applied.
o. Internal roughness, sharp edges or obstructions to air flow shall not be allowed.

p. External edges and corners formed from cleated joints shall be neatly dressed down with air tight joints.
q. Provide at least 75 mm clearance from ductwork to walls, ceiling and obstructions where a high standard of cleanliness shall be maintained.

3.2.11.3.9 Diffusers, Registers and Grilles Installation

a. Install diffusers, registers and grilles so that they can be key adjusted from the face directly without special tools.
b. Unless otherwise specified, install vanes, volume control dampers and multiple-blade extractors so that they can be removed through the diffusers and registers for access to the duct.
c. Install diffusers, grilles, registers and louvres with frame connected to the ductwork and provide soft gaskets inserted under the frame or otherwise so arranged so as to avoid air leakage around the diffusers and grilles.

3.2.11.3.10 MOD and MSFD/ MFD Installation

a. Each damper shall be installed so as to provide smooth operation, opening and closing without shock in accordance with the manufacturer's recommendations.
b. Undue flexing or bending of connecting rods and linkage will not be acceptable. Such connecting rod or linkage shall be replaced with either a corrected design, higher strength material or increased size of such a component at no extra cost to the Employer.
c. Dampers shall be supported independently of the ductwork.
d. Wall and floor mounted dampers: All slight, unavoidable spaces and purpose-provided spaces between the damper frames and the structure shall be sealed as required or as Approved. Blanking-off plates for such purpose shall be considered as part of the damper assembly and shall be provided at no additional cost to the Employer.
e. Damper module installations shall be fully sealed by gaskets between the module frame and the mounting frame. The gasket material for MSFD/MFD shall meet the continuous operation in an air stream temperature of 250°C for not less than one hour criteria. Identification of damper position is required on easy visible and accessible position, and the damper setting position after balancing shall be marked in a permanent manner.

3.2.11.3.11 Air Duct Cleaning points

The Contractor shall supply and install air duct cleaning point's access doors at suitable locations to the duct work system. The cleaning points shall be installed at fully accessible locations. All joints must be air/water tight to prevent leakage.

3.2.11.3.12 Grills and Diffusers

a. All grills and diffusers shall be designed and rated in accordance with ASHRAE 32-7.
b. All grills and diffusers shall be of pure polyester finish aluminium unless otherwise specified. Colour of grills and diffusers shall be selected by the Engineer. Samples of finishes shall be submitted for approval.
c. All supply, return and exhaust diffusers shall be complete with opposed blade dampers, suitable for mounting with appropriate diffuser and shall be fitted with concealed adjustment devices. Straightener grids are required before diffusers except for the last diffuser on the route. Each supply air grille shall be complete with an opposed blade multi-leaf damper. One set of tool for every 10 grilles or diffuser shall be provided for volume adjustment.
d. The inside of all components and surfaces of all diffusers and grilles shall be painted matt black. The diffusers and grilles shall be installed in accordance with the final detail drawings and reflected ceiling plans.
e. Velocities, net airways and distribution patterns shall give satisfactory air distribution and temperature equalisation, be free of draughts stratification or noise nuisance. The contractor shall make final adjustments to air patterns when balancing.

3.2.11.3.13 Square ceiling Diffusers

a. Diffusers constructed of extruded aluminium shall be power coated polyester finish to a colour approved by the Engineer.
b. Diffusers with removable cores shall have square necks or alternatively round necks as approved by Engineer.
c. Provide aluminium or steel opposed blades volume control dampers of black colour with concealed adjustment lever. In general, dampers will not be required for fan coil unit system having single supply diffuser.
d. Provide galvanised steel sheet painted black at the front view to seal off dummy parts of diffuser.
e. Diffusers ring or frames shall be compatible with the ceiling construction in which they are installed. A transition piece shall be provided to connect the diffuser to the duct. All edges exposed to view shall be rolled or otherwise stiffened and rounded. Internal parts shall be removable to permit cleaning of the diffuser and provide access to the duct.
f. Baffles, turning vanes or other devices shall be provided for the required air distribution pattern. Equalising grids shall be provided for ceiling diffusers.
g. Volume control dampers shall be equipped and factory fabricated by the diffuser manufacturer. The adjustment position shall be easily accessed.
h. Square and rectangular diffusers shall comply with the following performance requirements at design flow:
   - Maximum pressure drop : 30 Pa
   - Throw : 4m
   - Noise criteria : NC 30
   - Maximum air velocity at diffuser neck : 4 m/s
   - Maximum terminal velocity : 0.5 m/s

3.2.11.3.14 Supply and Transfer Air Grilles and Register for general use.

a. Double deflection supply air grilles/register shall be tapped from top or bottom of ducts with provision for tamper proof adjustment of air pattern spread along its width. Adjusting tool shell be provided by the manufacturer. Grilles/register shall have a minimum of 80% free area.
b. Provide grilles/registers to meet the size and capacities as shown in detailed design drawings.
c. Grilles and register shall be factory assembled with opposed blade volume control dampers operable through the grilles face. The adjustment shall be by a key through the face of the register and the volume control damper shall be group operated or opposed blade type. The operating mechanism shall not project through any part at the register face.
d. All edges exposed to view shall be rolled or otherwise stiffened and rounded. All edges shall be equipped with air tight, non-combustible neoprene or sealing strips to prevent leakage. The register ring of frames shall be compatible with ceiling construction in which they are installed.
e. Multi-blade volume extractors shall be of the air deflecting and air straightening type with blades spaced a maximum of 50mm apart.
f. Supply air registers shall comply with the following performance requirements at design flow as:
   - Maximum pressure drop : 30 Pa
   - Throw : 4m
   - Noise criteria : NC 30

3.2.11.3.15 Return/Exhaust Grilles and Registers for General use

a. Grilles shall have 45° inclined fins spaced approximately 19 mm apart which shall be vision proof to effectively mask the return opening.
b. Grilles and registers will be fixed type.
c. Return air diffusers shall match the supply diffusers in appearance and shall be constructed of the same material and identical in surface finish as approved by the Engineer.

d. Register rings or frames shall be compatible with the ceiling construction in which they are installed.

3.2.11.3.16 Linear Air Diffusers

a. Each diffuser shall be of single/multi-slotted vertical/horizontal discharge, ceiling mounted type fitted into a field-insulated boot with spigot for receiving supply air duct as detailed on the drawings.
b. Diffusers of extruded aluminium shall be power coated polyester finish to a colour as approved by the Engineer.
c. Number of slots and lengths of diffusers and capacity shall be as indicated on the detailed drawings.
d. Provide air boot to the diffusers as shown on the drawings. Air boot casing shall be constructed of 0.6 mm thick galvanised steel with interior surfaces insulted to prevent erosion. Insulation and air boot shall be extended to cover the collar of diffuser. Volume control dampers shall be provided in the air boot spigot.
e. Subject to the ceiling panel design, the flanges of the diffusers shall be designed to support "drop in ceiling pane".
f. Provide suitable support points independent of suspended ceiling for the air boots and the associated diffusers.
g. Air boot spigot location and dimensions shall generally be as indicated on the drawings.
h. Provide galvanised steel sheet painted black at the front view to seal off the dummy part of the diffusers.
i. Linear air diffuser shall comply with the following performance requirements at design flow as:
   - Maximum pressure drop : 30 Pa
   - Throw : 6m
   - Noise criteria : NC 35
   - Minimum terminal velocity : 0.5 m/s

3.2.11.3.17 Nozzle/Jet Diffusers

a. Nozzle/Jet diffuser assembly shall consist of round diffuser element which shall be fitted to square or rectangular back plate, opposed blade volume damper and duct collar.
b. Each nozzle/Jet diffuser assembly shall consist of the diffuser element and shall be compatible with the architectural design in which they are installed.
c. Individual diffuser element shall be capable of adjusting the air deflection up to 300 from any plane perpendicular to the face. Adjustment shall be accomplished from front or back of the diffuser without tools.
d. Volume control dampers shall be provided for the diffusers.
e. The Nozzle/Jet diffuser shall comply with the following performance requirements as design flow :
   - Maximum pressure drop : 60 Pa
   - Throw : 15m
   - Noise criteria : NC 35

3.2.11.3.18 Access door

a. Gasket airtight access doors shall be provided at the duct for access, inspection and maintenance of fans, equipment, dampers, filters, smoke probes and controls.
b. Doors shall be hinged type complete with minimal of two sash locks and shall be made of same metal thickness as ducts. Doors shall have suitable size to access.
c. Access doors for insulated ductwork shall be of double skin construction with insulation in between. The insulation for the access doors shall be of the same type and thickness as the adjacent ductwork.

d. The door panels shall be made of suitable material and they shall have not less than 12 mm wide neoprene rubber gasket around the entire perimeter to ensure air tightness. It shall have the same fire rating as the adjacent duct construction.
e. The access doors shall be hung on approved heavy duty hinges and provided with suitable quantity with locks. The locks shall be able to operate both from inside and outside. Where it is impracticable to use hinge doors, the access doors may be fixed in position with wedge type locks on opposite sides with suitable quantity per door. The section of the duct where the access door is located shall be reinforced with suitable material.
f. Where the duct is of smaller dimensions than the access door specified, the door shall be of the full width of the duct Sealant with gasket.

3.2.12 Duct and Pipe Insulation

3.2.12.1 General

This Section specifies furnishing thermal insulation for VAC plant and services.

3.2.12.2 Quality control

Relevant Codes and Standards

Standard	Standard no	Description
BS		**British Standard**
	BS 476	Fire Tests on Building Materials and Structures
	BS 5422	Method for Specifying Thermal Insulating Materials on Pipes, Ductwork and Equipment (In Temperature Range -40°C to +700°C)
	BS 5970	Thermal Insulation of Pipework and Equipment (In the Temperature Range – 100°C to +870°C)
		All insulating materials shall comply with the requirement of BS 5422 & BS 5970.
		All insulating materials shall be tested to comply with the following:
	BS 476: Part 5	Product shall not ignite when tested by source A for 10s by face ignition
	BS 476: Part 6	Fire propagation
	BS 476: Part 7 Class 1	surface spread of flame
	BS 476 : Part-4	Non Combustibility
NFPA		**National Fire Protection Association**
	NFPA Code 90A	Installation of Air Conditioning and Ventilating Systems
	NFPA Code 90B	Installation of Warm Air Heating and Air-Conditioning Systems Energy Conservation Building Code-2006
		Combustion rating when tested in accordance with NFPA Standard Nos. 90A and 90B, shall not exceed 25 for flame spread and 50 for smoke developed.

3.2.12.3 Technical and installation requirements

a Duct Insulation

- Insulation material shall be Closed Cell Elastomeric Rubber
- Density of Material shall be between 40 to 60 Kg/m3
- Thermal conductivity of elastomeric Closed Cell Elastomeric Rubber shall not exceed 0.035 W/m.K at mean temperature of 25°C
- Insulation material shall have anti-microbial product, which is EPA (Environmental Protection Agency), USA approved, as an integral part of insulation that can not be washed off or worn off.
- It shall give enhanced level of protection against harmful Microbes such as bacteria, mold, mildew and fungi and should confirm to following standards: Fungi Resistance – ASTM G21 and Bacterial resistance – ASTM G 22 / ASTM 2180.
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990
- Material should be FM (Factory Mutual), USA approved.
- Water vapour permeability shall not exceed 1.74 x 10-14 Kg / (m.s.Pa), i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 10000.
- Thickness of the insulation shall be as specified for the individual application. Each lot of insulation material delivered at site shall be accompanied with manufacturer's test certificate for thermal conductivity values, density, water vapour resistance factor, Samples of insulation material from each lot delivered at site may be selected by Employer's representative and gotten tested for thermal conductivity and density at Contractor's cost. Adhesive used for sealing the insulation shall be suitable for the application and as per the manufacturers recommendation It should have high water vapour resistance, good weathering properties and self-extinguishing once dried strictly as per manufacturer's recommendations

To provide mechanical strength and protection from damage all duct insulated shall be covered with thermal insulation protecting coating with alkali resistance glass fiber fabric (UL Listed) of weight 200 GSM and 7 mil minimum thickness reinforcement. The coating non-volatile content shall be as per guideline of ASTM 1644-01 and Water permanence (perms) as per guideline ASTM E-96. The coating flammability, surface burning characteristics shall be as per ASTM E-84 and UL 723.

The coating shall be applied as explained below.

- Apply 7 mil glass cloth (Dark Shaded) over the insulated surface adhered within two coat of fire resistant fungicidal protective vapor barrier. And Finished with one additional coat of Fire resistant Fungicidal Protective Vapor Barrier.
-

<u>External thermal insulation installation procedure:</u>

- Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.
- Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension.
- Material shall be fitted under compression and no stretching of material should be allowed.
- A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
- When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
- All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The adhesive shall be strictly as recommended by the manufacturer.
- The detailed Application specifications are as per the manufacturer's recommendation.

b Pipe insulation

- Insulation material shall be Closed Cell Elastomeric Rubber
- Density of Material shall be between 40 to 60 Kg/m3
- Thermal conductivity of elastomeric Closed Cell Elastomeric Rubber shall not exceed 0.035 W/m°K at an average temperature of 25°C
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990
- Material should be FM (Factory Mutual), USA approved.
- Water vapour permeability shall not exceed 0.017 Perm inch (2.48 x 10-14 Kg/m.s.Pa), i.e.
- Moisture Diffusion Resistance Factor or 'μ' value should be minimum 7000.
- All chilled water, refrigerant and condensate drain pipe shall be insulated in the manner specified herein. An air gap of 100 mm shall be present between adjacent insulated surfaces carrying chilled water or refrigerant and also between the insulated surface and the wall to allow natural ventilation without affecting its external surface coefficient of heat transfer. Before applying insulation, all pipes shall be brushed and cleaned. All Pipe surfaces shall be free from dirt, dust, mortar, grease, oil, etc. Closed Cell Elastomeric Rubber insulation shall be applied as follows:
- Insulating material in tube form shall be sleeved on the pipes.
- On existing piping, slit opened tube of the insulating material (slit with a very sharp knife in a straight line) shall be placed over the pipe and adhesive shall be applied as suggested by the manufacturer.
- Adhesive must be allowed to tack dry and then press surface firmly together starting from butt ends and working towards centre.
- Wherever flat sheets shall be used it shall be cut out in correct dimension. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The insulation shall be continuous over the entire run of piping, fittings and valves.
- All valves, fittings, joints, strainers, etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.
- Exposed piping and valves insulation shall be covered with 26 gauge GI sheet cladding and finished in neat and clean manner so as to achieve true surface. All longitudinal and transverse joints in the outer cladding shall have a minimum overlap of 50 mm duly beaded and grooved and shall be sealed with elastomeric metal sealant 95-44 of Benjamin Foster USA, or equivalent. Use of screws for fastening may puncture vapour barrier hence GI bands 0.50mm thick x 25 mm wide shall be provided at every 500 mm to retain cladding in position
- The detailed application specifications are as mentioned separately. The manufacturer's trained installer should only be used for installation.

c Insulation of Pumps

Fit insulation snugly against equipment without voids.

Bevel curved surface edges to provide a tight joint.

Provide metal insulated cover with metal fasteners, supports, frames and membranes.

d Piping

Install same thickness insulation as the adjoining pipe insulation on flanges, valves and other fittings to obtain the maximum strength and security. Seal joints, protruding metal parts and valve stems thoroughly.

All valves, traps, flanges and strainers shall be insulated in conformity with the pipework in which they are incorporated.

Insulate strainers in such a manner to permit removal of screen without disturbing the insulation of the strainer body. 1.2mm thick galvanised steel or aluminium split boxes shall be provided to ensure easy removal of insulation. Insulate valves up to and including bonnets.

3.2.13 Fans

3.2.13.1 General

This Section specifies the manufacture and installation of Fresh air, General exhaust, Smoke extraction, Pressurisation and all other ventilation fans.

The exact fan total pressure based on the duct run and the offered equipment shall be carefully checked and calculated for each fan before ordering the equipment. Calculation shall be submitted for Approval. No modification to the ductwork system shall be allowed without prior Approval. Any additional cost for the modification of the system (fans, motors, switchgears, cables, panel boards, switchboards, etc.) necessary to meet the specified duties, spatial conditions and the offered equipment shall be provided at no extra cost to the Employer.

Allowance shall be made for the effects on fan performance of all installation conditions including coils, eliminators, sound attenuator, plenums, enclosures, inlet and discharge arrangements so that actual installed fan performance equals that specified.

Proprietary bell mouth and wire guard shall be provided for fans without ductwork connection.

3.2.13.2 Quality control

Reference Codes and Standards

Standard	Standard No	Description
AMCA		**Air Moving and Conditioning Association**
	AMCA Standard 210	Laboratory Methods of Testing Fans for Rating
BS		**British Standard**
	BS 848	Fans for General Purposes
	BS 2757	Method for Determining the Thermal Classification of Electrical Insulation
	BS 4999	General Requirements for Rotating Electrical Machines
	BS 5000	Rotating Electrical Machines of Particular Types or for Particular Applications
	BS 5501	Electrical Apparatus for Potentially Explosive Atmospheres
IEC		**International Electro technical Commission**
	IEC 60034-1	Rotating Electrical Machines – Part 1: Rating and Performance
ISO		**International Organisation for Standardization**
	ISO 5801	Performance Testing using Standardized Airways Codes and regulations of the jurisdictional authorities.

All fans, drives and accessories shall be designed, constructed, rated and tested in accordance with the recommendations and standards of AMCA.

Fan tests shall conform to the requirements of AMCA Standard 210, ISO 5801 or to an Approved equal standard.

Sound ratings shall conform to AMCA standard test code for sound rating of air moving devices or BS 848: Part 2, whichever more stringent requirements shall apply.

3.2.13.3 Technical and installation requirements

3.2.18.3.1 Description

a Fans shall have non-overloading characteristic, except for forward curved centrifugal, over their entire operating range. The characteristic curves shall be such that the fan operating point falls between the no flow static pressure and the maximum mechanical efficiency. The fan characteristic shall also be such that for a 15 % increase in static pressure over the specified value, the fan shall deliver not less than 85 % of the specified air volume flow rate. The stability of fan operation shall not be affected under such situation.

b All fans with nominal rating above 7.5 kW shall have a minimum efficiency of 80%.

c Each fan unit including motor and drive shall be supplied from the manufacturer as a completely factory-assembled package and all guarantees and test certificates shall be deemed to apply to the entire assembly.

d All fans shall be capable of withstanding the pressures and stresses developed during continuous operation at the selected duty. Additionally, all belt driven fans shall be capable of running continuously at 15% in excess of the selected duty speed.

e Lifting eye shall be provided on all centrifugal and axial fans.

f All fans shall be statically and dynamically balanced.

g All centrifugal fan shafts shall have the ends drilled to receive a tachometer.

h Motor speed shall not exceed 1450 rpm unless otherwise specified.

i Nominal motor nameplate rating shall be higher than the peak operating power of the selected fan curve for non-overloading characteristic. The motor rating shall be a minimum of 15% higher than the motor operating point at design conditions unless otherwise specified.

j All fans and motors offered shall be of minimum vibration and noise level during operation. Should the vibration and noise level be excessive and not within acceptable standards, additional vibration isolation and sound attenuation shall be provided at no extra cost to the Employer to the satisfaction of the Engineer.

k All fans are required to be hot dip galvanised.

3.2.18.3.2 Propeller Fans

a The impeller shall be designed to give maximum volume with minimum noise level and minimum power consumption and shall be made of steel or other Approved material. The hub shall be steel with grey stove epoxy finish. The fan shall be complete with anti-vibration mount.

b The motor shall be dust and moisture protected to IP54 and of a totally enclosed construction with permanently lubricated ball bearings suitable for running in ambient temperatures of up to 40°C and relative humidity of up to 100%.

c Wire guards made of heavy gauge steel wire or rod with all joints and crossings welded and shall be fitted to impeller side or motor side or both where appropriate.

d Propeller fans shall be diaphragm mounted on not less than 3mm thick steel mounting plate with stove epoxy grey finishes.

e Provided with seal permanently lubricated bearings.

f With tip speed not exceeding 17.5m/s

3.2.18.3.3 Axial/ Mixed Flow Fans

a The Axial/ Mixed flow direct drive aerofoil fans shall be complete in all respects and shall generally comply with the specifications as given under.

b Fan Casing

A casing shall enclose the motor and impeller.

Fan casings shall be fitted with matching flanges on the inlet outlet ends with spigots for attachment of flexible connections.

Inspection doors or sight ports to enable direction of rotation to be established shall be provided.

Terminal boxes welded to the casing shall be provided for electrical connection using metallic flexible conduits to fan motor complying with BS 4999: Part 20 for dust and weatherproof conditions.

Grease nipples shall be brought to the outside of the casing in the most accessible position and fitted with lubrication tube made of copper or other Approved material.

Gasket access doors shall be provided in each fan housing or connecting ductwork, suitable for access to adjust or replace blades. For smoke extraction fans, the gaskets shall be suitable for continuous operation in an air stream temperature of 250 °C for not less than one hour.

Drain fittings shall be located with cap in the low part of the fan housing.

c Impeller.

Impellers shall be of die-cast aluminium alloy.

For hub size of 315mm (dia.) and above, blades shall be manual adjustable without removing the wheel.

Positive locking shall be provided for securing the impeller blades into the hub. Spun aluminium hub caps shall be fitted.

The blades and hubs shall have index marks which show the design operating blade setting and a minimum of three increments of stagger angle both larger and smaller than the design operating blade setting and stops at hub to prevent overload of the motor.

The blades shall be counter-balanced and mounted on a thrust bearing.

d Except smoke extraction fans and unless otherwise specified, drive motors shall be of class F insulation (BS 4999 and BS 2757) totally enclosed type and rated for continuous operation in ambient temperature of 40 °C. Performance and rating shall comply with BS 5000 and IEC 34-1 with protection to IP55.

e Fans shall be fitted with bell mouth inlets. Flow guards and bell mouth inlets shall be fabricated in steel and provided with flanges drilled and rigidly bolted to the fans.

f Provide wire guards on fan outlet/inlet not connected to ductwork and shall be made freely accessible for maintenance.

g Fans shall be provided with mounting feet and spring isolators.

h The average bearing life of the fan shall be at least 200,000 hours.

i Stationary, curved guide vanes shall be located on the outlet side of the fan to straighten the motion of the air leaving the blades to improve operating efficiency if required.

j For smoke extraction fan, adequate clearance shall be provided between blade tips and housing at all points to allow for expansion and contraction over a continuous operation in an air stream temperature range from 0 °C to 250 °C without developing interference to the specified flow capacity. The fabrication/shop drawings shall show the clearance at over a continuous operation in an air stream temperature range from 0°C to 250°C as well as any point of minimum clearance in between.

3.2.18.3.4 Centrifugal Fans

a Provide forward/backward curved centrifugal fans as specified below. Backward curved type shall be non-overloading.

b Unless otherwise indicated, centrifugal fans consuming more than 7.5kW at the fan shaft shall be of the backward bladed type having a fan total efficiency not less than 80%. Centrifugal fans with shaft power exceeding 15kW shall be of the aerofoil backward curve type.

c Fan Casing

i. Fan casing shall be of sheet steel construction adequately stiffened and braced and shall be entirely free from vibration or drumming during normal operation. The steel required to be hot dip galvanised.

ii. All fans with an inlet eye diameter exceeding 300mm shall have a bolted access door on the Screw for access purposes. The size of access panels shall be such as to facilitate cleaning and maintenance of the impeller.
iii. Drain sockets or holes with copper drain pipe brought out to an accessible point, valve and plugged, shall be provided.
iv. Fan casings shall be fitted with flanges on the outlet connection suitable for connection of discharge ductwork and flexible connections as shown on the Drawings.
v. Where the inlet side of the fan is connected to ductwork, matching flanges for connection of flexible connections shall be provided
vi. Inspection doors or sight ports to enable direction of rotation to be established shall be provided.

d Fan Impellers
i Impellers shall be double inlet, double width or single inlet, single width as shown on the Equipment Schedule and/or Drawings and shall be mounted on substantial hubs.
ii Fan impellers shall be backward/forward sloping blades as specified on the Equipment Schedule and/or Drawings.
iii Impellers shall be rigidly fixed to solid bright steel shafts adequately sized and proportioned to ensure that the maximum operating speed is not more than 60% of the first critical speed. The shaft shall be protected by reliable anti-rust coating.
iv Impellers shall be of steel, electro-galvanized after fabrication (or aluminium where indicated), of riveted or welded construction, with spiders or hubs, of robust design and shall be capable of running continuously at 15% in excess of normal speed.
v All forward curved fans shall be selected for use with speed not exceeding 1200rpm and backward curved fans shall be selected not to exceed 2000rpm, unless otherwise specified.

e Unless otherwise specified, drive motors to Class F insulation to BS 2757 shall be totally enclosed and rated for continuous operation in an ambient temperature of 40°C. Performance and rating shall comply with BS 5000: Part 99.

f The fan and motor shall be mounted on rigid galvanized steel channel base. Provide slide rails for adjustable mounting of motors.

g The driven V-belt shall be rated at 150% of the operating motor power input. Provide adjustable sheaves on the motor, capable of 20% adjustment in fan speed, with the design fan capacity settling at approximately the midpoint of the adjustment. Belt speed shall not exceed 25m/s.

h Type of V-belt shall be in accordance with the "Standards for Light-duty or Fractional-Horsepower V-Belts" of Rubber Manufacturers Association.

i Belt guards shall be of heavy gauge steel framing with expended mesh screen.

j All belt guards shall have access openings at the shaft ends to enable tachometer readings to be taken.

k Vibration isolators shall be provided in accordance with "Acoustic Treatment and Vibration Control" section of this Specification.

l The shafts shall be carried in ring lubricated self-aligning sleeve bearings for shafts of 150mm diameter and larger. Each bearing shall have large oil storage capacity to ensure efficient lubrication. On shafts of sizes smaller than 150mm diameter, grease lubricated self-aligning ball bearings resiliently mounted to reduce noise transmission shall be used.

m The shafts shall be extended beyond the drive-side bearing and keyed for overhung pulley in all cases.

n For centrifugal fans one coat of corrosion-proof coating shall be applied to all non-working surfaces of shafts at the factory.

o The average bearing life of the fan shall be at least 200,000 hours.

3.2.18.3.5 Smoke Extraction and Pressurization Fans

a In addition to the aforesaid requirements stipulated in this Specification, all fans used for smoke extraction and pressurization shall comply with additional requirements specified in this Clause.
b Smoke extraction fans shall be rated to deliver the designed flow rate and pressure for continuous operation in an air stream temperature of 250° C for not less than one hour. All smoke extraction fans shall be UL listed and certified.
c Fans for smoke extraction and pressurization systems shall have non-overloading characteristic.
d All finishes shall be factory-applied and certified by the respective manufacturer that the finishing materials are capable of withstanding exposure continuously to an air stream temperature of 250 °C for not less than one hour without producing smoke or any toxic fumes.
e Motor winding of smoke extraction fans shall be insulated to permit motor operation at design conditions for continuous operation in an air stream temperature of 250 °C for not less than one hour. The smoke extraction fans shall be performance tested at factory for the performance and operating condition before delivery. Type test certificates shall be submitted to the Engineer for Approval.

3.2.18.3.6 Installation

a All belts, pulleys, chains, gears, couplings, projecting set screws, keys and other rotating parts shall be adequately guarded so that any person can safely come in close proximity thereto.
b Fit fans and appurtenances to the space provided and make readily serviceable.
c Provide support beams, support legs, platforms, hangers and anchor bolts required for the proper installation of equipment as shown on the Drawings or as recommended by the manufacturer and Approved by the Engineer.
d Provide permanently attached lifting eyes of sufficient number for on Site installation and future dismounting of fan units.
e Provide factory inlet bells and other accessories for fan units as required for a complete and efficient installation.
f Where corrosion can occur, appropriate corrosion resistance materials and installation methods shall be used including isolation of dissimilar metals against galvanic interaction.
g Thoroughly clean the entire system before installing filters or operating the fans.
h For systems containing filters, install filters and permanently seal the filter frame air-tight before operating the fans. Replace all dirty filters and filter media before handing over the system to the Employer.
i Means of protection against overcurrent in the motor shall be incorporated in the control equipment when the motor rating exceeds 0.37 kW.
j A hole in the blanking off plate shall be provided for the cables leading to the fans. The hole shall be sealed around the cables with material suitable for sealing the hole effectively and continuously exposed to an air stream temperature of 250°C for not less than one hour rating if the fans are used for smoke extraction.

3.2.19 VAC Equipment Controls

3.2.19.1 General

This Section specifies furnishing of the VAC control equipment.

3.2.19.2 Quality control

Reference Codes and Standards

Standard	Standard no	Description
BS		British Standard

	BS 4504	Circular Flanges for Pipes, Valves and Fittings
	BS EN ISO 6817	Measurement of Conductive Liquid Flow in Closed Conduits –Method Using Electromagnetic Flowmeters
	BS EN 60529	Degrees of Protection Provided by Enclosures
		Codes and regulations of the jurisdictional authorities.

Furnish control hardware's which are products of a reputable control manufacturer who has made control equipment hardware's for a period of at least 10 years.

3.2.19.3 Technical and Installation of equipment's

3.2.19.4 Control Valves

a. All control valves shall have modulating actuators.
b. All valves shall be sized by the Approved control equipment manufacturer to assure fully modulating operation as generally specified in this section. Valves indicated as full line size shall have properly sized internals. If valves smaller than line size are specified, reduction pieces for installation in line size indicated shall be provided. Manual override facilities shall be provided.
c. Unless otherwise specified, control valves shall be normally closed, single-seated, cage-guided, brass/stainless steel trim, flanged 1500kPa cast-steel body with pilot positions. Valves shall be heavy duty with equal percentage, V-port plug.
d. Provide valve opening point at each actuator to indicate the valve opening and position.
e. Pressure rating shall be 150 PSI.

3.2.19.5 Fan Coil Control Valves

a. Fan coil control valve operators shall be electric-thermal type operating on line voltage of 240V AC.
b. Fan coil control valve bodies shall be 2-way, normally closed. Bodies shall be complete with union for connection.
c. Fan coil control valve operators shall be of absolutely silent operation.
d. Pressure drop across fan coil control valve shall be about 1 m. Valve working pressure shall not be less than 10 bar with 3 bar close off pressure.
e. Fan coil control valves shall be equipped with automatic reset to automatic control mode after fully opened.

3.2.19.6 Differential Pressure Control Valves

a. Provide differential pressure control valves across the chilled water supply and return lines.
b. Control valves shall comply with ANSI 300 with equal percentage V-port plug, normally close, electrically operated, single seated, cage guided, brass /stainless steel trim, bronze or cast-iron body.
c. Valve shall be actuated by differential pressure controller, control function wide band proportional, integral and differential (PID) type with set point adjustment, display pointer, process variable display pointer, and a red pointer for high limit setting.
d. Size the valve such that when fully open, 100 % of the rated flow of a circulating pump shall flow through the valve at the designed chilled water mains differential pressure.

3.2.19.7 Temperature Sensors/Transducers

a. Duct mounted or immersion temperature sensors shall be suitable for use with the maximum system temperature and the maximum system pressure and described in other Sections of this Specification. The sensor range shall be selected to give, where possible, the set point at the

centre of the range. Sensors shall be of corrosion resistant construction, suitable for mounting on a vibrating surface.

b. Immersion sensors shall be installed in stainless steel or copper wells packed with a heat transfer compound. The mouth of the well shall always be installed sufficiently above the external surface of pipework to retain the compound.
c. Sensors shall be of tamper-proof construction, calibrated at the control manufacturer's factory.
d. Provide remote sensing element type for thermometers and pressure gauges where the location of sockets exceeds 2.0 m from floor level.

3.2.19.8 Motorized Valve Actuators

a. Mount motorized valve actuators at factory or at Site under manufacturer's supervision.
b. Provide a hand wheel for each valve operator, which shall automatically de-clutch when motorized valve actuators operator is functioning.
c. The motorized valve actuators shall be capable of operating in any valve mounting altitude and capable of being mounted either in line or transverse to the pipeline.
d. The motorized valve actuators shall be bolted directly to the butterfly valve top without the use of special brackets, linkages or couplings if butterfly valves are used.
e. Where motorized valve actuators are exposed to weather, provide a 0.6 mm G.I. or aluminium removable housing to the Approval of the Engineer.
f. Motorized valve actuators shall be totally enclosed with no external moving parts. The actuator shall be of the rack and pinion type providing constant output torque.
g. Motorized valve actuators shall operate on 240 V, single phase, 50Hz power supply. Motorized valve actuators shall consist of motor, magnetic motor controller, control circuit transformer, built-in reversing contactors, opening and closing torque and limit switches, built-in open-close-stop momentary contact pushbuttons and open-close position indicating lights. Terminal posts shall also be provided for field wiring of remote momentary contact open-close-stop push buttons and open-close position indicating lights. All components shall be factory prewired in single enclosure.
h. Motor shall be of high speed and high torque type, of adequate capacity, especially suitable for valve operation. Motor winding insulation shall be to IEEE standard class B. Provide built-in thermal overload protection. Closing time of all motorized valves shall be set with an adjustable timer control which can be set to not less than one minute nor more than two minutes.

3.2.19.9 Motorized Damper Actuators (Also refer clause 3.2.19.20)

a. Motorized damper actuator shall be of the piston or rotary type with a 550 to 700 kPa working pressure and shall be capable of actuating the dampers against a differential pressure of 2000 Pa across the dampers. Motorized damper actuators for smoke extraction, and staircase pressurization systems shall be fully operational after exposure to ambient air stream temperatures of 250°C for a continuous period of not less than one hour for smoke and fire dampers and shall be UL listed and certified.
b. Motorized damper actuators shall be provided with spring-return devices capable of driving the dampers to their de-energized positions within a period of 10 to 20 seconds after the motorized damper actuators are de-energized.
c. Motorized damper actuators shall be mounted outside of the duct with support plates that are completely outside of the insulation or covering. Support plates shall be installed in a manner that will prevent condensation on the motorized damper actuator or on supports.
d. Motorized damper actuator mountings shall be supported so that the actuator does not deflect from its normal path when operating under load.

3.2.19.10 Differential Pressure Transmitters

The transmitter shall work in conjunction with the flow measuring element and shall have adjustable range which is factory calibrated and secured and will match with the flow measuring element together with field adjustment of damping up to 30 second time constant. It shall have an indicator to monitor the process differential pressure, and 4 to 20mA DC output for central monitoring. The device shall be rated at the working pressure of water pipe and have overload protection in either direction. Accuracy shall be better than ±0.5% of full scale with negligible dead band. Housing shall be weather-proof with Teflon gasket and stainless-steel cover. Process connection shall be via stainless steel capillary complete with isolation valves and bypass valve.

3.2.19.11 Limit Switches

a. Limit switches for monitoring open and closed positions of motor operated dampers shall be designed to withstand the environmental condition of the VAC operation. All limit switches monitoring motor operated damper installations for smoke extraction and staircase pressurization systems shall be suitable for continuous operation in an air stream temperature of 250°C for not less than one hour. Each module of a multi-module damper shall be equipped with two status indicating limit switches. Each limit switch shall have two contacts, one normally open and one normally closed for status and alarm monitoring.
b. Construction shall be suitable for outdoor installation with a centre neutral and two-point detection mechanism. Sensing arm shall be adjustable and lockable into desirable lengths to fit each specific installation. Standard mounting bracket shall be provided to facilitate adjustments on site and shall be complete with cable terminal board and conduit fixings. Contact rating shall be 10 A minimum at 240 V AC with overall life of over one million operations at one ampere resistive load at 240 V AC.

3.2.19.12 Automatic Flow Control Valves

a. Provide automatic pressure compensating flow control valves of sizes as recommended by manufacturer to water system where indicated on the approved Drawings. Provide transformation pieces for valves larger than line size.
b. Valves shall be factory set and shall automatically limit the rate of flow to the required capacity within 5 % accuracy over an operating pressure differential of at least 14 times the minimum required for control.
c. The control mechanism of the valve shall consist of a self-contained open-chamber cartridge assembly with unobstructed flow. Internal working parts shall be Type 300 passivated stainless steel. Plated materials will not be accepted.
d. The Type 300 passivated stainless steel cartridge assembly shall consist of a spring-loaded cup. The cup shall be guided at two points and shall utilise the full available differential pressure across the valve to actuate the cup and thereby reduce friction and hysteresis and eliminate binding. It shall have a thin orifice plate for self-cleaning of the variable inlet ports over the full control range.
e. Valves shall be available in four differential pressure ranges with minimum range requiring pressure of less than 10kPa to control the flow. Cast iron valve bodies shall be provided with inlet and outlet tapping's suitable for connection of instruments for verification of flow rates. Valve bodies shall be rated for not less than 150% of system design working pressure.
f. Submit certified performance data for the flow control valve based on independent laboratory tests for Approval.

g. Each automatic flow control valve shall be provided with a valve kit consisting of 6.35mm by 50mm minimum size nipples, quick-disconnect valves (to be located outside of insulation), and fittings suitable for use with the measuring instruments specified.
h. Provide a metal identification tag with chain for each installed valve. The tag to be marked with model number and rated flow rate in litres/second and GPM.
i. Provide flow measuring instrument to verify flow rates. Correct flow shall be verified by establishing that the operating pressure differential across the valve tapping is within the range indicated on the submittal data sheet for that model number. The pressure measuring apparatus shall be portable.

3.2.19.13 Electromagnetic Flowmeters

a The electromagnetic flowmeter shall operate on the principle of magnetic induction. The flowmeter shall comprise an in-line flow detector head and a separately mounted flow converter for producing a current and pulse output directly proportional to the flow rate of the liquid measured.
b The design and operation of the flowmeter shall comply with BS EN ISO 6817 with flange connection to BS 4504 PN 16.
c Test reports or certificates issued by the manufacturer to certify the measuring accuracy of the electromagnetic flowmeter shall be submitted for Approval.
d Materials of components of the flowmeter (including lining, measuring electrode) shall be suitable for use with the measured fluid.
e Design and measurement requirements:
General
Overall accuracy: Better than ± 0.5 % actual flow from 10 % to 100 % of flow range
Total power consumption: Less than 30 W.
Long term stability: Better than ±1 % of calibrated span per 12 months.
Flow Detector Head
Field excitationer: Stabilized AC or bipolar pulses from flow converter.
Flow Converter
Input signal: Induced e.m.f. from flow detector head.
Output Signals
Current: 4-20 mA DC to drive 600 ohm maximum.
Pulse: 24 V/200 mA DC pulses with an adjustable maximum pulse rate of 5 pulses/ second suitable for driving a pair of electromechanical counters each with coil resistance of 180 ohms.
Low flow signal cut off: Automatic output signal cut off at less than 1 % of full scale flow range with resumption of normal measurement when flow is above 2 %.
Signal average time: Field adjustable between 0 to 5 seconds.
Linearity error: Better than ±0.5 % of span.
Repeatability: Better than ±0.1 % of span.
Supply voltage effects: Less than ±0.1 % of calibrated span per +/-10 % change in supply voltage.
Frequency effects: Less than ±0.1 % of calibrated span per ±20 % change in supply frequency
Temperature effects: Less than ±0.05 % of calibrated span per °C.
Power supply: 240 V AC/50 Hz
f Flow Detector Heads
The flow detector head shall be flanged at both ends to BS 4504 PN 16 suitable for installing in the pipeline between a fixed flanged at the upstream end and a straight pipe spigot cut to fit the installation at the downstream end by means of a slip-on coupling.
The flow detector head shall be constructed from non-magnetic material lined with (PTFE) Teflon and pressure rating to PN16. The field excitation coil assembly shall be epoxy resin

encapsulated. The complete housing, including cable termination, shall have a certified degree of protection to BS EN 60529 IP54 for continuous 5m deep water submersion. External cable connections for field excitation and signal transmission shall be made via a sealable die-cast termination box or IP54 water-tight plugs and sockets.

Suitable earthing arrangement shall be provided with the flowmeter. Resilient gaskets shall be provided for fitting between the flanges of the detector head and the pipeline. The gasket material shall be chemically resistant to the liquid being measured.

The sensing electrodes shall be fabricated from stainless steel.

The design and construction of the electrode assembly shall prevent any ingress of water into the detector coil housing. A liquid sensing electrode or equivalent device shall be fitted to the detector head to provide an automatic zero flow signal output when the metering tube is only partially filled with water.

g Flow Converters

The electronics package shall be withdrawable to allow easy access to the circuit board for testing or fault diagnosis under operating conditions.

The converter shall provide an automatic zero flow setting function to ensure that the flowmeter can be set up with stable zero point for measurement.

The enclosure of the flow converter shall be to BS EN 60529 IP 65.

The Contractor shall provide the following accessories with each flowmeter:

i. A flanged end spigot, of the same size and pressure rating as the flowmeter, for connection at the system.
ii. Downstream side of flowmeter and cut to fit the connection to the pipeline by means of a slip-on coupling.
iii. One set of flange gaskets and bolts and nuts for each end of the flowmeter.
iv. Screened cables for field excitation supply and flow signal transmission between the detector head and flow converter.
v. An electrode cleaning unit suitable for the fluid being measured.
vi. A portable electromagnetic flowmeter calibrator for checking/calibrating the flow converter.

h Testing

The following tests shall be carried out on certified testing apparatus at the manufacturer's works or other Approved testing facility.

Pressure test to 150 % of the required working pressure.

Flow calibration for the complete flow detector head and flow converter to verify the accuracy over the full flow range. The flow measurement shall be carried out using actual water flow rate through the flowmeter over the entire measuring range, and Degree of protection of the flow detector head to IP 54.

3.2.19.14 Static Pressure Sensors

The sensor shall have a range of 0 to 1500 Pa, operate over a 500 Pa range, using a slack diaphragm sensing element, with force balance pneumatic feedback. The sensor shall have an accuracy of ±1%.

3.2.19.15 Airflow Sensors

The sensor shall be suitable for operation within the design velocity and temperature range and without any substantial change in the accuracy in its own operating conditions.

Provide air straighteners and equal area transverse pressure sensors mounted in a complete galvanized iron casing.

3.2.19.16 Water Flow Switches

a. Flow switches shall be provided as per the approved detailed design Drawings.
b. Switch cover and base plate shall be constructed of cast aluminium or hot-dipped galvanized cast steel and the paddle shall be of stainless steel. A rubber gasket shall be provided between the base plate and the cover.
c. The paddle shall be able to be trimmed to size on Site and the unit shall be suitable for 240 V, single phase, 50 Hz operation.
d. The assembly shall be properly rated and be suitable for the working pressure.
e. The unit shall be installed in accordance with the recommendation of the manufacturer.

3.2.19.17 Humidity Sensors

a. Humidity sensors shall be of capacitance type and shall provide a voltage output between 0 to10 V DC or 4 to 20mA.
b. Sensors shall have a range of 20 to 90 % relative humidity.
c. Room sensors shall be combined humidity/ temperature sensors and shall have a connection plate to permit removal of the sensor during decoration of the room.
d. Duct sensors shall have an insertion length of minimum 200mm and shall have a separate mounting flange with snap on connection to permit sensor removal.

3.2.19.18 Level Controllers

a. **The unit shall consist of probe fitting complete with stainless steel probe rods (electrodes)** and a controller.
b. The controller shall be operated in a bridged circuit principle with a built-in arrester circuit to protect against surge from power source and lightning surge from electrode side.
c. The electrodes shall be capable of withstanding the corrosiveness of chemicals.
d. Separators made of porcelain shall be provided to prevent short-circuit between electrodes.

3.2.19.19 Water Level Controllers

a. Water level controllers shall be fitted in water tanks for monitoring the water levels in the tank and to give the appropriate control/warning signals for the system. The water level controller shall be provided with built-in micro switches. The micro switches shall be protected with smooth polypropylene. No toxic material shall be used.
b. The water level controllers shall be of submersible maintenance-free type.

3.2.19.20 Modulating Damper Actuators

a Modulating damper actuators shall be spring return and electronic direct-coupled types, which require no crank arm and linkage.

Modulating damper actuators shall be suitable for operation between 2 to 10 V DC. A 2 to 10 V DC feedback signal shall be provided for position indication.

Modulating damper actuators shall provide clockwise or anti-clockwise fail safe operation as required by the Engineer.

Modulating damper actuators shall use brushless DC motor and shall be protected from overload at all angles of rotation.

Modulating damper actuators shall have a manual positioning mechanism and readily accessible.

b <u>Installation</u>

Fit equipment and appurtenances to the space provided and make readily serviceable.

Install the entire automatic control system, including control equipment and wiring under the supervision of the automatic control equipment manufacturer.

Mount damper operators outside of the duct with support plates that are completely outside the insulation or covering. Install support plates in a manner that will prevent condensation on damper operator or on supports.

Support valves and damper operator motor mountings so that the operator does not deflect from its normal path when operating under load.

Locate sensing elements and duct sensors where they will respond to representative temperature within the duct or casing.

Install duct sensors and remote transmitters outside of ducts and casings.

Where ducts or casing are insulated, mount sensors flush with outside insulation so that moisture will not condense on sensors or on supports.

Install duct sensor capillary tubes and wires to pierce the thermal insulation at the least practicable number of points

Seal insulation properly where wiring passes through.

Protect control wires by conduit or use flexible armoured cables. Coil control wires and fasten excess lengths to provide a tidy installation.

The buttons side of control panel shall be mounted at 1200 mm above the finished floor level.

Provide 100 mm clearance between rear of panel and wall by a bracket mounting.

Mount controls, instrument gauges, thermostats and relays flush on the front of the panel.

Mount framed schematic control diagram adjacent to each control panel or cabinet.

3.2.19.21 Pressure Independent Control valve (PICV)

a. Valve shall be electronic, dynamic, modulating, 2 ways, control device. Maximum flow setting shall be adjustable to different setting within the range of the valve size. It shall be BMS compatible.
b. Valve actuator housing shall be rated to IP44. Actuator shall be driven by 24 VDC motor and shall accept 2-10 VDC, 4-20mA, 3-point floating or pulse width modulation electric signal and shall include resistor to facilitate any of these signals. Actuator shall be capable of providing 4-20mA or 2-10VDC feedback signal to control system. Optional fail safe system to power valve to either open of closed position from any position in case of power failure shall be available Extended LED read – out of current valve position and maximum valve position setting shall be standard.
c. It shall comply with following specification
    i. The PICV valves shall meet the following high performance generic specific criteria: Valves should be pressure independent and should have integral differential pressure control over built in control valve and flow control.
    ii. The valves should have a bonnet for temperature control and diaphragm operated differential pressure controller all built in one valve body.
    iii. Valves should be protected against overload with a safety spring. Valves should be inline body type and should be suitable for modulating control at temperatures between -10° C to +50° Centigrade.
    iv. Valves shall be suitable for Pressure class PN25.
    v. The diaphragm and gaskets shall be made from EPDM.
    vi. The valve sear shall be made from stainless steel.
    vii. The valve should be designed for readjustment of flow rate at site without removal of actuator.
    viii. The pressure drop on the flow control spring / throttle should not exceed 45kPa.

d. The PICV for FCU air terminal units shall have the following criteria with respect to the above mentioned:
   i. The valve should have integral spring and diaphragm arrangement for differential pressure control.
   ii. Valve should be capable of operating under maximum differential pressure of 500 KPa.
   iii. The pressure drop on the flow control spring / throttle should not exceed 40kPa.
   iv. The minimum lift on the control valve shall be 10 mm and 3 mm resp. Generally PICV valves shall be a single assembly.

3.2.19.22 Carbon dioxide & Air quality monitor sensors

a. CO2 & air quality sensors shall be installed to monitor air quality during operational hours. CO2 & air quality sensors shall be provided in the VAC plant room through in built controller (VSD) which synchronise the fresh air flow as per the requirement guided by CO2 & air quality level in the occupied areas.
b. CO2 & air quality monitor cum sensor shall be provided for the occupied areas to monitor the CO2 & air quality level.
c. Lowest detection of the monitor shall be 0 to 2000 PPM with a resolution of less than 30 PPM.
d. The sensing element for CO2 & air quality sensor shall be dual beam infrared absorption type.
e. The sensor shall have a relay output with programmable selection to control CO2 & air quality.
f. The communication interface shall be RS port.
g. Visual digital display shall be provided which shall read CO2 & air quality level in PPM.
h. The sensor, monitor and all components shall be mounted in one neat and compact case, suitable for wall mounting. The indication light shall be mounted on the cover of the case, if surface mounted. All components shall be factory mounted.
i. The monitor shall provide 4 to 20 mA or 0 to 10 volts DC output signal.
j. The monitor shall be capable of interfacing with BMS.

3.2.20 Acoustic Treatment and Vibration Control

3.2.20.1 General

a It is the intention of this Specification to direct the Contractor to provide sufficient noise and vibration control measures on his plant/equipment, the interconnected piping, ductwork and conduit so that when his systems are put into operation, the resulting noise and vibration levels at locations within the building and at adjacent locations shall not exceed the acceptable limits.

b The Contractor shall comply with the Employer's Requirements for balancing and mounting of the equipment, alignment of driving and driven units and operating speeds.

c The Contractor shall install all mechanical and electrical plant and services in accordance with the methods of installation and precautions stated herein. Such additional precautions as may be necessary to ensure that the operation of the plant does not result in noise levels or vibration amplitudes beyond the specified limits and the limits set by all relevant local authorities.

d The Contractor shall guarantee that the complete plant and installation, when operated within the design criteria shall comply with the Noise Criteria ratings specified in this section below.

e The Contractor shall be responsible for all costs of any corrective action, which may be necessary either during construction or after completion of the works, to achieve the design objectives specified herein and as specified elsewhere in the Technical specification.

f The Contractor shall carry out his own assessment on the noise levels to the external

surrounding environment, particularly for critical rooms within depot and cooling tower enclosures. The Contractor shall be responsible for all costs to provide the necessary liaison officers to handle public complaints and of any preventive and corrective action, which may be necessary, to achieve the design objectives specified herein and as specified elsewhere in the Technical specification and to resolve the complaints from the public.

g If the equipment offered fails to meet the specified limit, the Contractor shall supply, at no additional cost, all necessary additional noise control measures to compensate for the excess.

h Unless otherwise specified, the total noise level, whether it be airborne, structure-borne or duct-borne, shall not exceed the following limits when all the plant/equipment installed by the Contractor are put into operation. The specified noise level limits apply to every position within a room at a height of 1.5 metres from the floor and not closer than 1.5 m from any air outlet, or equipment.

Location	**Maximum Sound Pressure Level**
a) Station public areas (during normal operation)	55 dBA
b) Station public areas (during emergency operation)	75 dBA
c) Platform public areas (with PSDs open during normal operation)	55 dBA
d) Platform public areas (with PSDs opened during emergency operation of the tunnel ventilation system)	75 dBA
e) Stairs/corridor	65 dBA
f) Pump room/Chiller Plantroom/ Mechanical (VAC) Equipment room/Fan Rooms/ /Cooling Tower area / /AHU Rooms.	85 dBA
g) Electrical rooms (Transformer Rooms/Switch Rooms/ TPSSs/Traction Transformer Rooms/UPS Rooms/EPS Rooms/VAC Control Rooms)	75 dBA
h) Distribution Board (DB) Room/Clean Gas Rooms/LSC Rooms/Stores/Permanent Way Stores (PWSs)	65 dBA
i) Fire Pump Rooms (when all ventilation fans and pumps are in operation)	75 dBA
j) Dry Toilets/Pantries	55 dBA
k) Employee-occupied Operation Rooms/Offices	55 dBA

i The noise level at adjacent location external to the stations shall meet the requirement of Maharashtra pollution control board.

3.2.20.2 Quality control

Reference standards

Standard	**Standard no**	**Description**
ASTM		**American Society of Testing Materials**
	ASTM C423	Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
	ASTM E90	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
	ASTM E413	Rating Sound Insulation
	ASTM E477	Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated

Standard	Standard no	Description
		Silencers
BS		**British Standard**
	BS 476	Fire Tests on Building Materials and Structures
	BS 2750	Measurement of Sound Insulation in Buildings and of Building Elements
	BS 4718	Methods of Test for Silencers for Air Distribution Systems
	BS 5588: Part 9	Fire Precautions in the Design and Construction of Buildings Part 9: Code of Practice for Ventilation and Air Conditioning Ductwork
	BS 8313	Code of Practice for Accommodation of Building Services in Ducts
	BS EN 20354	Acoustics–Measurement of Sound Absorption in a Reverberation Room
IEC		**International Electro technical Commission**
	IEC 60651	Sound Level Meters
NFPA		**National Fire Protection Association**
	NFPA 90A	Installation of Air-Conditioning and Ventilating Systems
ASHRAE Handbook		**American Society of Heating, Refrigerating, and Air-Conditioning Engineers**

3.2.20.3 Technical and installation requirements

3.2.20.3.1 Equipment Bases

a. Floor mounted equipment shall be installed on minimum 100mm high concrete housekeeping pads provided by the Building Contractor covering the whole floor area requirements of the equipment bases plus a minimum of 150mm further on each side. Vibration isolators/ Floating foundation are then mounted on this concrete pad.
b. Unless otherwise directed in this Particular Specification, plant/equipment to be isolated shall either be supported by structural steel bases or concrete inertia bases.
c. Welded Structural Steel Bases: Bases shall be constructed of adequate T or channel steel members reinforced as required to prevent the bases flexing at start-up and misalignment of drive and driven units.
d. All perimeter members shall be steel sections with a minimum depth equal of $1/10^{th}$ of the longest dimension of the base but need not exceed 350mm provided that the deflection and misalignment are kept within acceptable limits as determined by the isolated equipment manufacturer.
e. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 50mm.
f. Detailed design calculations of the base and its anti-vibration isolator arrangements plus shop Drawings for each base shall be provided for approval before manufacture.

3.2.20.3.2 Concrete Inertia Bases

a. Concrete inertia bases shall be formed within a structural steel beam or channel frame reinforced as required preventing flexing, misalignment of the drive and driven units or transferral of stresses into equipment. The base shall be complete with height saving brackets, concrete reinforcement and equipment bolting down provisions.

b. In general the thickness of concrete inertia bases shall be a minimum of $1/12^{th}$ of the longest dimension of the base but never less than 150mm. The base depth needs not exceed 300mm unless specifically required.
c. As an indication of the standards required, minimum thickness of the inertia base shall generally comply to the following table or be $1/12^{th}$ of the longest dimension of the base, whichever is the larger:

Motor Size (kW)	**Minimum Thickness**
3.7 – 11	150mm
15 – 37	200mm
45 – 55	250mm
75 – 185	300mm

d. Base forms shall include minimum concrete reinforcement consisting of 13mm bars or angles welded in place on 150mm centres running both ways in a layer 40mm above the bottom, or additional steel as is required by the structural conditions. Angle nosing frames shall be provided.
e. Unless otherwise specified, concrete inertia bases shall weigh from 2 to 3 times the combined weight of the equipment/plant to be installed thereon.
f. Base forms shall be furnished with drilled steel members and with anchor-bolt sleeves welded below the holes where the anchor bolts fall in concrete locations.
g. Height saving brackets shall be provided in all mounting locations to maintain a base clearance of 50mm.
h. Detailed design calculations of the base and its anti-vibration arrangement plus shop Detailed Design Drawings for each base shall be provided for approval of the Contractor before manufacture.

3.2.20.3.3 Horizontal Pipe Isolation

a. All pipework in Auxiliary Building Chiller Plantroom and Cooling Tower Plantroom shall be suspended from vibration isolation hangers.
b. All chilled water pipework suspended under station platforms (or in platform ceilings) shall be suspended from vibration isolation hangers.
c. All rotating or reciprocating equipment shall be mounted on vibration isolation mountings or suspended from vibration isolation hangers.
d. The Contractor shall be responsible for ensuring that there is no rigid connection in whatever form between the isolated equipment and the building structure, which will otherwise short-circuit the vibration isolation system and degrade its performance. This includes the necessary co-ordination with other trades by the Contractor.
e. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.
f. All vibration isolators shall have their known un-deflected heights or calibration markings so that, after adjustment when carrying their loads, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that correct degree of vibration isolation is being achieved according to the design.
g. The static deflection of the isolator at each support point shall not differ from the design objective for the equipment as a whole by more than ±10%.
h. The ratio of lateral to vertical stiffness for springs shall be not less than 0.9 nor greater than 1.5.
i. All neoprene mountings shall have hardness of 40 to 65 durometer, after minimum aging of 20 days or corresponding over-aging.

j. In order to resist corrosion, all vibration isolation mountings and hangers shall be treated as follows:
   i. Springs to be neoprene coated or hot dip galvanised.
   ii. Wearing hardware to be cadmium plated steel with stainless steel of an appropriate grade.
   iii. All other metal parts to be hot dip galvanised.
k. For a particular contract, all vibration isolators and associated equipment bases shall whenever possible be the product of a single manufacturer. Acceptable manufacturer's systems shall strictly comply with the design intent of this.

3.2.20.3.4 Selection Guide for Equipment Base and Vibration Isolator

Unless otherwise specified, the selection of type of equipment base and vibration isolator (mounting/hanger) for differing plant/equipment and on differing floor spans & levels may follow the requirements as indicated in the Selection Guide for Vibration Isolation. Table 48 Chapter 47 of the ASHRAE Application's Handbook 2007 or its latest edition, and the static deflection of the vibration isolator selected shall either provide a minimum isolation efficiency of 90% in ground floor areas and 95% in upper level areas or be not less than the corresponding values shown in Table 48. However, the Contractor is responsible for ensuring that the selected vibration isolation system is suitable for his specific plant/equipment and the specific building structure on which the plant/equipment is mounted.

The Contractor shall provide more efficient isolation than those suggested in Table 48 if the adjacent occupied space is a noise critical area such as board room or executive office. Advice from vibration isolator manufacture shall be sought if necessary.

3.2.20.3.5 Method of Installation

The equipment structural steel or concrete inertia base shall be place in position and supported temporarily by blocks or shims. The machinery shall then be installed on the base and when that is complete, the isolators are to be installed without raising the machine and frame assembly.

After the entire installation is complete and under full operational load, the isolators shall be adjusted such that the load is transferred from the blocks to the isolators. When all isolators are properly adjusted, the blocks or shims will become slightly free and can then be removed.

The springs of vibration isolators shall in general have a loaded working height equal to 1.0 to 1.5 times the outside diameter of the spring and shall be compressed to approx. 50% of their unloaded height.

Where any vibration isolation system permits equipment motion in all directions, provide where necessary additional resilient restraints to flexibly limit the lateral movement of the equipment to 6mm at start and stop.

Prior to start-up, remove all foreign matter underneath the equipment base and verify that there is no short-circuiting of the vibration isolation system.

Electrical circuit connections to isolated equipment shall be looped to allow free motion of isolated equipment.

3.2.20.3.6 Pipework Vibration Isolation

a Pipe supports

Unless otherwise indicated, all piping located in mechanical equipment rooms and having connections to vibrating equipment shall be isolated from the building structure by means of noise and vibration isolation hangers for a distance of at least 15m or 100 times the pipe diameter from the vibration equipment, whichever is the greater. This "floated" pipe run shall include, where situation permits, bends in two mutually perpendicular directions in order to give three

degrees of freedom of movement, with approximately equal distance between successive elbows or bends.

All horizontal and vertical pipework throughout the building that has connection to vibrating equipment shall also be isolated from the building structure by means of noise and vibration isolation guides and supports.

All piping to be isolated shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping, and a clearance of 10 to 15mm around the outside of the piping shall be maintained. This clearance space shall be sealed with fire rated sealant.

The inlet and outlet connections of all vibrating equipment shall be fitted with either flexible connectors or flexible hoses as appropriate.

Horizontal Pipe Isolation: Where horizontal pipe isolation is required, the first three pipe hangers in the main line near the mechanical equipment shall be of Pre-Compressed Spring Hangers and the hangers for the horizontal run in all other locations shall be of Spring Hangers or Spring and Double Deflection Neoprene Hangers, the latter being used for more sensitive situations where a higher degree of noise and vibration attenuation is required.

Pre-Compressed spring hangers shall have the same static deflection as that of the mountings under the connected equipment. Spring Hangers and spring and Double Deflection Neoprene Hangers shall have a minimum deflection of 20mm.

Pipe Riser Isolation: Where pipe riser isolation is required, the pipe risers to be isolated shall be suspended from Pre-Compressed Spring hanger or supported by Restrained Spring mountings and anchored with pipe anchors or guided by pipe guides. Steel spring deflections shall be a minimum of 20mm except in those expansion locations where additional deflection is required to limit deflection or load changes to plus or minus 25% of the initial stress.

b Flexible Connectors

Flexible connectors shall be fitted to the inlet and outlet connections of all pumps, water Chillers, and other centrifugal or reciprocating vibrating equipment.

Flexible connectors shall be the full line size of the equipment connection and fitted as close to the source of vibration as is practical. Straight connectors shall, where practical, be installed in a position that is parallel to the equipment shaft, as equipment vibration tends to be most severe in a direction radial to the shaft.

Flexible connectors shall consist of a single or twin-sphere body manufactured with reinforced rubber, the ends of which are raised and wire reinforced to form the cuffs for sealing purposes. The cuffs shall be backed by floating steel flanges.

For use in water, the rubber type shall be EPDM. For other duties, a suitable rubber shall be selected in accordance with the manufacturer's recommendation.

The rubber body shall be reinforced by multi-layered nylon tire cord fabric.

Flexible connectors shall have a life in excess of 10 years under the design working conditions.

The rubber membranes shall have an indelible identification system to clearly identify the model and hence suitability for the application and working conditions and shall have the date of manufacture moulded into the cover to ensure no units are used that have exceeded their recommended shelf life.

Straight connectors shall be of twin-sphere construction whilst elbow connectors shall be of single-sphere construction.

Flexible connectors connected to resiliently supported equipment must be equipped with tie rods to prevent excessive elongation.

3.2.20.3.7 Ductwork Vibration Isolation

Flexible connection shall be installed at all FCU, AHU's and fans and from duct branch take-offs to risers in platform area.

Flexible connections shall be provided between the vibrating equipment and the ductwork and shall be made of approved materials such as lead vinyl or similar of minimum surface density of 5kg/m² and installed such that airflow is not obstructed. The material used must be in compliance with local statutory requirements for fire retardant period but this period shall not be less than 2 hours.

Unless otherwise specified, all discharge duct runs for a distance of 15m from the connected vibrating equipment which has a discharge pressure of 1 kPa or above shall be isolated from the building structure by means of spring hangers. Spring deflections shall be a minimum of 20mm.

Except in the case of ducts passing through compartment walls requiring a fire damper, all ductwork to be isolated shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of ductwork, and a clearance of 20 to 32mm around the outside surface of the ducts shall be maintained. This clearance space shall be sealed with fire rated sealant after installation of ductwork.

In cases where a fire damper is required, ductwork to be isolated shall be fitted with a flexible joint on the side of the fire damper from where the vibration originates.

3.2.20.3.8 Ductwork Acoustic Insulation

Unless otherwise specified, the acoustic duct liner shall conform to the requirements of ASTM C1071 Type II. It shall be composed of long textile-type glass fibres firmly bonded together with a thermosetting resin into a rigid board of 50mm thickness and 48 kg/m^3 density. The air stream surface shall be overlaid with a fire-resistant black acrylic coating that adds strength to the product during fabrication, installation and system operation. The manufacturer's product identification shall appear on the air stream surface.

All duct works immediately upstream and downstream of all VAC ventilation fans and AHU shall be internally acoustic lined up to 5 meters length.

Transverse joints of the duct linerboard shall be neatly butted and there shall be no gaps. Board shall be cut to assure tight, overlapped corner joints. Board shall be adhered to the sheet metal duct with 100% coverage of adhesive conforming to ASTM C-916, and all exposed edges and joints shall also be coated with adhesive. Board shall be additionally secured with mechanical fasteners that shall start within 75mm of the upstream transverse edges and 75mm from the longitudinal joints and be spaced at a maximum of 150mm centres around the perimeter of the duct and 100mm from corner joints. Elsewhere the fasteners shall be spaced at a maximum of 150mm centres in the direction across width of duct and 400mm centres in the direction along length of duct and not more than 75mm from longitudinal joints and 100mm from corner joints. Entering and leaving edges of the duct linerboards shall be provided with continuous sheet metal edge protectors.

All components of the acoustic insulation including coverings and adhesive shall have a fire hazard classification with a flame spread rating of not over 25, and a smoke developed rating of not-over 50. Ratings shall be established by tests conducted in accordance with UL 723, ASTM E-84 or NFPA 255. The Contractor shall certify in writing, before any insulation is installed, that the products to be used meet the above criteria.

The acoustic linings shall have the following minimum sound absorption coefficients when tested in accordance with ASTM C-423.

Octave Band Centre Freq. (Hz)	125	250	500	1k	2k	4k
Sound Absorption Coefficient	0.12	0.67	0.99	0.97	0.91	0.87

Air duct internal linings shall not be installed within 1m of the fire damper.

Where internally lined ductwork is used for smoke exhaust or pressurisation systems, the surface shall be additionally protected by a perforated sheet metal covering securely fitted as an internal duct to ensure the lining does not break free of the duct wall.

3.2.20.3.9 Duct Silencers

The outer casing of rectangular duct silencers shall be fabricated from not lighter than 0.8mm galvanised steel in accordance with the recommended practices in the ASHRAE Guide. Seams shall be lock-formed and mastic filled. Each silencer shall be provided with a flanged inlet and outlet. The internal baffles or splitters shall be not lighter than 0.5mm galvanised perforated steel having a nominal open area of 30%.

All internal components shall be spot welded in place with welds on centres not exceeding 100mm. All spot welds shall be treated after welding with anti-corrosive epoxy resin or other approved coating.

Mani folded silencers shall be installed with continuous metallic nosing crimped in place. Nosing pieces and tails shall be as per manufacturer's design. The filler material shall be of inorganic mineral or glass fibre of a density sufficient to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture proof.

Combustion rating for the silencer acoustic in-fill shall not exceed the following when tested in accordance with ASTM E-84, NFPA Standard 255 or UL No. 723.

Flame Spread	25
Smoke Developed	15
Fuel Contributed	20

The silencer shall be leak-proof at a differential air pressure of 2 kPa.

Before ordering duct silencers the Contractor shall submit for the Contractor's approval the proposed manufacturer's certified test data for pressure drop and insertion loss ratings.

3.2.20.3.10 Acoustic Enclosure

Acoustic enclosures for equipment shall be fabricated from 18 G GI sheets, with 50 mm thick fibreglass, as specified for ductwork acoustic insulation, covered with RP tissue and 0.5 mm thick perforated aluminium sheet.

3.2.20.3.11 Acoustic Lining of Equipment Rooms:

The walls and ceiling of AHU room shall be provided with fix resin bonded glass wool 50mm thick of density 32 kg/m³ for acoustic lining as per following specifications:

Installation:

- Clean the surface
- Fix section (size 25 x 50 x 50 x 50 x 25mm) fabricated out of 24G GI frame with spacing not more than 600mm x 600mm centre to centre to be laid in horizontal and vertical formation.
- Fix resin bonded glass wool 50mm thick of density of 32 kg/m³ in the GI frame and cover with tissue paper.
- Cover the insulation with 24G perforated aluminium sheet with at least 20% perforation.
- Cover the joints in aluminium sheet with 25mm x 1mm aluminium beading secured with GI frame by means of steel screws.

3.2.21 Water treatment for Chilled water system (Chemical Dosing System)

Also refer to specifications for Water Treatment Plant in E&M Specifications.

The Chemical treatment system (dosing) described below is optional depending on Employer's decision to procure Water Treatment Plant.

The method given below is the basic form of treatment for re-circulated chilled water circuits. The minimum provisions are as follows:

a. **Pre-cleaning and flushing out operation**

The entire chilled water circuit shall be flushed out using appropriate chemical dispersant, detergent and defoamer of type and strength recommended by a reputable chemical water treatment manufacturer and guaranteed in writing by that company as suitable in every respect for the application.

The chemical shall remain in the system for 72 hours including a minimum of 24 hours with pumped circulation in operation, unless otherwise recommended by supplier with free technical support accepted by the contractor.

The system shall then be completely drained and flushed until tests at all drain points show that traces of suspended matter have been substantially removed to the contractor's approval.

The system water shall be completely drained as rapidly as possible and contractor shall provide temporary 50 mm valve drain outlets on all lower points where the main pipe works is 50 mm or over, for this purpose.

Subsequent to the flushing out operations the large drain down points shall be reduced to dia 25 mm ball valves. The system shall be refilled and flushed as necessary to achieve the required water quality level.

b. **Chemical Treatment to prevent corrosion, scaling and sludge formation**

The agent shall be a liquid chemicals such as molybdate or a nitrite based agent blended with corrosion inhibitor that can provide such protection to the metal of closed circuit pipelines, system and equipment.

Where applicable storage tanks shall be fabricated from glass reinforced plastics (GRP) or material as specified.

Chemicals used for the water conditioning shall have no detrimental effect on non-metallic materials such as elastomeric or plastic products used in the system. Chemicals shall be low toxicity, non-flammable, suitable for the application and the system operating conditions.

Dosing and metering pumps shall inject into the system by means of flexible plastic piping and an injector fitting.

Overall corrosion rate shall not exceed 5 μm per year for steel components of the circuit in continuous contact with the conditioned water.

The contractor shall provide suitable comparative corrosion test coupons representing the metals in the treated circuit(s) for the purpose of measuring overall corrosion and pitting rates.

Formation of adherent mineral deposits in the form of scale that cannot be flushed from heat transfer surfaces shall be prevented.

The water for the chilled water system shall be maintained at the following specification.

pH value	8.0-10.0
Total Dissolved Solids	below 2500 ppm
Total Hardness (as CaCO3)	below 50 ppm
Turbidity (FTU scale)	below 5 ppm
Iron (increment)	below 1.0 ppm
Copper (increment)	below 0.2 ppm
Nitrite (NO2)	above 250 ppm

The above chemical treatment system is an integral part of the Chilled water system in scope of the Contractor, whether specifically included in BOQ or not.

3.2.22 Water treatment for Condenser water system

Also refer to specifications for Water Treatment Plant in E&M Specifications.

The Chemical treatment (dosing) described below is optional depending on Employer's decision to procure Water Treatment Plant.

The method given below shall be included for by the contractor as the basis form of treatment for water re-circulated between cooling tower and condenser applications. The minimum provisions are as follows:

a. **Pre-cleaning and flushing out operation**

The entire cooling tower, condenser water system shall be flushed out using appropriate chemical dispersant, detergent and defoamer of type and strength recommended by a reputable chemical water treatment manufacturer and guaranteed in writing by that company as suitable in every respect for the application in question.

The chemical shall remain in the system for 72 hours including a minimum of 24 hours with pumped circulation in operation, unless otherwise recommended by supplier with free technical support accepted by the contractor.

The system shall then be completely drained and flushed until tests at all drain points show that traces of suspended matter have been substantially removed to the contractor's approval.

The system water shall be completely drained as rapidly as possible and contractor shall provide temporary 50 mm valved drain outlets on all lower points where the main pipe works is 50 mm or over, for this purpose.

Subsequent to the flushing out operations the large drain down points shall be reduced to 25 mm ball valves. The system shall be refilled and flushed as necessary to achieve the required water quality level.

b. **Chemical Treatment to prevent corrosion, Scaling and Sludge Formation**

The chemical agent employed shall be a combination of chemicals that shall provide corrosion protection, scaling and microbiological inhibition to the metal pipelines and the construction material within condenser and cooling towers.

The chemical agent shall be a non-flammable liquid chemical such as molybdate or a phosphate-based agent blended with anti-foulant and amine based biocide. The agent shall be guaranteed by the chemical manufacturer as suitable in every respect for the application. Chemicals used for the water conditioning shall have no detrimental effect on non-metallic materials, such as elastomeric or plastic products used in the system.

Storage tanks shall be fabricated from glass reinforced plastics (GRP) or material as specified.

The water treatment program shall provide corrosion control for the water circuit(s) by use of suitable corrosion inhibitors and pH control.

Overall corrosion rate shall not exceed 5 μm per year for steel components of the circuit in continuous contact with the conditioned water.

Dosing and metering pumps shall inject into the system by means of flexible plastic piping and an injector fitting.

A continuous bleed-off shall be specified for the cooling tower circuits.

Internal chemical treatment of water in the circuit and external treatment of the make-up water shall be provided when bleed-off alone is inadequate to prevent scale formation, or if bleed-off is uneconomical because of excessive use of corrosion inhibitors.

The electrical conductivity of the re-circulated water shall be used to control the cycles of concentration and chemical feed.

Algae growth shall be prevented by using suitable algaecides. Algaecides that may cause damage to equipment or impair operation shall not be used.

Chemicals shall be fed to circuits requiring continuous make-up by automatic proportional feeding devices.

Bleed off shall be automatic type.

Acid feeders, when used, shall be controlled by electronic pH controllers.

3.2.22.1Water testing equipment

Water testing equipment corresponding to the type of water treatment system and chemical used shall be provided to monitor and verify the performance of the water treatment system offered and shall be handed over by the contractor to MMRC operation and maintenance team.

The equipment shall be of portable type suitable for field sampling and testing. For pH value testing, pH meters or phenol red solution and colour discs shall be provided. Other relevant test kits shall include total dissolved solids and corrosion inhibitor level testers.

3.2.23 Training operation and maintenance facilities

No matter which type of water treatment system is offered, adequate on site operational training and demonstration of the water treatment system shall be provide for the principal's operation and maintenance staff prior to hand over of the system or after completion of installation. It shall include but not be limited to the following

i. Familiarisation of equipment and system including the function of each chemical treatment system.
ii. Water treatment equipment set up/ adjustment instructions.
iii. On-site training of water sampling and testing, equipment and system operation and maintenance procedure.
iv. Precautions required for handling the chemicals and remedial actions required following a spillage.

A competent person from the approved water treatment specialist and equipment suppliers shall hold on-site training, which shall last for at least two months period with one full day in-hand training per month.

The contractor shall provide prominent warning notices, goggles, gloves and necessary accessories for handling the chemicals.

A sufficient number of sampling points in the pipe work or equipment for water analysis, routine inspection and testing shall be provided.

The contractor shall provide the chemical volume based on system water volume and considering 10% wastage.

3.2.24 Electronic Anti fouling system

The electronic anti-fouling system shall prevent the scale fouling by including dissolved minerals ions to precipitate into larger particles by the use of square wave current source. Which shall be supplied along with this equipment. Which shall be wrapped around condenser water circuit. Which shall comprise of

Control Box

Electrical Input 110-240v AC, 50-60 Hz

Enclosure NEMA 12

Solenoid coil

Enclosure ABS Plastic weather resistant.

3.2.25 VRF/ VRV System

3.2.25.1 SCOPE OF WORK

a) Scope of work under this contract shall include but not limited to the design, manufacture, testing

at manufacturer's workshop, supply, storage, erection, site testing and commissioning of the Air-conditioning & Ventilation System mainly comprising of:

b) Outdoor and indoor units of VRV / VRF / High performance air-conditioning system along with refrigerant piping and drain piping etc.

c) Ventilation fans

d) Air distribution system

e) Drain Piping

f) Electrical works

g) Any other item required to complete the work except the specified items mentioned under para "works & services to be arranged by other than HVAC Contractor".

h) Scope of work shall also include the following:

- The Contractor shall include the supply of entire materials in accordance with this specification and the whole of the work necessary for the complete installation as set down in this Specification and with the accompanying schedules and drawings. Materials and components not specifically stated in the specifications and/or bill of materials or noted on the drawings but which are necessary for satisfactory installation and operation of the system shall be deemed to have been included in the scope of work.

i) The Variable Refrigerant Volume / Flow system shall be provided for Workshop & Central Store Building. The complete VRF system including outdoor units, indoor units, copper piping and controls and shall be provided in Duty + Standby configuration for 24 x 7 operating rooms as per Table no 3.1. For non 24 x 7 operating rooms running units shall be provided.

j) The VRF units shall be air cooled, split type multi system air conditioner consisting of one or multiple outdoor units and combination of indoor units, each having capability to cool independently for the requirements of the rooms.

k) The VRF indoor units shall be specially designed for 240Volts/1 phase/ 50 Hz electrical systems and meet the room temperature and humidity level.

l) The refrigerant piping shall be capable of extending up to 300 mtr with 50 mtr level difference without any oil traps and the total pipe length up to 1000 mtr.

m) The Variable Refrigerant Volume / Flow system shall have Variable Digital Screw compressors to provide proportional power consumption as per actual load requirement. It should also be provided with duty cycling for multiple / variable compressor switching starting sequence of multiple outdoor unit.

n) The unit shall be provided with its own microprocessor control panel.

o) The outdoor unit should be fitted with low noise, aero spiral design fan with grill for spiral discharge air flow to reduce pressure loss and should be fitted with DC fan motor for better efficiency. The unit should also be capable to deliver external static pressure to meet proper exhaust of condensing Air.

p) Centralised remote controller shall be provided for controlling, sequencing, scheduling the complete VRF system and to monitor the operation of units and its various parameters. The central remote controller shall be interfaced with VAC BMS system through Bacnet/ Modbus protocol.

3.2.25.2 Quantum of Materials to be ordered

a) The Schedule of Quantities shall not be used as a basis for ascertaining the quantum of materials to be ordered and these are for guidance only. The Contractor shall assess the quantities of materials to be ordered as per requirement and shall be entirely responsible for the same. The design/drawings of the layouts/system shall be submitted by the DDC of the Contractor and got approved from the Employer's representative.

3.2.25.3 WORKS & SERVICES TO BE EXECUTED BY OTHER AGENCIES

a) The following associated works and services are excluded from scope of this contract and shall be executed by other agencies in accordance with contractors approved shop drawings.

b) Insulation to exposed roofs with 50mm thick expanded polystyrene or equivalent insulation.

c) Civil works of providing foundations for major equipment – chillers, pumps and cooling towers.
d) Provision of 415 volt, 3 phase power near each outdoor units and 220 volt single phase supply near each indoor units for VRV system.
e) Provision of 415 volt, 3 phase power near each outdoor units for high performance unit.
f) False ceiling work.

3.2.25.4 Quality control

Reference Codes and Standards:

Standard	Standard no	Description
ARI		**Air-conditioning and Refrigeration Institute**
	ARI Standard 210	Unitary Air-Conditioning and Air-Source Heat Pump Equipment UL Requirements
		Codes and regulations of the jurisdictional authorities.

3.2.25.5 Technical and Installation Requirements

a **General**

Units shall be of minimum vibration and noise level during operation. Additional vibration isolators and sound attenuators shall be provided at Contractor's expense if noise and vibration are found excessive.

Provide units completely piped, wired, charged, and factory tested as a package.

All components shall be dehydrated, sealed and shipped with holding charge/refrigerant.

b **Compressor**

The compressor shall be highly efficient Screw type and should be capable of varying the capacity from 100% to 10% load. It shall change the speed/ loading in accordance to the variation in cooling load requirement.

All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Proper lubrication may also be employed.

Oil heater shall be provided in the compressor casing.

c **Heat exchanger**

The heat exchangers shall be constructed with copper tubes mechanically bonded to Aluminium fins to form a cross fin coils. Aluminium fins shall be covered by anti-corrosion resin film.

The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard

d **Refrigerant circuit**

The refrigerant circuit shall include liquid and gas shut off valves and solenoid valves at condenser end.

All necessary safety devices shall be provided to ensure the safely operation of the system.

All refrigerant piping for the air conditioning system shall be constructed from hard drawn seamless copper refrigerant pipes with copper fittings and silver-soldered joints. The refrigerant piping arrangements shall be in accordance with good practice within the air conditioning industry, and are to include expansion valves, charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

The suction line pipe size and the liquid line pipe size shall be selected according to the manufacturer's specified outside diameter. All refrigerant pipes shall be properly supported and anchored to the building structure using still hangers, slotted angle tray, anchors, brackets and supports which shall be fixed to the building structure by mean of inserts or expansion shields of adequate size and numbered to support the load imposed thereon. The supports shall be of rigid type.

The Outside diameter and wall thickness of copper refrigerant piping shall be as recommended by the manufacturer.

e **Safety devices**

All necessary safety devices including single-phase preventer etc. shall be provided to ensure safe operation of the system.

Following safety devices shall be part of the outdoor unit; High Pressure Switch , Fuse, Fan drive overload Protector , Fusible Plug , Over Load relay, Overload Protection for inverter.

The Refrigerant used shall be CFC free.

f **Indoor unit- General**

Indoor unit shall be either ceiling mounted cassette type, or ceiling mounted duct able type or floor standing type or wall mounted Hi wall type. Each unit shall have electronic control valve to control refrigerant flow rate respond to load variations of the room.

The address of the indoor unit shall be set automatically in case of individual and group control.

The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

The cooling coil shall be made out of seamless copper tubes and have continuous aluminium fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Each coil shall be factory tested at 21kg/sqm air pressure under water.

Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be side away type and neatly inserted.

Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling or cooling and heating.

Each unit shall have wireless LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self –diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

g **Ceiling mounted cassette type unit (multi flow type)**

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX- coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be able to suspend from four corners. The fan shall be aerodynamically designed diffuser turbo fan type.

Unit shall have an external attractive panel for supply and return air. Unit shall be four way supply air grilles on sides and return air grille in centre.

Each unit shall have high lift drain pump, fresh air intake provision.

All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view. It should have provision of connecting branch ducts.

h **Ceiling mounted ductable type unit**

Unit shall be suitable for ceiling suspended arrangement above false ceiling. The unit includes pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel with secondary drain pan.

i **High wall mounted units**

The units shall be wall-mounted type. The unit includes filter, fan section, & DX coil section. The housing of unit shall be light weight powder coated galvanized steel. Unit shall have an attractive external casing for supply and return air.

3.2.26 SPLIT AIR CONDITIONERS

3.2.26.1 GENERAL

The contractor shall supply and install split system air conditioner wherever indicated or required. The system shall be complete in all respects and comply with the specifications as given. The system will work at 240V, 1-Phase, 50 Hz, AC supply. The unit shall be operated by remote control and should show temperature on the cooling units.

3.2.26.2 CONDENSING UNITS

a Each condensing unit shall be complete unit with compressor/s, air cooled condenser, condenser fans with motors, internal piping, switches and internal wiring and shall be enclosed in a weather proof outdoor type housing.

b The compressor shall be hermetic, with enclosed gas cooled motor. The compressor shall be suitable for R-22.

c The condenser coil shall be air cooled type with aluminium sine wave fins and copper tubes and necessary refrigerant connections. The copper tubes shall not be less than 1/2" O.D.

d The condenser air fans shall be propeller type direct driven, each complete with motor. The air quantity and area of the condenser shall be adequate for working in the specified outdoor conditions.

e The casing shall be fabricated from galvanized steel and finished with powder coated paint. The casing shall make the whole unit fully weather proof Suitable for outdoor installation.

f The necessary charge of refrigerant gas and lubricated oil shall be provided to run the system.

3.2.26.3 COOLING UNIT

a The cooling unit shall be matched to the respective condensing unit and shall consist of cooling coil, blower, filters, outer casing, drain pan, accessories etc.

b The cooling coil shall have copper tubes of not less than 1/2" O.D. and continuous aluminium sine fins with integral collars. The tubes shall be staggered in the direction of the air flow.

c The fan section shall comprise of 1 No. statically and dynamically balanced centrifugal blower, motor, drive package, mounting arrangement etc.

d The unit shall include a remote control assembly with thermostat and starter and speed switches.

e The unit casing shall be made of galvanized steel, the casing shall be insulated to lower the noise level and eliminate condensation.

3.2.26.4 REFRIGERANT PIPING

a The condensing unit and evaporator unit shall be interconnected by type `L' seamless copper Refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit. This includes the entire piping work as required.

b The suction and liquid line shall be insulated with 13 mm thick expanded polyethylene/ Nitrile rubber insulation.

c Necessary chases and holes in walls and floor etc for laying the piping work shall be done by contractor, after completion of work necessary repair work shall be done by contractor and brought to its original finish.

3.2.26.5 MISCELLANEOUS

a The unit shall have control panel, housing the starting switches, contractor, relays etc.

b Isolation pads shall be provided under the units.

c Insulated drain line shall be provided from indoor unit upto drain trap.

d Suitable M. S. channel supporting frame shall be provided for the condensing unit and supporting arrangement for the indoor units.

e Interconnecting power and control cabling shall be provided between condensing unit and evaporator unit.

f PVC flexible sleeves shall be provided to cover the insulated refrigerant piping and electrical cabling from indoor to outdoor units.

3.2.26.6 INSTALLATION

a The split type air conditioner shall be mounted on vibration isolators and installed in accordance with the manufacturer's recommendation such that no disturbing vibration or noise is being transmitted to the nearby structure.

b Refrigerant pipes that exposed to outdoor shall be covered with UV coating to protect insulation from direct UV exposure.

c All galvanized support beams, galvanized legs, galvanized hangers, anchor bolts, vibration isolators, duct works and shall be provided for the installation of the units.

d The MS frame required for mounting outdoor condensing units onto the wall or the floor shall be provided by Contractor as required, and after due approval of shop drawings by Employer.

3.2.26.7 TESTING AND COMMISSIONING

a After installations are completed, all air handlers shall undergo test run. Any adjustments that are needed shall be made to assure that all air handlers will operate either the required performance. Report forms to contain following minimum data listings shall include design and actual conditions for each Item mentioned below:

- Date and time of test.
- Air handling unit and fan coil unit make, type, name and serial number.
- Fan rpm.
- Fan motor amperage
- Rated motor amperage, starter number and ampere rating.
- Fan CFM
- Fresh air CFM in case of duct table units
- Outside conditions (DB and WB)
- Entering coil conditions (mixing) (DB and WB)
- (10)Leaving coil conditions (DB and WB)

b During test run, the air filters of testing sets shall be used.

3.2.27 Precision Air Conditioners

3.2.32.3. General

i. The Contractor shall furnish and install the precision air conditioner as per BOQ and/or specified herein.

ii. Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, valves, control valves and controls; for vertical floor mounting in downflow air supply configuration.

iii. The precision air conditioner shall be specially designed for 50 Hz. electrical systems and the cooling capacity shall not be less than that indicated on the BOQ.

3.2.32.4. Standards and References

The precision air conditioner shall comply with the following codes and standards.

i. ANSI/ASHRAE 128: Method of Rating Unitary Spot Air Conditioners (ANSI approved).

ii. AMCA 301: Method for Publishing Sound Ratings for Air Moving Devices.

iii. IS: Indian Standard

3.2.32.5. Material Description

3.2.27.5.1 The air conditioning equipment shall be chilled water type, factory tested. The unit shall be in accordance with the following Specifications as stated below.

3.2.27.5.2 Precision air conditioner shall be extendable modular type. Each module is provided with its own air section, electrical section and cooling section. They shall be designed for maintenance access from the front.

3.2.27.5.3 Type of precision air conditioner shall be specified as shown on the BOQ /Drawings. General classification type of the units shall be as follows:

i. Supply air flow direction

a. Down flow: The units shall discharge cold air on the bottom and intake air (return air) on the top.

ii. Cooling system

1. Chilled water cooling system.

3.2.27.5.4 Component

3.2.27.5.4.1 **Cabinet and Frame:**

a) The unit consists of a frame made of natural coloured aluminium extruded profile and inner steel walls serving for air direction of highest stability.

b) The unit is closed on all sides with removable doors. All parts of housing which are in direct contact with water are made of aluminium and lifetime protect against corrosion.

c) Surfaces in contact with airstream shall comply with requirement in ASHRAE 62.1.

3.2.27.5.4.2 **Exterior Panel Work**

a) The panel work is lined out with a noise absorbing insulation, which is thermally treated. The thickness of insulation is minimum 32 mm.

b) Casing constructed from minimum 1.0mm thick zinc anneal steel sheet.

c) Panels are designed to a total air pressure difference of minimum 1000 Pa.

d) Floor stand shall be welded tubular steel, 450mm high, with adjustable legs and vibration isolation pads

3.2.27.5.4.3 **Cooling Coil**

a Seamless copper tubes with aluminium fins 4/6 rows deep. Maximum face velocity 2.5 m/s.

b Mount coil assembly over stainless steel drain pan complying with ASHRAE 62.1 and having condensate pump unit with integral float switch, pump motor assembly, and reservoir.

3.2.27.5.4.4 **Filter**

a) 50mm thick, disposable glass fiber media.

b) Initial resistance shall be 150Pa.

c) Recommended final resistance shall be 249Pa.

d) Arrestance shall be shall be 30% according to ASHRAE 52.1.

3.2.27.5.4.5 **Fan and Blowers**

a) Fan shall be of the centrifugal type, plug type fans backward curved with EC motor mounted on a single shaft. It shall be with low revolutions and low noise emission. Both statically and dynamically balanced EC fans.

b) Fan housing shall be of heavy gauge galvanized steel, die-formed with streamlined inlets designed to eliminate eddy and shock.

c) The fan wheel or impeller shall be of mild steel or new generation fibreglass material, fabricated construction and well-formed shroud and shall be both statically and dynamically balanced. Shafts shall be steel, either solid or hollow, and ground to close tolerances on all working surfaces. Shafts shall operate well within their critical speeds.

d) Bearing shall be of the self-aligning, maintenance free pre-lubricated ball bearings, sealed type, mounted in cast-iron housing, and shall have balls and races specially lapped and individually tested and selected for quiet operation.

e) Bearings shall be equipped with externally accessible grease fittings and shall be of a size designed to ensure an average operating life in excess of 100,000 hours.

3.2.27.5.4.6 **Motor and Drive**

a) Fans will be directly coupled with EC motor and the speed will vary based on return air temperature.

3.2.27.5.4.7 **Heater**

a) Electrical reheat elements shall be with low watt density finned tubular construction, Elements filled with airflow and high temperature interlocks, made of chrome-nickel steel finned rods, fins made of chrome-nickel steel to reduce surface temperature and frame made of galvanized steel.

b) Each stage is protected by an overheat thermostat and an addition circuit breaker in electrical box.

3.2.27.5.4.8 **Humidifier**

a) Humidifier shall be Ultrasonic type, stainless steel pan, serviceable without disconnecting water, drain or electrical connections. Immersed electrode type humidifiers also are acceptable.

b) Prepiped and using RO water with stainless steel or brass float valve mechanism; located in bypass airstream; with flush cycle mechanism and solenoid drain valve.

c) Reverse Osmosis (RO) water shall be used for humidifier.

3.2.27.5.4.9 **Pressure Independent Control valve (PICV)**

a) Valve shall be electronic, dynamic, modulating, 2 ways, control device. Maximum flow setting shall be adjustable to different setting within the range of the valve size.

b) Valve actuator housing shall be rated to IP44. Actuator shall be driven by 24 VDC motor and shall accept 2-10 VDC, 4-20mA, 3-point floating or pulse width modulation electric signal and shall include resistor to facilitate any of these signals. Actuator shall be capable of providing 4-20mA or 2-10VDC feedback signal to control system. Optional fail safe system to power valve to either open of closed position from any position in case of power failure shall be available Extended LED read – out of current valve position and maximum valve position setting shall be standard.

c) It shall comply with following specification

i. The PICV valves shall meet the following high performance generic specific criteria: Valves should be pressure independent and should have integral differential pressure control over built in control valve and flow control.

ii. The valves should have a bonnet for temperature control and diaphragm operated

differential pressure controller all built in one valve body.

iii. Valves should be protected against overload with a safety spring Valves should be inline body type and should be suitable for modulating control at temperatures between -10° C to +50° Centigrade.

iv. Valves shall be suitable for Pressure class PN25.

v. The diaphragm and gaskets shall be made from EPDM.

vi. The valve sear shall be made from stainless steel.

vii. The valve should be designed for readjustment of flow rate at site without removal of actuator.

viii. The pressure drop on the flow control spring / throttle should not exceed 45kPa.

ix. The valve should have integral spring and diaphragm arrangement for differential pressure control.

x. Valve should be capable of operating under maximum differential pressure of 500 KPa.

xi. The pressure drop on the flow control spring / throttle should not exceed 40kPa.

xii. The minimum lift on the control valve shall be 10 mm and 3 mm resp. Generally PICV valves shall be a single assembly.

d) Valve shall be electronic, dynamic, modulating, 2 ways, control device. Maximum flow setting shall be adjustable to different setting within the range of the valve size.

e) Valve actuator housing shall be rated to IP44. Actuator shall be driven by 24 VDC motor and shall accept 2-10 VDC, 4-20mA, 3-point floating or pulse width modulation electric signal and shall include resistor to facilitate any of these signals. Actuator shall be capable of providing 4-20mA or 2-10VDC feedback signal to control system. Optional fail safe system to power valve to either open of closed position from any position in case of power failure shall be available Extended LED read – out of current valve position and maximum valve position setting shall be standard.

f) It shall comply with following specification.

i. The PICV valves shall meet the following high performance generic specific criteria: Valves should be pressure independent and should have integral differential pressure control over built in control valve and flow control.

ii. The valves should have a bonnet for temperature control and diaphragm operated differential pressure controller all built in one valve body.

iii. Valves should be protected against overload with a safety spring Valves should be inline body type and should be suitable for modulating control at temperatures between -10° C to +50° Centigrade.

iv. Valves shall be suitable for Pressure class PN25C.

v. The diaphragm and gaskets shall be made from EPDM.

vi. The valve sear shall be made from stainless steel.

vii. The valve should be designed for readjustment of flow rate at site without removal of actuator.

viii. The pressure drop on the flow control spring / throttle should not exceed 45kPa.

ix. The valve should have integral spring and diaphragm arrangement for differential pressure control.

x. Valve should be capable of operating under maximum differential pressure of 500 KPa.

xi. The pressure drop on the flow control spring / throttle should not exceed 40kPa.

xii. The minimum lift on the control valve shall be 10 mm and 3 mm resp. Generally PICV valves shall be a single assembly.

3.2.27.5.4.10 **Water Leak Detector**

The water leak detector sensing cable provided completed with the unit module.

The sensing cables are installed under raised floor and detect water leakage under the unit. The cable detects the presence of water at any point along their length.

The sensing cable constructed of 2 sensor wires and continuity wire embedded in a Fluor polymer carrier rod. The cable structure has no alarm error when touching any steel

3.2.27.5.4.11 **Microprocessor-Control System:**

Continuously monitors operation of process cooling system; continuously displays room temperature and room relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.

1. Malfunctions:

a. Power loss.
b. Loss of airflow.
c. Clogged air filter.
d. High room temperatures.
e. Low room temperatures.
f. High humidity.
g. Low humidity.
h. Smoke/fire.
i. Water under floor.
j. Supply fan overload.
k. Control valve status

2. Digital Display:

a. Control power on.
b. Humidifying.
c. Dehumidifying.
d. Control valve position in percentage
e. Heat operating.

3. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.

4. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status.

5. ASHRAE 135 (BACnet) or LonTalk communication interface with the BAS shall enable the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

3.2.27.5.4.12 **Front Panel / Display Face**

i. Front panel equipped with user friendly large surface LCD display. The software is structured in three different levels: Information, Operation and Service, which can be operated by a user friendly windows base via the display and the keys consists of

1. Selector Button: Select menus and change parameter
2. Confirmation: Acknowledge function and parameter
3. On/Off Switch: On/Off

4. LED Alarm: LED lights up in the event of alarm.
5. Audible Indicator: The audible indicator issues and alarm tone when the alarm signals in the display.

ii. The controller has to display at least:

a. Actual values of temperature and relative humidity and display of the temperature and humidity curve over at last 24 hours.

b. Symbols for operation modes cooling, reheat, dehumidification and humidification of every modules.

c. The RS232 provide for printer interface or for interface with building management system (BMS).

d. The graphic display can be switch to various languages and different character including both English and Thai.

e. Module and component running time.

f. The previous 60 alarms with date and time, alarm delays adjustable, priorities of the alarm.

g. Maintenance request symbol appear when the service required.

h. The alarm signals have to transmit via the controller (front panel), paper, mobile phone and fixed line. The front panel alarm with LED indicator and audible alarm with the following display at least:

i. Temperature too high / too low

ii. Humidity too high / too low.

iii. Clogged filter.

iv. Compressor high / low pressure.

v. Water leak alarm

3.2.27.5.4.13 Supervisor Controller

1) The Supervisor controller produces by the same manufacturer as precision air conditioner unit. Each controller has to provide complete with own supervisor controller.

2) The supervisor controller acts as a supervisor to the controller and takeover the controller in the event of failure by keeping the same parameter and all features as master controller and front panel and every module still operation with current status.

3.2.27.5.5 Installation

3.2.27.3.5.1 The precision air conditioner shall be mounted on vibration isolators and installed in accordance with the manufacturer's recommendation such that no disturbing vibration or noise is being transmitted to the nearby structure.

3.2.27.3.5.2 Chilled water pipes that installed exposed shall be cover with aluminium pipe jacket for protected insulation from damage.

3.2.27.3.5.3 Location of on/off switch and thermistor or temperature controller shall be installed as per drawing drawings or manufacturer standard, In case of installation problems that cannot be mounted as indicated, Engineer shall indicated the proper location for installation.

3.2.27.3.5.4 Vibration isolator shall be provided and noise control shall be concerned for installing each air-conditioning unit.

3.2.27.3.5.5 Conduit of Electric wiring shall be metal tube. EMT-type shall be installed within indoor area.

3.2.27.3.5.6 Conduit of transmission wiring shall be the type of conduit of Electric wiring tube.

3.2.27.3.5.7 Power cables (including power supply to air conditioner) and signal cables must not be laid inside the same conduit (Power cables and signal cables must each have their own individual conduits).

3.2.27.3.5.8 Fresh air supply duct shall be connected to the unit with motorised and volume control dampers.

3.2.27.5.6 Testing and Commissioning

3.2.27.5.6.1 Operating test run shall be provided from manufacturer.

3.2.27.5.6.2 After installations are completed, precision air conditioner shall undergo test run. Any adjustments that are needed shall be made to ensure that all precision air conditioner will operate either the required performance. Report forms to contain following minimum data listings shall include design and actual conditions for each Item mentioned below:

i. Date and time of test.
ii. Air handling unit and fan coil unit make, type, name and serial number.
iii. Fan rpm.
iv. Pressure drop across filter
v. Fan discharge static pressure
vi. Fan motor amperage
vii. Rated motor amperage, starter number and Ampere rating.
viii. Re-circulated air CFM
ix. Outside air CFM
x. Outside Condition (DB and WB)
xi. Return air condition (DB and WB)
xii. Entering coil conditions (mixing) (DB and WB)
xiii. Leaving coil conditions (DB and WB)

3.2.27.5.6.3 During test run, the air filters of testing sets shall be used.

3.2.28 Ventilation & Smoke Extraction Fan (Jet Vent Fan)

NOTE :

It is the scope of the Depot E&M Contractor to design and implement the basement Car park ventilation system comprising axial fan system and Jet fan system, according to the requirements of NBC 2016. Liaising and taking prior approval of Fire Authority shall also be in the scope of Depot E&M contractor

a General Instructions

Supply, installation, testing & commissioning of Jet Vent System for underground parking as indicated on the Drawings.

b Composed

The fan should be furnished as factory assembled. Having characteristic as high performance of ventilation with small air volume. Each unit shall consist of inlet bell mouth with protective screen, silencer both inlet and outlet discharge nozzle, terminal box and mounting arm.

c Fan

Specifications

Jet fans shall be of the direct drive axial type with cast aluminium aerofoil propellers.

The casing shall be constructed of continuously welded steel and include integral punched inlet and outlet flanges to prevent air leakage.

The casing and motor base shall be constructed from precision laser cut and formed members of heavy gauge steel to prevent vibration and rigidly support the motor. Motor support brackets shall be welded to fan casing for increased strength. The entire fan section shall be coated using a hot-dipped galvanizing process.

The silencers shall be two fan diameters long and shall be fitted with an integral inlet bell on both the inlet and outlet of the fan to provide a streamlined low profile design. The silencers shall be manufactured of galvanized material and fitted with 50mm of acoustic insulation which is held in place using a galvanized wire mesh screen on the interior of each silencer.

Fan performance shall be based on tests conducted in accordance to AMCA 210 (meets BS848 part 1). All published GJ sound data shall be tested in accordance to AMCA 300.

Motor Information

All motors are available as 380, 400 and 415 V, 50HZ motors and are DOL Start only all motors have temperature ratings of 300 deg.C for 2hrs. Certificate of CE certified High Temperature fans should be submitted.

A unique high efficiency Aero- foil section blade shall have smoothed hub and clam- plate for adjustable pitch angle flexibility. The impellers shall be of precision die-cast to offer thin Aero-foil sections for low generation of noise levels. Every cast aluminium component shall be X-rayed using Real Time Radiography inspection prior to assembly. This feature shall provide evidence of casting quality against product liability legislation if specified. Aero-foil Fan impellers shall have a unique aerodynamic section blade to optimize the efficiency of performance and minimize the generation of noise.

The thin sections shall be obtained by precision die cast manufacturing techniques to have a lighter weight assembly.

Precision die cast aluminium hub and clamp-plate shall be equally spaced, fully adjustable, high pressure die cast Aero-foil section blades.

All rotating aluminium components shall be X-ray examined prior to machining to assure quality and suitable for operation at 300 Deg C for two hours.

d Casings:

Either a long cased form complete with an externally mounted pre-wired electrical terminal box, or short cased for duct or plate installation.

Casings are spun from sheet steel with integral pre-drilled flanges, fully welded seams and hot-dipped galvanized after manufacture for excellent durability.

e Motors:

Squirrel cage type, insulated to class F, bearings lubricated with wide temperature grease, Keyed shaft. To comply with BS5000 Pt 99 and IEC 34-a, Weatherproof to IP55. (Overheat protection shall be provided on most single phase motors).

2 Speed operation by Delta/Star reconnection available on most three phase motor up-to frame size F22. Two speeds can be obtained by reconnecting a Single winding via six winding terminals to give two separate pole numbers Integral pre-wired capacitor on most single phase fans.

f Dual Wound

This type of motor has two separate individual windings of the requisite poles to give the speeds required.

Performance shall be independently approved by AMCA, and established in accordance with ISO5801:1997 installation category D, method of testing air performance and BS848 Pt 2 1985 method of noise testing.

g Discharge Nozzle

The nozzle shall be made of aluminium round shaped aerodynamically and finished with polishing coat.

h Inlet Bell Mouth

The bell mouth is made of aluminium 3003 and transparent paint coated. It is shaped to reduce air turbulence in the inlet of the fan.

i Protective Bird Screen

The screen shall be circle screen, made of chrome coated.

j Terminal Box

The box shall be equipped with high temperature type indication lamp the wire to the motor shall be enclosed with fiberglass tube for fire protection. It shall be sealed with fire rated sealant and all internal wiring and components tested by PSB to BS 7346 Part2.

k Mounting Arm

Mounting arm shall be permitted adjustment of the air stream, discharge of 180 degree angle horizontally and 90 degree of vertically.

Acoustic - Data the sound levels quoted shall be based on tests shall be carried out by the manufacturer in in-house certified laboratory by AMCA and British

Standards by using the spectrum corrections stated on each performance chart, an un-weighted sound power spectrum shall be obtained for the fan.

l Non-Overloading

The fans shall have a non-overloading characteristic; the peak power input occurs within the range of normal operating pressures and is always exceeded by the motor rating.

m Testing

Performance data has been obtained in accordance with the internationally recognized standard – ISO5801:1997 installation category D (AMCA approved) for aerodynamic performance and BS848 Part 2 (1985) for acoustic performance.

n Fixings

All fixings are protected with an organically based zinc coating to provide excellent corrosion resistance.

o Quality Assurance

The Aero-foil fans shall be licensed to bear the AMCA seal based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program.

Quality Assurance for design and manufacturing should be Register to BS EN ISO 9001.94, the manufacturer should own laboratory which is British Standard and AMCA accredited for aerodynamic performance are identified by the AMCA Seal on the appropriate characteristic curves(s)

The jet fans should be fitted with IP 55 motors as a standard and should come with 2 years ex-works warranty.

All JETVENT fans shall be supplied for a one off emergency operation at temperatures up to 300 Deg C for 2 hours (H.T. Category 200/2).

This facility should be independently certified by the Loss Prevention Certification, Board

- Mounting Feet
- Impeller and Motor Side Guards
- Two Silencers of length 710 mm (Minimum) with or without pod 2 speed switch type MDS3.10
- Air Operated Dampers
- Matching Flanges
- Bellmouth Inlets
- Flexible Connectors
- Vibration Isolators

3.2.29 Vane Axial Fan Specifications

Inline fans shall be of the direct drive vane axial type with cast Aluminium aerofoil / Extruded Aluminium propellers.

The casing shall be constructed of continuously welded galvanized steel and include integral punched inlet and outlet flanges to prevent air leakage. The motor shall be supported in the centre of the casing by an inner tube that is attached to the outer casing with aluminium air foil straightening vanes.

Blades shall be air foil design, 800 mm and smaller units will utilize a high efficiency, low sound twisted extruded air foil prop that is welded to a central hub. and larger units will have a hub and blades that are made from a high strength cast aluminium alloy which are manually adjustable without removing from the fan casing. All rotors shall be statically and dynamically balanced.

Fan performance shall be based on tests conducted in accordance to AMCA 210 for air performance, the minimum acceptable fan efficiency shall be 70%. The noise level for fans shall have to be 75 dba at 1.5M distance or lower as AMCA 300 for Inlet sound power levels. These fans shall be licensed to bear the AMCA seal for air and sound performance. These fans should also be licensed to bear the AMCA seal for Fan Efficiency Grade (FEG) Certification.

Fans meant for high temperature performance shall be certified in accordance with EN1210-3:2002 for 300 Degree C for 2 hrs for design time and temperatures used in emergency heat and smoke extract application and to carry the CE label. Certificate of Fan & Motor Assembly tested for High temp for 300 Degree for 2 hrs should be submitted.

3.2.30 Impulse Jet Fans

Supply, erection, testing & commissioning of jet fan as per specification suitable for normal ventilation & smoke extraction application. Minimum diameter of jet fan shall be 350 mm. Each fan shall be complete with motor & impeller. Unit shall be complete with silencer at suction & delivery side. The entire unit shall be factory assembled. Fans shall be fore rated. Complete fan assembly shall be certified as "Tested for 300 deg. C for two hrs. Operation". The motor shall be suitable for operation on 415 ± 10%V, 50 Hz, 3-ph air supply. The fan shall operate at dual speed delivering at least 10 N at low speed and 40 N at the higher speed.

3.2.31 Carbon Monoxide Sensors

Supply, erection, testing & commissioning of CO sensors for sensing carbon monoxide in the Basement. The sensors shall operate within the measuring range of 0-300 ppm CO, IP 44 protected housing, electro-chemical sensor cell, proportional output, 2-wire loop current connection. Response time shall not be more than 90 secs. Sensor cell shall be filled replaceable plug in type. The unit shall be capable of working during fire also and capable of operation in 24V DC/AC power supply.

3.2.32 Controls and Monitoring of VAC System

3.2.32.1. General

This section specifies furnishing of the control and monitoring of VAC system through BMS M&E SCADA specified in Section VI-BMS-M&E SCADA.

3.2.32.2. Quality control

Reference Codes and Standards are species in Section VI-BMS-M&E SCADA.

3.2.32.3. Scope of Work

The design requirements of BMS /M&E SCADA for VAC system is to control, monitor and supervision to ensure the safety and efficient operations of VAC equipment.

3.2.32.4. Field Equipment to be Monitored and Control

The BMS contractor shall undertake an interfacing process with the VAC contractor supplying the field equipment to identify the final number and form of data items to be monitored and the necessary form of controls to be transmitted to the field equipment to initiate and confirm transfer of data to the BMS /M&E SCADA.

The items to be transmitted over the BMS /M&E SCADA include, but are not limited to the entries in the following clauses:

a) Sufficient indications of plant state shall be logged and transmitted to the BMS/ M&E SCADA to permit a full analysis of plant running / fault conditions and also to provide adequate indication in the BMS /M&E SCADA that all operational and safety related equipment are operating in desired manner.

b) The following list identifies some, but not necessarily all items, which shall be monitored in the BMS /M&E SCADA, for which abnormal conditions shall be alarmed:

   i. The status of the local control switch and starter power isolator switch shall be monitored to ensure that fans are operable.

ii. Ventilation Exhaust air fans / Fresh air fans, air handling unit fans and associated dampers, FCUs and Motorized modulating control valves etc
iii. Chilled/Condenser water pumps
iv. Individual chillers
v. Condenser/chilled water flow
vi. Condenser/chilled water temperature "in and out" of chiller
vii. Central equipment room temperature and humidity.
viii. Precision Units
ix. Motorized dampers, fire dampers and valves
x. To provide Daily Report, Weekly Report, Monthly Report of total energy consumption and Operating Hours Report of all VAC equipment.

3.2.32.5. Unitary Controller (UC) for Fan Coil Units:

a) Each fan coil unit shall have a UC. The number, type and location of FCU shall be as indicated on the Mechanical Drawings.

b) The FCU manufacturer shall provide the following components for each fan coil unit for interface and mounting of the UC:

i. 24Vac fan control relay interface

ii. Suitable mounting device for the temperature sensor/thermostat for the FCU. The FCU manufacturer shall provide a suitably constructed enclosure with electrical barriers as required by the applicable codes and standards.

c) The BMS contractor shall furnish the following components for each FCU:

i. Unitary controller.
ii. 24Vac control transformer.
iii. Wall mounted temperature sensor/thermostat.
iv. Chilled water valve and actuator.

d) Provide a wall mounted space temperature sensor or thermostat for the monitoring of the space temperature associated with the FCU. The sensor shall meet the following minimum requirements:

i. RTD or thermistor sensors.
ii. Temperature reported at the SCADA workstation shall have an accuracy of ±0.5ºC.
iii. Enclosure shall be rugged plastic and shall be white for thermostats.
iv. Thermostat shall have an LCD display. Temperature reported at the LCD shall have an accuracy of ±0.5ºC and the difference between the LCD and the workstation reported temperatures shall not differ by more than 0.2ºC. Cover shall be removable to allow access to the plug for the POT.
v. The functions displayed by LCD via selector button shall be space temperature, space temperature set point.
vi. The enclosures shall be submitted to the MMRC Representative for approval and shall be amended as instructed by the MMRC Representative at no cost to the Employer.
vii. Thermostat temperature sensor housings with LCD display shall be intelligent and shall communicate with their associated UC via a digital communications network over screened twisted pair cable or equivalent. This communications network may use a proprietary protocol. Enclosures associated with FCU that have speed control shall also incorporate speed selection buttons.
viii. The temperature sensor/thermostat enclosures or flush plate recessed temperature sensor installation that are wall mounted shall be locate 1,500 mm above finished floor level. Coordinate exact locations with Architectural Plans.

e) The UC shall monitor and control the following parameters for FCU:

i. Space temperature.

ii. Fan on/off control.
iii. Cooling coil valve..
iv. Set point reset.
v. Fan speed control selection.

f) PID algorithms shall maintain the system operation within ±0.5ºC of the space temperature set points.

g) The operator shall be able to access the UC by connecting the POT to the UC LAN at the thermostat enclosure. Operator shall be able to undue the following functions via the POT when connected at the temperature sensor/thermostat housing:

i. Change space temperature set points for a single FCU
ii. Change an alarm limit/value.
iii. Change the operating mode for a single FCU
iv. Change the schedules for a single FCU.
v. Turn the fan on/off for a single FCU.
vi. Set the cooling coil valve to fully open and fully closed and any intermediate position.

h) The BMS Specialist shall install data into the UC on site as necessary for the correct operation of the FCU including:

i. FCU-UC LAN address.
ii. Occupied space temperature set points.
iii. Unoccupied space temperature set points..
iv. Control constants.
v. Engineering units conversion factors.
vi. Default operating schedules.
vii. Definition of FCU type.
viii. Other parameters as necessary to define the operation of the FCU in accordance with the Specifications.

i) The BMS contractor shall calibrate the space temperature sensor/thermostat at the project site.

j) Following the installation of the FCU the BMS contractor shall undertake the following tasks:

i. Physically connect the UC into the BMS LAN.
ii. Enter all parameters that may not have been entered before shipment of the FCU to the site.
iii. Verify that the UC modulates the cooling coil valve from fully open to fully close and vice versa.
iv. Verify that the FCU-UC is satisfactorily integrated into the LAN.
v. Verify that the operating sequences are correct and that there is stable modulation of the cooling coil valve.
vi. Calibrate the temperature sensor/thermostat.

k) UC shall have opto-isolation or equivalent protection.

l) UC shall be native BACnet and shall comply with all of the requirements of ASHRAE SSPC/135.

m) The BMS Contractor shall provide interoperability documentation for the UC. All the data related to the UC shall be presented along with their respective BACnet object ID created in the system, along with their PIC, BIBBS, addresses and method statements to read and write data via integration of the UC with another system in future. This may be part of the overall interoperability documentation.

3.2.32.6. Variable Speed Drives (VSD) Controller:

The variable speed drive (VSD) controller shall be microprocessor based and shall have a data port that enables the exchange of data between the VSD controller and the BMS/ M&E SCADA.

The interface between the variable need drive controller and the Automation Level Network shall enable, at minimum, the following information to be transferred to the BMS /M&E SCADA:

i. Start and stop control.
ii. Speed control
iii. Speed reference feedback
iv. Motor operating status
v. VSD alarm
vi. Motor power in kW
vii. Motor kWh
viii. Motor current
ix. Motor voltage
x. Hours run
xi. DC link voltage
xii. Thermal load on motor
xiii. Thermal load on VSD
xiv. Heat sink temperature
xv. Any other information available from the VSD controller as selected by the Employer

The interface between the VSD controller and the Management Level Network shall enable, at minimum, the following information to be transferred from the BMS /M&E SCADA to the VSD controller:

i. Speed control signal
ii. Start/stop control signal

3.2.32.7. Precession A/C Unit for Central Equipment Room (CER)

The precession A/C unit controller shall be microprocessor based and shall have a data port to enable the exchange of data between the BMS Automation Level and the CER A/C unit controller.

The interface between the CER A/C unit controller and the BMS Automation Level shall enable, at minimum, the following information to be transferred from the CER A/C unit controller to the BMS /M&E SCADA:

i. Cooling stages
ii. Dehumidification.
iii. Humidification.
iv. High temp alarm.
v. Low temp alarm.
vi. Air flow loss.
vii. High hum. Alarm.
viii. Low hum. Alarm.
ix. Change filters.
x. Local alarm.
xi. High head pressure.
xii. Humidity status.
xiii. Temperature.
xiv. Humidity.
xv. Unit status.

3.2.32.8. Chillers

The water cooled package chiller controller shall be microprocessor based and shall have a data port to enable the exchange of data between the BMS Automation Level Chiller.

The interface between the Chiller controller and the BMS Automation Level shall enable, all the information to be transferred from the chiller controller to the BMS/ M&E SCADA:

3.2.32.9. Technical and Installation of equipment's

3.2.29.9.1 Temperature Sensor Sensor/Thermostat: Wall Mounted

Thermostat: Provide wall mounted temperature sensor that meets the following:

i. White protective enclosure. There shall be no manufacturer's logos, name or thermometer on casing. Overall dimension of thermostat: 90 mm wide x 125 mm H x 30 mm deep.

ii. Thermostat shall be a network device that provides input into the BMS system for control FCU. The technologically advanced thermostat shall feature a BMS network communication capability that enables remote monitoring and programmability functions for space temperature control. The programmable functions shall include the ability for the BMS system to override the space temperature set point during un-occupied mode of operation, allow the user to only adjust the temperature set point 1.1ºC up or down from the BMS set point during occupied mode of operation.

iii. Provide thermostat with intuitive user interface with backlit display that makes adjustment of temperature quick and easy, by simply pressing an up/down arrow key. Backlit LCD, plain text message with constant backlight that brightens during user interface.

iv. Thermostat location shall be reviewed with MMRC Representative. No wall mounted thermostat shall be mounted until the temperature element location has been approved by MMRC Representative.

v. Monitored temperature shall be reported with an accuracy of 0.5ºC.

vi. Provide a two wire 4-20 mA RTD transmitter where required.

vii. Temperature range of 10 to 60ºC.

viii. Sensor shall have LCD display.

3.2.32.10. COMBINATION RELATIVE HUMIDITY AND TEMPERATURE SENSORS: OUTSIDE AIR:

Provide a combination wet bulb temperature and dry bulb temperature sensor for exterior wall mounting. .

i. Stainless steel probe with an IP65 to BS 60529 housing for an exterior housing.

ii. Two wire, 4-20 mA output proportional to minimum wet bulb temperature range of -7 to +49ºC.

iii. Two wire, 4-20 mA output proportional to minimum dry bulb temperature range of -29 to +49ºC.

iv. Monitored dry bulb temperature shall be reported with an accuracy of 0.5ºC.

v. Monitored wet bulb temperature shall be reported with an accuracy of 3% of reading.

vi. Sensor shall have a solar screen.

3.2.33 Automatic Vacuum Degasser

The Vacuum Degasser should be a fully automatic degasser for cooling installations and a working pressure of up to 6 bar. It should have electronic control and should offer numerous facilities for reading system information, status and logged data. The Degasser should be BMS compatible. The device should be supplied with ready to use, complete with flexible connection hoses, fitted with coupling nuts. By adjusting a number of parameters, in combination with adjusting 2 valves in the inlet and outlet piping, the degasser should be optimally adjusted in a fast and easy way for any particular installation. The Degasser should be fitted with a high-grade, vertical, multistage centrifugal pump and intelligent control. The comprehensive control should offer numerous facilities for reading system information, status and logged data. The Degasser should be able to measure the installation pressure continuously and, if necessary, fill up the installation with degassed fluid. This keeps an installation on pressure continuously, without the need for additional devices. The Degasser should be fitted with an automatic switch which should

continuously register when gases are removed. It should be able to switch off the Degasser when it is not required to run. Hence, it should only run when required.

a) Control:

The Various Parameters that can be read from the Interface of the system should be:

- Cutting-off times
- Refill pressure
- Start times
- Refill alarms
- Maximum system pressure
- Desired system pressure
- Operation time
- Status
- Refill history
- Failure data
- Degassing

3.2.34 Air & Dirt Separator:

The combined Air & Dirt Separator unit allows it not just to remove free and dissolved air but also dirt particles of up to 10 microns without any change to the designed Pressure drop. The special design of the tube is at the heart of the unique combined action of the separator. Dirt particles of all sizes should sink to the bottom of the unit and collect in the dirt chamber, whilst the air bubbles rise and collect in the air chamber. The dirt can be flushed out while the system is in full operation through the drain valve. The air should release via the automatic air vent. The medium used to de-aerate and remove dirt shall be manufactured of Steel Tube & copper wire & Tin. The large collector at the bottom should ensure that flushing is only required now and then. The automatic air vent should be guaranteed not to leak and cannot be closed. There should be a special constructed air chamber to protect the valve mechanism from dirt. Sufficient volume to take care of pressure fluctuations. Air Separation via centrifugal force is not acceptable Large capacity collection chamber should reduce the need for frequent draining. A drain valve is installed at the bottom of the tube for flushing out the dirt. All connections, fittings and heads shall be of carbon steel. The Design and manufacturing of the unit should be in accordance with 97/23/EC. The unique tube element should cause a local change of the flow in the steel housing, from turbulent to laminar. Because of this, microbubbles of air are removed from the fluid and dirt particles will sink down. The microbubbles are collected in the air chamber and released to the environment by means of an automatic air vent. The dirt particles are collected at the bottom of the separator and can be released manually during operation. A good flow-through of the piping should be guaranteed.

b) Testing

All water piping shall be tested to hydrostatic tests pressure of at least two times the maximum operating pressure, but not less than 7Kg/cm2g for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Consultant/Employer. Piping repaired subsequent to the above pressure shall be retested in the same summer. Piping may be tested in sections and such sections shall be securely capped.

c) Cleaning Piping

After piping system has been tested and proved tight, the Contractor shall clean piping system of dirt, scale, oil, grease, waste & other foreign substance, which may have accumulated during process of installation. Strainer, screens shall be removed, cleaned and replaced after cleaning process and cleaned after flushing process.

d) Painting

After all piping has been installed, tested and run for at least two weeks it shall be coated

with primer coat and synthetic enamel paints of approved shades as per the colour code. The direction of fluid in the pipes shall be visibly marked with paint.

4 WATER TREATMENT PLANT

4.1 General

This section specifies the furnishing and installation to complete and operate softening plant for reducing the hardness of raw water to below 5 mg/lit commercial zero so as to generate Water fit for makeup requirements for cooling Towers of HVAC system.

4.1.1 All materials shall be new and of the best quality conforming to specifications and subject to the approval of engineer.

4.1.2 All equipment shall be manufactured by reputed firms.

4.1.3 All equipment shall be installed on suitable foundations, true to level and in a neat workman like hammer

4.1.4 Equipment shall be installed so as to provide sufficient clearance between the end walls and equipment in addition to sufficient clearance between equipment to equipment.

4.1.5 Piping within the pump house shall be done so as to prevent any obstruction in the movement within the pump house.

4.2 Standards

4.2.1 IS 8419: Requirements for water filtration equipment: Part I Filtration media – sand and gravel

4.2.2 IS 10500: Drinking water

4.2.3 IS 2825: Code for unfired pressure vessels

4.3 Quality control

4.3.1 Engage the services of a specialist for initial cleaning and pretreatment

4.3.2 Specialist's services shall include monthly laboratory testing of water samples and adjustment of automatic water treatment system

4.3.3 A complete testing report regarding the quality of the supplied water together with the recommend water treatment system shall be submitted for approval prior to ordering

4.4 Technical and Installation Requirements

4.4.1 Water Filtration unit

4.4.1.1 Water filters shall be sand /gravel and anthracite pressure filters, downward or upward flow type, suitable for a rate of filtration given in schedule of quantities. The basic function of filtration unit is to remove suspended impurities so as to reduce turbidity to below 5 NTU and the colour to below 5 Hazen units

4.4.1.2 Filters shall be vertical type of required diameter. The shell shall be fabricated from M.S plates suitable to withstand a working pressure given in bill of quantities. The thickness of shell and dished ends shall be as per IS: 2825. The filter shall have two pressure tight manhole cover one at the top and other at side shell portion. Each filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary and required. Filters shall be rubber lined with 3mm thick non-toxic, non-leaching rubber. Rubber lining to be tested with spark Tester for pin holes etc. Rubber lining to be done after cleaning the inner surfaces thoroughly by sand blasting. Primary painting of all exposed surfaces to be done.

4.4.1.3 Under drain system

4.4.1.3.1 Each filter shall be provided with an efficient under drain system comprising of collection pipes, polypropylene nozzles of manufacturer's design. The entire under draining system shall be provided on M.S plate or cement concrete supports provided by the contractor.

4.4.1.4 Face piping

4.4.1.4.1 Each filter shall be provided with interconnection face piping comprising of inlet, outlet and backwash complete with diaphragm valves/ ball valves.

4.4.1.5 ACCESSORIES

4.4.1.5.1 Each filter shall be provided with the following accessories:

a) Air release valve with connecting piping
b) 100 mm dia bourden type gun metal pressure gauges with gunmetal isolation clock and siphon on inlet and outlet.
c) Sampling cocks on raw water inlet and filtered water outlet.
d) Individual drain connection with ball valves for each filter
e) Connection with valve for air scouring
f) Rate of flow indicators in the raw water inlet line.
g) Quantity meter in the filter water outline line.

4.4.1.6 Filter media

4.4.1.6.1 Each filter shall be provided with clean and washed filter media, Conforming to IS 8419 (part-I).Following is recommended

Coarse silex pabbles	6.0 – 10.0 mm size	(150mm deep)
Fine silex sand	1.4 – 2.5 mm size	(600mm deep)
Anthracite	0.80 – 1.6 mm dia	(600mm deep)

4.4.1.6.2 The above filter media arrangement may be altered to suit contractor's own design for the most efficient performance.

4.4.1.7 Test kits

4.4.1.7.1 Provide one test kit with initial requirement of reagents for the following:

a) Residual chlorine indicator
b) PH meter(electronic)

The contractor shall supply the details of equipment (including test kit) with literature for the equipments quoted by him.

4.4.2 SOFTENER

4.4.2.1 Mild steel pressure vessel complete with dished ends , supporting legs and facing pad for pipe connection internally rubber lined with non-leaching, nontoxic rubber of 3mm thickness and painted externally with two coats of red oxide primer and two coats of synthetic enamel paint complete with manhole and cover . It should be heavy class M.S rubberlined having frontal pipe work fitted with valves and provided with inlet , outlet, Pressure gauges and sample valves complete with manual ball/ Diaphragm valves for normal operation and regeneration , Hydraulically operated ejector, initial charge of resin and internals consisting of distributor, collector and regeneration tank to store and measure chemicals for generation.

The basic function of the softening plant is to reduce the total hardness to commercial zero i.e total hardness to below 5 mg/lit. (as Ca Co3)

4.4.2.2 Under drain system

4.4.2.2.1 Each softner shall be provided with an efficient under drain system comprising of collection pipes, polypropylene nozzles of manufacturers design. The entire under draining system shall be provided on M.S. plate or cement concrete supports provided by the contractor.

4.4.2.3 Face piping

4.4.2.3.1 Each softener shall be provided with interconnection face piping comprising of inlet, outlet, and backwash complete with diaphragm valves/ball valves.

4.4.2.4 ACCESSORIES

4.4.2.4.1 Each softener shall be provided with the following accessories:

a. Air release valve with connecting piping
b. 100 mm dia bourden type gun metal pressure gauges with gunmetal isolation clock and siphon on inlet and outlet.
c. Sampling cocks on raw water inlet and filtered water outlet.
d. Individual drain connection with ball valves for each filter
e. Connection with valve for air scouring
f. Rate of flow indicators in the raw water inlet line and re-generation line.
g. Quantity meter in the filter water outline line.

4.4.2.5 Test kits

4.4.2.5.1 Hardness test kit

4.4.2.5.2 The contractor shall supply the details of equipment (Including Test kit) with literature of the equipment quoted by him.

4.4.2.6 Salt saturation tank system

Salt saturation tank located at Ancillary Building (at ground level) will have the following facilities:

1. 2 Brine Feed pumps (Polypropelene) with motor etc. of 2 lps and 25 m head.
2. 50mm dia UPVC pipe for discharging concentrated brine solution into the brine tank located at ground floor of the Ancillary Building.
3. The ' saturator Tank' will have filter box, Media coarse silex, pebbles, PVC/UPVC/HDPE Box etc.
4. Pipes and Accessories etc.

4.5 PAINTING AND FINISHES

4.5.1 General

4.5.1.1 All exposed metal surfaces, after inspection and testing either in the factory or on site shall be thoroughly cleaned of all dust, oil grease, dirt, scale and rust by grit or shot blasting to the satisfaction of the engineer.

4.5.1.2 Surfaces of castings, steel work, piping and plant and machinery which are to be in direct and permanent contact with concrete shall be properly painted and covered, prior to dispatch from the contractor's premises, with a substantial coating of cement wash other proprietary coating plus a lapping of weatherproof tape. The method of coating and waterproof tape shall be approved by the engineer.

4.5.1.3 Except where otherwise specified, all embedded pipes and fittings located in inaccessible positions (e.g. in pipe trenches, pits) shall be externally coated by dipping in acid-free hot bituminous compound. The coating thickness shall be approved by the engineer. The pipe or fitting shall then be lapped with a layer of anticorrosion tape which shall be approved by the engineer.

4.5.1.4 The internal surfaces of all oil services ferrous pipes and fittings shall be carefully inspected to ensure that all scale and other particles or contaminants have been removed and shall then be protected in a manner approved by the engineer to prevent deterioration during transport and subsequent erection.

4.5.1.5 The external surface of all oil service ferrous pipes and fitting shall be carefully inspected to ensure that all scale and other particles or contaminants have been removed and shall then be protected in a manner approved by the engineer to prevent deterioration during transport and subsequent erection.

4.5.1.6 The external surface of accessible ferrous pipes and fittings shall be treated with two coats of primer paint approved by the engineer prior to dispatch from the place of manufacture.

4.5.1.7 The external surfaces of all building services Equipment in damp environments shall, unless made of nonferrous metal, be coated with a bituminous compound approved by the engineer. All

access ladders and platforms and associated supporting steelwork provided by the contractor shall be galvanized.

4.5.1.8 All other exposed surfaces, except where otherwise specified, shall be thoroughly cleaned of all dust, oil, scale, rust or other contaminants by power tool operated metal brush, or preferably by shot or grit blasting, and shall then be coated immediately with one coat of primer paint.

4.5.1.9 Any damage to priming coats made good by the contractor on completion of installation shall be finally painted in colours approved by the engineer.

4.5.2 Paint Finish Schedule

4.5.2.1 Unless otherwise specified in the particular specification, a paint finish to a colour to be approved by the engineer shall be applied to all exposed services including but not limited to supporting rods and brackets, cable ladders, cable trays, trunking, lighting fittings, pipework, ductwork, access doors/panels, surface conduits and accessories and other equipment installed in the following areas.

4.6 The water for the chilled water and condenser water system shall be maintained at the following specification:

Ph value	8.0-10.0
Total Dissolved solids	below 2500ppm
Total Hardness (as CaCo3)	below 50ppm
Turbidity(FTU scale)	below 5 ppm
Iron(increment)	below 1.0ppm
Copper(increment)	below 0.2ppm
Nitrite(NO2)	Above 250ppm

MUMBAI METRO LINE 3

(COLABA-BANDRA-SEEPZ)

CONTRACT NO: MM 3-CBS-DEM

Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

VOLUME 4 OF 6

EMPLOYERS REQUIREMENTS-
TECHNICAL SPECIFICATIONS

SECTION VI – F – BMS-M&E SCADA
(Building Management System)

DECEMBER - 2017

Mumbai Metro Rail Corporation Ltd.
Plot No. R-13, 'E' Block,
Namttri Building
Bandra - Kurla Complex,
Bandra (East), Mumbai – 400051, India

Composition of Documents

Volume 1	**Bidding Procedure**
Section I	Notice Inviting Tender (NIT)
Section II	Instructions To Tenderer
Section III	Form of Tenders
Volume 2	**Conditions of Contract and Contract Forms**
Section IV	General Conditions of Contract (GCC)
Section V	Special Conditions of Contract (SCC)
Volume 3	**Employer's Requirement- General Specification**
Volume 4	**Employer's Requirement – Technical Specifications**
Section VI – A	Electrical - HT
Section VI – B	Electrical - LT
Section VI – C	Ventilation & Air Conditioning (VAC)
Section VI – D	Fire Alarm and Detection System (FADS)
Section VI – E	Fire Suppression (Fire Fighting System)
Section VI – F	**Building Management System (BMS)**
Section VI – G	EOT Cranes (Electric Over Head Travelling Crane)
Section VI – H	Air Compressor (Compressed Air System)
Section VI – I	Plumbing Pumps (Drinking, Treated and Sewer)
Volume 5	**Tender Drawings**
Section VII – A	Electrical - HT
Section VII – B	Electrical - LT
Section VII– C	Ventilation & Air Conditioning (VAC)
Section VII – D	Fire Alarm and Detection System (FADS)
Section VII – E	Fire Suppression (Fire Fighting System)
Section VII – F	Building Management System (BMS)
Section VII – G	EOT Cranes (Electric Over Head Travelling Crane)
Section VII– H	Air Compressor (Compressed Air System)
Section VII – I	Plumbing Pumps (Drinking, Treated and Sewer)
Section VII – J	Civil Tender Drawings (Architectural / Utility)
Volume 6	**Bill of Quantities**

Table of Content

1) General –

a) This section describes the minimum standards of the BMS System for the project. The works executed under the Contract include design, development, manufacture, , supply, delivery, installation, testing, commissioning (including integrated testing and commissioning) for a complete BMS. The System shall fully integrate the control, monitoring and supervision of the E&M Systems, including the electrical and mechanical works installed at the Depot, Administration building and Aarey Station (At grade station).

b) The Contractor shall fully coordinate with the Engineer and/or Interface Contractors for collecting all necessary technical interface details and information to produce the necessary interface document between depot contractor and signalling and telecommunication contractor.

c) The BMS System shall integrate the control, monitoring status and failure alarm of utilities in depot area and at Aarey station, in to the computer based system.

d) The BMS System data transmitted to the, BMS Room provided at ground floor of Admin building, shall enable to control and monitor of the E&M system during normal and abnormal working condition.

e) The control system shall be as indicated on the drawings and described in the specifications.

f) Programmable Logic Controller (PLC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.

g) The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data. The system shall be fully web enabled as shown on the drawings and as specified in this specification.

h) The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

i) Communication between the control panels and all workstations shall be over a high speed TCP/IP network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.

j) This specification contains a description of the system concepts and major components, and sections covering definitions, requirements for interfaces with system wide facilities.

k) The Contractor shall fully coordinate with Employer and/or Designated Contractors, for the requirement of control and monitoring of all relevant systems and obtain all necessary technical interface details and information to produce the necessary BMS System interface document.

l) The BMS System configuration such as architecture, graphics, layout, setting, group display etc., shall be submitted to the Employer for approval.

The BMS System operator workstation shall be capable to control and monitor the E&M system equipment, including the electrical and mechanical works installed at the depot, Administration building and Aarey Station (at grade station) including but not limited to the following:

a. Fire Alarm System
b. Fire Fighting System
c. Lifts and Escalators
d. Lighting System
e. Low Voltage Power Supply System
f. Uninterruptible Power Supply (UPS)
g. Diesel Generator Set (DG)
h. Plumbing and Drainage System
i. Sewage Treatment System
j. S&T
k. PSD at Station
l. VAC/VRV system for depot only

The equipment items, shall be monitored and controlled via BMS System including but not limited to the following;

a. All Main Incoming ACBs of normal, emergency and very essential panel of ASS-1, ASS-2 and all Depot building,
b. All outgoing ACBs of all buildings which built with under voltage release for load shedding control,
c. Mode control through PLC sequence control, of all main Switchboards interlocking scheme,
d. Lighting Control System and Lighting Relay Panels,
e. Pump operations (Sump Pumps, Fire Pump, Water Transfer Pump, Drainage Pump)
f. AHU, VAV, Chillers, Dampers for depot only
g. Energy Management System for Electrical
h. Asset Management System
i. Other E & M Systems
j. Provide a Building Management System (BMS) incorporating Programmable Logic Controller (PLC), equipment monitored and controlled by Building management system (BMS); Advanced PLC Controllers (PLCs) interfacing directly with sensors, actuators and environmental delivery systems (i.e. chilled water distribution, etc.); Air Handling Unit PLC controllers, electric controls and mechanical devices of depot only, for all items indicated on drawings described herein including dampers, valves, panels etc; a primary communication network to allow data exchange from PLC to PLC; terminal equipment, PLC Controllers interfacing with sensors, actuators, terminal equipment devices;
k. Secondary Modbus, Profinet, BACnet MS/TP communication network interfacing PLCs to network automation controllers; hardware and software interfaces to third-party control equipment.
l. The Building Management Control System (BMS) shall be a Programmable Logic Control (PLC) system, state of the art technology, freely expandable for any future expansion plans. The system (BMS) shall have a minimum controlling capacity of 10,000 physical points without upgrading the BMS data server software or related hardware. In general the system shall support “Open Architecture Concept” with capability to Dynamic Data Exchange (DDE) Link. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

- Operator information, alarm management and control functions.

- Enterprise-level information and control access.
- Information management including monitoring, transmission, archiving, retrieval, and
- Reporting functions.
- Diagnostic monitoring and reporting of BMS functions.
- Offsite monitoring and management access.
- Energy management
- Standard applications for terminal VAC systems for depot only
- Indoor Air Quality monitoring and control

2) Standard & References –

The BMS system and its components shall comply with the following codes and standards.

Sr. No.	Standard/ Code No	Title
1	ANSI/ASHRAE 35-2001, BACnet	Data Communication Protocol for Building Automation and Control Networks
2	Standard 135-2004 – BACnet®	Data Communication Protocol for Building Automation and Control Networks (ANSI Approved)
3	EN 50081-1: Generic Emissions	Residential, Commercial, and Light Industrial Environments
4	EN50081, Electromagnetic Emissions	Generic Emissions Standard
5	IEC 445	Identification of equipment terminals and terminations of certain designated conductors, including general rules for an alphanumeric system
6	IEC 571-1	General requirements and tests for electronic equipment
7	IEC 571-3	Components, programmable electronic equipment and electronic system reliability
8	IEC 617-12	Binary logic elements-Graphical symbols to represent dependency notation, combinative and sequential element, as well as complex-function elements
9	IEC 60950	Information Technology Equipment – Safety-Part 1 General Requirement
10	IEC 60529/1989	Degree of protection provided by enclosures (IP Code)
11	IEC 801-3	Radiated electromagnetic field requirements
12	IEC 870-1-1	Tele-control equipment and systems- General considerations
13	IEC 870-2-1	Operating conditions
14	IEC 870-4	Performance requirements
15	IEC 870-5-4	Definition and coding of application information elements- Transmission protocols

Sr. No.	Standard/ Code No	Title
16	IEC 1082-1	Preparation of document (Signals, Diagrams)
17	ISO/IEC 4873	Information technology ISO 8-bit code for information interchange-Structure and rules for implementation
18	IEC 60848	Preparation of function charts for control systems
19	IEC 61175	Designations for signals and connections
20	IEC 61346 (All parts)	Industrial system installation, equipment and industrial products-Structuring principles and reference designations
21	IEC 61850-Part 2	Glossary
22	IEC 61850-Part 3	General requirements
23	IEC 61850-Part 4	Communication networks and systems in substations-System and Project management
24	IEC 61850-Part 6	Substation automation system configuration description language
25	IEC 61850-7-1	Basic communication structure for substation and feeder equipment- Principles and models
26	IEC 61850-10	Conformance testing
27	BS 4737: Part 2	Specification for installed systems for deliberate operation
28	BS 4737: Section 4.1	Code of practice for planning and installation
29	BS 4737: Section 4.2	Code of practice for maintenance and records
30	BS EN 14908-1:2005	Open data communication in building automation, controls and building management, building network protocol, protocol stack.
31	BS EN 50090-2-1	Home and building electronic systems-System overview, Architecture
32	BS EN 50090-2-2	Home and building electronic systems-System overview, General technical requirements
33	BS ISO/IEC 6592	Information technology. Guidelines for the documentation of computer-based application systems
34	BS 5839-1:2002	Code of practice for system design, installation, commissioning and maintenance for fire detection and alarm systems for buildings
35	BS EN 54-2	Specification for control and indicating equipment
36	BS 6266	Code of practice for fire protection for electronic data processing installations
37	BS EN ISO 9000-3	Development, supply, installation and maintenance of computer software
38	IS: 1765	Direct current potentiometers

Sr. No.	Standard/ Code No	Title
39	IS: 3043	Code of practice for Earthing
40	IS: 3700	Essential rating and characteristics of semiconductor devices
41	IS: 4007 Part1	Terminals for electronic equipment- General requirements
42	IS: 5051 Part1	Relays for electronic and telecommunication equipment- General requirements
43	IEEE 802 series	Local area network
44	ISO 3511	Process measurement control functions and instrumentation-Symbolic representation-Part 1 Basic requirements
45	IEC 947-7-1	Low-voltage switchgear and control gear – part 7-1: Ancillary equipment – Terminal blocks for copper conductors
46	IEC 60529	Degree of protection provided by enclosures (IP code)

3) Submittals –

The details of all material, equipment installations, schematic drawings, any other drawings and programmable schedules (flow chart) shall be submitted for the Engineer's approval before giving the BMS manufacturer a purchase order and installation. The submittals shall consists of:

- System Architecture showing all PLC Devices.
- Data Sheets of all products.
- Equipment list of all proposed devices and equipment's.
- Control Schematic of all graphics.
- Sequence of operation of all systems.

4) Shop Drawings –

A complete schedule of drawings to be produced by the contractor shall be submitted to the Employers representative within one month (30 days), of contract award. BMS Contractor shall provide shop drawings for the following:

- All automatic control devices.
- Schematic control diagrams for all systems. Each diagram shall indicate control components, component catalogue number, operation sequence, and interlocking.
- Riser diagram showing the physical location of BMS equipment and the system architecture with all communication buses.
- List of connected data points, including controllers to which they are connected and input / output devices (sensors, transducers, level controllers....).
- Complete sequence of operation of each VAC system (for Depot only) connected to BMS in both flow chart and program format.

- BMS central system configuration complete with all peripheral devices, batteries, power supplies, with interconnecting diagrams
- Technical specification data sheets of each component.
- Operator & Maintenance manuals.

5) Installations –

a) System Architecture:

The System Architecture is as follows –

(i) The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

(ii) The system shall be designed into three tiers and contain, a field tier (the tier that contains all of the field level controllers, and application specific controllers), an automation tier (this is the tier that connects all of the field tiers), and an enterprise tier (this is the tier that connects all of the automation tiers). No two-tier design is acceptable.

b) The Building Management System shall consist of the following:

- Standalone Network Automation Engines
- Field Equipment Controllers
- Input / Output Modules
- Local Display Devices
- Portable Operator Terminals
- Distributed User Interfaces
- Network processing, Data Storage and communication equipment's
- Other equipment's required for complete and working BMS

c) Peer to peer Devices:

All controllers shall be designed as Peer to Peer devices - all communicate with each other by BACnet IP/Modbus and / or MS/TP. This gives the flexibility for information to be shared locally from one controller to another instead of all the information are sent to the central location and then sent back to others. All BMS devices on the automation tier shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

d) Control Network:

Network Control Automation Controller shall provide supervisory control over the control network and shall support all three (3) of the following communication protocols:

(i) The communication between E&M equipment to RPU such as MODBUS, BACnet, LonTalk, ARCNET and etc.

(ii) The communication between RPU to the Workstation such as MODBUS, BACnet, LonTalk, ARCNET and etc. over TCP/IP.
(iii) The communication between Multifunction Meters and Energy meters and their communication to RPU/Workstation such as MODBUS, BACnet, LonTalk, ARCNET and etc. on RS 232/485 port.
(iv) The communication between Dimming Light Control Panel, Fire Alarm Control Panel, MDB & Electrical panels, Lift Panel, AMF Panel, UPS etc. to the RPU/SCR Workstation such as MODBUS, BACnet, LonTalk, ARCNET etc. on RS 232/485 port.
(v) Communication backbone network between OCC Server and Remote workstations: TCP/IP protocol on optic fiber backbone network supply by STPT.

e) The system head end shall comprise of a BMS data server that utilizes windows based software to provide web enabled access to the operator workstation. The BMS data server shall be capable of storing trend & other BMS data The following shall also be provided:

- An Internet connection located in the BMS room
- The system shall be connected to the internet for external web access.

f) LAN/Protocols:
The following is a summary matrix of the LAN and Protocols within the BMS within the buildings:

Layer	Physical Media	Protocol	Carrier	Speed
Field	Twisted Pair Cable	BACnet/Modbus/ Profinet	RS 485	Auto mode Max. Speed to 76.8k
Supervisory	Cat 6 Cable	BACnet IP	TCP/IP on Ethernet	100/1000 Mbps
Enterprise	Fibre Optic	BACnet IP	TCP/IP Ethernet	100/1000 Mbps

g) All wiring shall be in accordance with IEE wiring regulations but not in contradiction with Local Authorities requirements and the same shall be properly supported. The wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in rigid galvanized conduit in accordance to the electrical specifications. All electronic wiring shall be #18 AWG minimum and shielded. All wiring in the central control room shall be installed in conduit.

h) All wiring above false ceilings shall run in PVC conduits embedded in the structural slab above the false ceiling. Wiring located within the false ceiling maybe permitted to be installed without conduits provided that this wiring is neatly installed, labelled and properly supported.

i) Provide a minimum 450mm long coil of wire at each device termination.

j) The BMS Contractor shall coordinate with Electro-Mechanical Contractor for assuring that the conduit size and wire quantity, size and type are suitable for system supplied. The Contractor shall review the proper installation of each type of device with the equipment supplier.

k) The Contractor shall provide all sensing, control, and wiring for all devices following unless shown or specified elsewhere.

l) The BMS Contractor shall enter all computer data into the related computers including all graphics, control programs, initial approved parameters and settings, and English descriptors. The BMS Contractor shall maintain diskette copies of all data file and application software for reload use in the event of a system crash or memory failure. One copy shall be delivered to the Owner during training sessions, and one copy shall be archived in the BMS Contractor's local software vault.

Warranty

All components, system software, and parts supplied by the BMS Contractor shall be guaranteed against defects in materials and workmanship for one year from acceptance date. Labour to repair, reprogram, or replace components shall be furnished by the BMS Contractor at no charge during the warranty period. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks.

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6) Building Management System – General

a) The Building Management System (BMS) shall perform the following general functions:

- Monitoring and Control of Controllers, Remote Terminal Units and Programmable Logic Controllers.
- Operator Man-machine interface.
- Video Display integration
- Data Collection and Historization
- Alarm Management
- Trending
- Report Management
- Network Management
- Data Exchange and integration with a diverse range of other computing and facilities systems using industry standard techniques.

b) The BMS supplier shall ensure compatibility between the BMS system and any third party control system providing the data on open protocol.

c) It is also the responsibility of the BMS supplier to discuss the interface with all other systems' suppliers in order to ensure that the end results are achievable. It will not be acceptable to provide equipment that does not provide the information and control as required by this specification and the associated control diagrams.

d) The system shall allow the distribution of system functions such as monitoring and control and graphical user interface etc. across the network to allow maximum flexibility and performance. The architecture shall include support of various Wide Area Networks using standard hardware and software to link nodes into a single integrated system. The network protocol used shall be industry standard TCP/IP. The system shall also support remote configuration and operation using standard dial-up modems.

e) The BMS shall allow communications with a wide variety of control devices utilising off the shelf driver packages.

f) The BMS system server shall be based around the Microsoft windows software. The BMS shall be a true 64-bit application to take advantage of Microsoft Server 2008s enabling technologies.

The BMS data server database should be based on SQL Server or equivalent database so that all the data (including trend data, audit trail messages and alarm event messages with user annotations) is available for Integration with other MIS Applications.

g) Monitoring and Control:

- The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
- If the system has the integration with Fire and other third party system, the Integration should be such that points from third party system should be in the same database. It shall also be possible to see points for other systems in the Alarm history, Trends and on the User Graphics.

- The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

h) Communications:

- Given the sufficient level of system privilege, it shall be possible to view, manipulate and analyse all data in the system from any Operator Station in the system, including those operating remotely via dial-up modem links.

- Once a control device is configured and placed in service, the system shall automatically begin background diagnostic scanning of the device to ensure that communications are monitored independently of any monitoring scanning.

i) Monitoring:

- The system shall support acquisition of data using Report by Exception. The system shall support scan intervals, ranging from less than 1 second to 30 Sec.

j) Device Control:

- Control transactions issued by the operator shall be communicated to control devices using a write followed by read to ensure the integrity of the transaction. If the read following the write to the device indicates that the control action has failed, the operator shall be informed by means of a control failure alarm. The priority of the control failure alarm shall be configurable by the user.

7) Material Description –

The BMS specified herein shall be capable of integrating building utility functions including equipment supervision, control alarm, energy management, and historical data collection and archiving. The BMS shall consist of the following equipment:

a) Microprocessor based distributed controllers interfaced directly with sensors, actuators and environmental delivery systems, i.e. electrical system, plumbing & drainage, Fire Alarm system, Firefighting system, Lighting system, DG & UPS system etc.

b) Remote process units (RPU) required for interface with different depot and Aarey station (At grade station) building services/equipment's.

c) Inside building communication network (LAN / Serial) to allow data exchange between devices in the system, if required, i.e. Fire alarm system, Firefighting system, Lift, VAC, Plumbing and Drainage system, Lighting control system, Low voltage distribution system, Uninterruptible power supply (UPS), Diesel generator set at depot & station and AFC, S&T, , PSD, Escalators at station only.

d) Outside Building – Depot Area, communication network (WAN) to allow data exchange between various nodes (buildings).

e) Protocol Converters / Gateways.

f) Associated Power and Control cables.

g) Marshalling Cabinets (MS) shall be provided for termination all BMS SCADA interface monitor and control signal wiring.

h) Interface with the BMS system under E&M Station Contract.

8) Component and Technical Requirement –

Workstation:

BMS Workstation shall comprise of the following minimum hardware: Intel Dual Core 3.2 GHz processor, 4 GB of RAM,
Dual Screen 22" LED Color Display, 108 Keys - Keyboard, Optical Scrolling Mouse and Pad, 500 GB HDD 2 SATA Hard Disk Drive DVR Combo Drive, Built in dual gigabit port RAID controller, Graphics Card – Nvidia Quadro K6000 graphics or equivalent for High Quality BMS Graphics, Removable storage device (DVD - Read/ Write), Minimum 8 X Speed. 2 Nos. USB 2.0 port, 1 Centronic parallel port Minimum 4 USB port, 2parallel Port, 2 Serial Port, Dual LAN Card, License copy of MS office & antivirus software and with all the required software SQL server Fully Redundant Power Supply & Fan Unit 100/1000Mbps network card as per Tender Specifications/relevant standards/as per direction of engineer-in-charge.
132 Column 240 CPS Printer
500 VA UPS with half an hour battery backup

Laser Printer:
A hard-copy multi-color graphics laser printer shall be provided for recording graphic displays and associated dynamic data.
Printer shall meet minimum requirements as follows:
Print speed – Black: up to 22 ppm; color: up to 4 ppm
First page out – 18 seconds black, 15 seconds color
Resolution- 600 by 600 dpi
Hi-Speed USB 3.0, IEEE 1284-B compliant parallel port
Languages – PCL 6 and Postscript level 3 emulation with automatic language switching
Font capabilities – 80 TrueType TM internal scalable PCL 6 fonts;
80 TrueType internal scalable HP postscript fonts.

a) A router / gateway shall be provided for interface between each building and . All the gateway devices / building nodes would be networked using TCP /IP over Ethernet WAN (fiber optic network). The network shall be laid and installed by STPT contractor. All network devices shall support remote management (SNMP), alarm and logging, fault reporting.
b) The network Connectivity from Ethernet IO Point to Equipment or Devices shall be provided by Depot Contractor

c) Contractor shall provide protocol converters / gateways for interfacing devices communicating on different protocols - BACnet / Modbus / LonTalk / Arcnet / Serial devices / TCP-IP / Ethernet.

d) Network Switches, Modems, Gateways, Routers

9) Remote Processing Unit (RPU)

a) The RPU shall be microprocessor based design for performing control, alarm and monitoring programs.
b) Each RPU shall be sufficiently equipped with input/output points including 30% spare capacity. Expansion by at least 50% shall be possible simply by adding more I/O modules and reconfiguring the software.
c) The RPU shall be provided for interfacing with the equipment to be monitored/controlled via hardwired cables and shall be located in proximity of the equipment in order to minimize the amount of hardwired cables.
d) The RPU shall as well as provided for interfacing with systems through serial or LAN data interface. The RPU shall communicate with the BMS workstation via the Ethernet LAN.
e) The RPU shall capable of control on-off command, mode change, status input and digital alarms etc. The RPU shall also include energy management program for time of the day program, optimum start/stop and duty cycling etc.
f) RPU shall be installed in electrical room or mechanical room. It shall be possible to expand each RPU by additional input/output modules and shall be housed in the metal enclosure with IP 55 Protection in accordance to the requirement of IEC 60529 standards.
g) The RPU shall accept the following type of inputs and outputs.

Input	**Output**
Analog 4 – 20 mA Dry contact (NO or NC) Pulse accumulator Override switch Photocell contact Transducer sensors etc.	Analog 4 – 20 mA Dry contact (NO or NC), 20A, 250V Momentary-pulsed and Mechanically latched

h) If the CPU transmission network fails but power to RPU does not, the RPU shall continue to monitor all changes of state or value and shall retain the most recent values for 30 minutes. The RPU shall also maintain all analog set points and command positions.

10) Sensors and operating equipment

The contractor shall supply the sensors, transmitters, relays and all types of actuators (valve / damper etc.) necessary for the BMS system, where necessary.

a) Filter pressure drop of each filter bank shall be sensed by means of a diff. pressure sensing device which closed a contact when the filter pressure differential exceeds a typical pressure.
b) Low Temperature Limit Thermostats as described in the sequences of operation, install low temperature limit thermostats complete with 6.1 m. {20 ft.} of sensing capillary sensitive to

406 mm. {16"} and shall have manual reset provide one limit thermostat for approximately every 6 m2 [65 sq. ft.] of duct area.

c) High Temperature Limit Thermostats as described in the sequences of operation for individual systems, provide high limit thermostats to shut down respective fan system (S). Provide a single rod and tube type manual reset limit thermostat set a 57.5 °C.

d) Air proving switches shall utilize a differential pressure activated, diaphragm actuated, snap acting SPDT switch.

e) Air flow for each AHU for depot, as specified herein shall be indicated by means of a diff. Pressure sensing device which shall open a contact when the pressure is different. All fans shall use diff. pressure sensor or AUX. contact for start/stop indications, pressure of air flow falls below a typical value. Pressure transmitters shall be suitable for continuous contact with the material being measured (i.e. air, water glycol, or steam as applicable).

f) Pressure transmitters shall have a linear output of 0-10V. Pressure transmitters shall be a span of not greater than twice the static pressure at maximum flow or differential pressure at shutoff as applicable.

g) Water flow for pumps shall be indicated by means of diff. pressure or flow switches which open a contact as the diff. pressure or flow falls below a typical value. Water flow switches shall have a paddle actuated, snap acting SPDT switch.

h) Humidity sensors shall be suitable for operating ranges of 10 to 100% RH and shall incorporate a solid state sensing element. Sensor accuracy shall be 3% over a range of 5 to 95% RH. Humidity sensors shall also incorporate a transducing circuit for conversion of the sensed variable to a voltage level for digital conversion.

i) Water-flow measuring devices consisting of annular averaging pilot tube flow elements having the following minimum Specifications. Select the Annular for the operating flow range, pipe size and fluid temperature:

   Accuracy - 2%
   Repeatability - 1.2%
   Pressure Drop - 1.5 kPa maximum
   Operating Temperature Range - 4°C to 95°C [140°F to 203°F]
   Operating Pressure Rating - 174 kPa [250 psig]
   Provide weld couples for installation by the contractor. Provide Model 1440, 25 mm. [1"] carbon steel coupling with MPE stainless steel cap for future Annubar corrections. Install the annubar flow device in accordance with the manufacturer's recommendations and located with sufficient upstream and downstream straight pipe without obstructions.

j) Pressure sensing elements shall be bourdon tube, bellows or diaphragm type. Adjustable set point and differential. Pressure switches shall be snap action type rated at 220 volts, 10 amp AC or 24 volts DC.

k) Temperature sensing element shall be liquid, vapour or bimetallic type. Supply adjustable set point and differential. Snap action type rated at 220 volts, 10 amps or 24 volts DC as required. Sensors shall operate automatically and reset automatically.

l) Temperature switches shall be of the following types:

m) Room type shall be suitable for wall mounting on standard electrical box with or without protective guard.

n) General purpose duct type shall be suitable for insertion into air ducts, insertion length of 450 mm. [18"].

o) Thermowell type shall be complete with compression fitting for 20 mm. [0.8"] NPT well mounting of length of 100 m. [4"]. Immersion wells shall be stainless steel.
   Strap-on type shall be complete with helical screw stainless steel clamps.

   i. Start/stop relay modules shall if possible provide either momentary or maintained switch actions as appropriate for the unit being started and depending on the fact whether the units are subjected to a power fail restart program or not. All relays shall be mounted in interface panels and/or starter panels.
   ii. All types of actuators necessary for carrying out remote operations.

iii. All control point requiring remote adjustments shall be provided normally with control devices that will hold the last requested output regardless of CPU malfunction or power failure to control panel unless it is specified otherwise in the control specs.

11) Communication and Control Cables

Type of cable shall be as per manufacturer or recommendations as follows:-

i. Multi-core-twisted pair with shielded cable shall be used between CPU and RPU.
ii. Twisted pair with aluminum shielded cable shall be used for analogue input/output point between RPU and Marshalling cabinet.
iii. Multicore cable shall be used for digital input/output points between RPU and Marshalling cabinet.
iv. Male and female connector shall be provided for RL bus.
v. Terminal blocks shall be provided in panel for RPUs to load points.
vi. If screen is required, aluminum tape laid longitudinally and in contact with the un-insulated drain wire or un-insulated circuit protective conductor (c.p.c.) shall be provided.

All field control wiring associated with analogue inputs/outputs shall be run in screened cable with a minimum cross sectional areas of 0.5 mm².
All field control wiring associated with digital inputs/outputs shall be wired in unscreened cable with a minimum cross sectional areas of 1.0 mm².
All field control wiring shall be wired contained in trunking or conduits
All field control wiring for equipment used for life safety shall be of fire resistant cable.

12) Building Management System – Software

a) The system shall provide a real-time database incorporating data from analog, logical or pulse inputs. The database shall be configurable by the end user without the need for any programming and shall be able to be modified on-line without interrupting operation of the system. In addition to point based information, the database shall also provide Historization capabilities for analog, digital, pulse and event based information. This information shall be accessible by all facilities of the system such as custom displays, reports, trends, user written applications, etc.

b) Configuration:

- All configuration of the database shall be possible while the system is on-line by users with sufficient security access. Configuration shall not require the need for any programming, compiling or linking and shall not require shutting down or restarting of the system. In addition, historical data collection shall not be interrupted for points not affected by configuration changes.

- A configuration utility shall be provided with the BMS that shall allow configuration of all point records, printers, control devices or RTUs, and operator station connections. This utility shall be in the form of a relational database and operate in a true 32 bit environment such as Windows NT or Windows 2000. The utility shall also have the ability to export information to and import information from Microsoft applications such as Microsoft Excel.

- The utility shall also support free format text fields, which the user can use for additional information such as cabinet or wire numbers. These additional fields shall be simple extensions to existing items in the database such as BMS points.

- A filtering mechanism shall be provided with the utility so that the user shall view only relevant information. The filter shall provide standard choices for the user to select, and also provide user defined filtering.

- It should be support up to 1000 TCP/IP addresses for the supervisory controllers in the Enterprise network.

c) Database Structure:
The real-time database shall support collection of data and storage using the following structures:
- Analog Point Structures
- Status Point Structures
- Accumulator Point Structures
- Historical Data Structures
- Event Data Structures
- User Defined Structures

d) Each of the Point database structures shall be comprised as a composite point with a number of associated parameters which may be referenced relative to a single tag name. Specifically, each of these parameters shall be accessible by various sub-systems such as the Graphical Operator Interface, Report Generation system and Application Program Interface in a simple POINT.PARAMETER format without the need to know any internal storage mechanism.

e) The system shall maintain portions of the database requiring frequent high-speed access as memory resident information and other less frequently accessed data as disk resident data. Memory resident data shall be checkpoint to disk every minute to minimise loss of data in the event of loss of power or other system failure.

f) Database backup shall be possible with the system on-line including backup of historical based data.

g) Analog Point database:

- Analog data shall be stored in a composite point database structure that provides the following parameters:
- Point Name
- Point Description
- Process Variable (PV) Set point (SP)
- Output (OP) Mode (MD)
- Up to 4 user definable inputs
- Scan Status
- Scan Period
- Scan Address
- Alarm Permit Flag
- Alarm Status
- Associated Display
- Operator Control Level
- PV Clamp Flag
- Engineering Units

- Alarm Deadband
- Drift Deadband
- Control Deadband

h) Status Point database:
Status (digital) information shall be stored in a Status Point type in the database. The status point shall be capable of processing from a single to a three bit digital input, allowing up to eight possible states. The Status Point shall be a composite point including the following parameters:

- Point Name
- Point Description
- Process Variable
- Output Mode
- Scan Status
- Scan Period
- Scan Address
- Alarm Permit Flag
- Alarm Priority
- Re-Alarm Status
- Associated Display
- Input Width
- Operator Control Level
- Output Width
- Output Pulse Width
- Control Failure
- Alarm Priority
- Control Time out
- Normal Mode

i) Historical database:

- Historization of point data shall be configurable as part of the point definition. Historization shall be provided for both snapshots and averages with intervals ranging from 5 seconds to 24 hours.
- Once assigned to history, point data shall be available by POINT.PARAMETER access used in conjunction with a history offset to locate the particular value of interest. The graphical operators interface, trend, and report generation and application interfaces shall be able to access historical data.

- Modifications to the history collection of a point shall be possible on-line without the loss of previously collected data for the point being changed or any other points in the system currently being historized.

- Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis.

- The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format.

j) Event database:
The system shall maintain a journal containing the following event information:

- Alarms
- Alarm Acknowledgements
- Return to Normal
- Operator Control Actions
- Operator Login & Security Level Changes
- On-line database Modifications
- Communications Alarms
- System Restart Messages

k) Standard Displays shall be provided to show the current journal file with the most recent event at the top of the display. Subsequent page forward actions shall allow display of progressively older events. Sorting and filtering of the journal shall be possible via a standard report which shall be configurable by filling-in-the-blanks. Coding or scripting of any kind shall not be required.

l) It shall be possible to have an on-line event file as large as the disk capacity can accommodate. For example, given the appropriate disk space it shall be capable of storing up to 1,000,000 (one million) events on-line.

m) The events file system shall be fully integrated with the standard reporting system. The system shall automatically reference the restored playback file if a Report is requested containing a time search window covered by the current playback file.

n) User Definable database:
In order to support other types of data such as user entered or calculated data from application programs, the system shall also provide a User Definable database area that can be fully integrated into the system. Data contained in this database must be accessible by:

- Custom Graphics
- Custom Reports
- Application Programs
- Network Applications using a Network API

o) Algorithms:
In addition to standard point processing functions, the system shall allow additional processing through the use of standard algorithms that may be attached to an analog, status or accumulator point. Typical functions to be provided by these algorithms are listed below:

- Arithmetic Calculation
- Boolean Calculation
- Maximum/Minimum Value
- Integration
- Run Hours Totalisation
- Group Alarm Inhibit
- Report Request

- Application Program Request
- Auto Discovery

p) Historical Data Archiving:
The system shall support archiving of historical data to allow a continuous record of history to be built up over a period of time. Archived data shall be stored on the hard disk of the system. The number of archives maintained on the system before transferral to off-line media shall only be limited by the size of the hard disk or remote network drive. The system shall allow the user to define the specific intervals of history to be archived to avoid archiving of unnecessary data.

- Archiving of historical data may be activated by one of the following methods:
    - Operator Demand
    - Periodic Schedule
    - Event Initiated

- Once archived, the data shall be available for re-trending through the system trend facilities in combination with the current on-line history or other archives. Providing the archived history is present on the BMS Server's hard disk the trend facilities must be able to access it transparently for display.

q) Application Programming Interface:

- Two types of application programming interface (API) are required, the first is for applications written on the BMS server and the second is for applications that are required to run on network based clients (that are not necessarily operator stations).
- The BMS API's must have support for either html or xml or web services or both. Proprietary programming languages are not acceptable.

r) Operator Interface:

- The operator interface provided by the system shall allow for efficient communication of operational data and abnormal conditions. It shall provide a consistent framework for viewing of information. Critical areas (such as alarm icons) shall be visible at all times. A predefined area on the screen shall provide operator messaging, and this area shall also be visible at all times. A set of standard displays for configuration, and navigation around the BMS are to be provided.
- The operator interface software shall be capable of running on Windows Server 2008 R2, and Windows 7. The operator interface shall appear similar in all environments.
- The operator interface shall be interactive and totally graphics and/or icon based. Graphics shall be capable of supporting up to 256 colours at a minimum 1024 x 768pixel resolution.
- The operator interface shall support the ability to "full screen lock" the window so that user cannot access other applications. If "full screen lock" is not enabled, support for copy and paste facilities shall be provided between the operator window and other Microsoft applications.

s) Operator Interface Connection:

- The operator interface shall be flexible in its connection to the BMS server. Both serial wireless, 3G and LAN connection shall be possible. The operator interface shall provide standard dial-up modem support. Using other packages such as Microsoft Terminal to make the modem connection shall not be acceptable.
- The operator interface LAN connection shall also be flexible to support both permanent and casual access to the BMS server. Unlimited number of casual users shall be permitted

without any additional licensing burden on already licensed OWS. Those users with casual access shall automatically disconnect from the BMS server after an idle timeout period.

- BMS Contractor shall provide and install all computer hardware and software required for the purpose of configuration and consolidation of information and programs required for the delivery of a Task Focused, Web Based Portal to the BMS. This Ready Access Portal shall provide a natural, complementary extension to the BMS site management user interface previously described.
- Ready Access Portal Architecture – The architecture of the system shall be implemented to conform to industry standards, so that it can accommodate the required applications provided by the BMS Contractor as well as communicate information to and from the BMS system head end.

t) Pointing and Input Devices:
- The operator interface shall be capable of being mouse driven and simultaneously support keyboard data input. Both fixed menus and configurable function keys shall be supported to aid novice and experienced operator respectively.

u) Multi-mode Window Sessions:
The core computer display unit shall also be capable of supporting multiple concurrent sessions. Each session shall allow an operator to choose between the following different modes:

- Master Operator Station Mode: Normal operator access to the system
- Engineering and Maintenance Mode: System configuration or application programming
- Graphics builder Mode: Display construction using the Graphics Display Building package
- It shall be possible for all modes to appear as separate Windows running simultaneously on one screen.
- It must be possible to limit access to all modes via password protection.
- Operator Security and Sign-On/Sign-Off
- Security Levels: The system shall support at least 6 levels of operator security.
- It shall be possible to assign operators either single or multi-user passwords. Single user passwords enable the operator to sign-on to only a single operator station thus preventing simultaneous sign-on be the same operator. Operators with the highest sign-on security level who may require simultaneous access to more than one
- It should be possible to support Microsoft Windows Active Directory with Single Sign-On operator station would typically use the multi-user password.

v) Area Assignment:
Each operator shall be assigned one or more specific areas of the building with the appropriate monitoring and control responsibility. An area shall be defined in this context as a logical entity comprising of a set of points in the system. This in turn may represent a physical space in the building. It shall be possible to define individual tenant access by means of area assignment. It should be support for up to 100 concurrent users who access the through a thin client PC, notebook and/or mobile phone (Android or iOS).An operator can only view or control those points within the assigned areas.

Password format supports unlimited length. The system shall provide a facility to allow all operators to change their own passwords at any time.

A minimum of 100 unique passwords shall be supported.

- Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
- Operators shall be further limited to only access, command, and modify those buildings, systems, and subsystems for which they have responsibility. Provide a minimum of 100 categories of systems to which individual operators may be assigned.
- The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.
- When a password is changed, the system shall not permit the new password to be the same as any of the last ten (10) passwords used in the past three (3) months. This shall be configurable with the appropriate level of security. All passwords stored in the system shall be encrypted.
- Time Schedules
- A minimum of one thousand (1000) time schedules shall be provided by the system. The time schedule facility shall allow the scheduling of Point control on both a periodic and one-off Basis by the BMS. The time schedule facility shall execute every 60 seconds and it shall be possible to schedule Point controls on minute boundaries.
- Weekly Schedules shall be provided for each group of equipment with a specific time use schedule.
- It should be possible to define one or more exception schedules for each schedule including references to calendars.
- Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of 5 years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined in the exception schedule.
- Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.
- Schedules and calendars shall comply with ASHRAE SP135/2008 BACnet Standard
- Standard System Displays:
- The following displays shall be included as part of the system:

  - Alarm Summary Display
  - Event Summary Display

w) Point Detail Template Displays (for each point in the database):

- Trend Set Template Displays
- Group Control and Group Trend Template Displays
- Communications Status Displays
- System Status Displays
- In the case of the Trend and Group displays, configuration of these displays shall only require entry of a point name to completely configure the display. The Alarm Summary, Event Summary, Point Detail, Communications Status, System Status shall not require any configuration.

x) Custom Displays:
The system shall allow configuration of custom displays via a Graphic.

y) Display Building editor:

- The Graphic Display Building editor shall be capable of operating in a window of the operator interface on both the BMS server and connected operator stations. It shall allow one step on-line building of display static and dynamic objects. It shall be a WYSIWYG editor (what you see is what you get) allowing the displays drawn using the editor to appear exactly the same when viewed from an operator station. The saved display shall automatically be available for use on the system if it created on any LAN connected operator station.
- Static objects created using the Graphic Display Building Editor usually shall not have associated dynamic objects. Static objects shall include static text, rectangles, arcs and circles. However, it shall be possible to animate static objects to give the dynamic characteristics. For example, a tank could be drawn and then animated so that it is level filled based on a point's value.
- Dynamic objects shall be linked to the BMS database. They shall allow information to be displayed from the database or to allow an operator to interact with them in order to make changes in the database and to perform control actions. Dynamic objects shall include dynamic text, push buttons, indicators, charts, check boxes, combo boxes and scroll bars. The use of scripting or programming to provide these features shall not be acceptable.
- It shall be possible to include static and dynamic display objects on the one display. The editor shall allow display objects to be manipulated by pointing, clicking and dragging. The editor shall allow display objects to be drawn, re-sized, copied, grouped, aligned and
- Web Browsers:
  The Graphic Display Builder Editor shall have the ability to imbed web browser objects into custom displays. This shall allow information from intranets, the internet or ActiveX documents
- This shall allow information from intranets, the internet or ActiveX documents to appear in the operator interface along with other building data. It must be possible to restrict access to the World Wide Web, therefore launching an external browser application shall not be acceptable.
- Launching External Applications:
  It shall be possible to launch applications (such as Microsoft Word, Excel, custom help files or any third party applications) from the custom display. The application shall be launched from a push button on a custom display, but shall open a file within the launched application. It shall also be possible launch applications from the operator station pull down menus.

13) Alarm Management:

a) Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:

- Log date and time of alarm occurrence.
- Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
- Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
- Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

- Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
- Any attribute of any object in the system may be designated to report an alarm.

b) The BMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.

- The BMS shall allow a minimum of 4 categories of alarm sounds customizable through user defined wav.files.

14) Alarm Annunciation:

a) Alarms shall be annunciate by:
- Alarm message appearing on dedicated alarm line on operator interface.
- Alarm message appearing on alarm summary display.
- Audible Tone (either using the PC Speaker or a sound card)
- Alarm message printed on the alarm printer

b) Alarm annunciation shall take advantage of multimedia technology by providing realistic alarm sounds (via .wav files).
ACK: Acknowledges events and stops the event from appearing on the Alarms Window.
Snooze: Sends the currently displayed alarm message away for 5 minutes, allowing any pending next highest events to appear in the Alarms Window. After 5 minutes, the alarm appears in the Alarms Window again (if it is the highest priority event). To change the amount of time the Alarms Window snoozes.

c) **Snooze All:** Puts the entire Alarms Window to sleep for 5 minutes. For the next 5 minutes, the Alarms Window disappears, even if high priority alarms or events occur. To change the amount of time the Alarms Window snoozes.

d) **View Item:** Shows the Focus tab of the object in alarm in the Display Frame.

e) **View Graphic:** Displays the graphic associated with the alarm extension of the item in alarm in the available display frame.

f) **Discard:** Deletes the alarm with acknowledgement.

g) **Minimize:** Minimizes the Alarms Window to the Windows task bar. If a new alarm occurs, the Alarms Window appears again as the top window.

h) **Alarm Filtering:** The Alarm Summary shall be able to filter the alarms displayed to the operator. The filtering criteria shall include as a minimum:

- Individual Priorities (i.e. Urgent, High, Low)
- Ranked Priorities (i.e. Urgent only, Urgent & High only, Urgent, High & Low)
- Unacknowledged Alarms only
- Individual Areas only

15) Trending:

a) The system shall provide flexible trending allowing real-time, historical or archived data to be trended in a variety of formats. In addition, trend data types shall be able to be combined to allow for comparisons between data e.g. current real-time data versus archived data.

b) Trend Capabilities:
The system shall provide trending capability with the following functions:

- Real time trending
- Historical trending
- Archived History trending
- Trend Scrolling
- Trend Zoom
- Engineering Unit or Percent
- Cursor readout of trend data

c) Trend comparisons between archived, real-time and historical data (for example, this year vs. last year). Comparisons between the same point offset in time, or different points must be possible.

d) Independent Y-axis per point on multi-plot style trends. It must be possible to display the Y-axis for any point on the trend by simply selecting the point using the mouse or keyboard copying the currently displayed trend data to the pasting into spreadsheet or document.

e) Configuration of trends shall only require the entry of the Point Name into the desired trend template to produce the trend. All trend configuration must be possible on-line without interruption to the system. Historization of data shall not be affected by changes to trend configuration.

f) Trend Types. The system shall be able to present real-time, historical or archived data in a variety of formats as defined below:
- Single Bar Trend
- Dual Bar Trend
- Triple Bar Trend
- Multi-Plot Trend
- Multi-Range Trend
- Numeric Trend
- X-Y Plot Trend

g) For each trend set display it shall be possible for operators to configure the number of historical samples and ranges displayed. Points configured in trend sets shall be changeable on-line.

h) Operators shall be able to zoom in on information displayed on trend sets for closer inspection. Scroll bars shall be available to move the Trend set backwards and forwards across the historical records. The trend sets shall automatically access archived history files without operator configuration.

i) Loop Tuning Trends: Dedicated loop tuning trends shall be available on the BMS. Access to these trends shall be via the detail information display for each point. This loop tuning display shall be generated automatically with no configuration required.

16) Reporting:

a) The system shall support a flexible reporting package to allow easy generation of report data. The reports provided should include pre-configured standard reports for common requirements such as Alarm Event reports and custom report generation facilities that are configurable by the user.

b) Standard Reports. The following pre-formatted reports shall be available on the system:

- Alarm/Event Report
- Operator Trail Report
- Point Trail Report
- Alarm Duration Report
- Point Attribute Report
- Database Cross-Reference Report
- All points in the BMS
- All points in each BMS application
- All points in a specific controller
- All points in a user-defined group of points
- All points currently in alarm
- All points locked out
- All user defined and adjustable variables, schedules, interlocks and the like.

c) Free Format Reports. In addition, configurable report generation facilities must be provided to allow custom reports to be produced. They shall be able to be configured at any time with the system ON LINE. These reports shall be able to access any data base values and have the facility for carrying out inter-point calculations in order to produce averages, summations, efficiencies or any other derived values. Results of these calculations shall be stored in the database or in files. The report layout shall be also user defined and shall be up to 132 columns wide and of unrestricted length. The report generator shall have the following capabilities:

- Access to all real-time and historical databases
- Access to user entered data
- Arithmetic calculation capability
- Statistical Calculation capability
- User definable Report Format

d) Report Activation: Reports shall be activated in one or more of the following ways:

- Periodic activation at user specified intervals
- Operator Demanded
- Event Initiated
- Application Initiated

e) Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.

f) Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.

g) Provide the capability to view, command and modify large quantities of similar data in tailored summaries created online without the use of a secondary application like a spreadsheet. Summary definition shall allow up to seven user defined columns describing attributes to be displayed including custom column labels. Up to 100 rows per summary shall be supported. Summary viewing shall be available over the network using a standard Web browser.

h) Provide a focused set of reports that includes essential information required for effective management of energy resources within the facility. Energy reports shall be configurable from predefined, preconfigured templates. Required includes but shall not be limited to:
- Energy Overview
- Load Profile
- Simple Energy Cost
- Consumption
- Equipment Runtime
- Electrical Energy
- Energy Production

i) Reports shall be selectable by date, time, area and device. Each report shall include a colour visual summary of essential energy information.

17) System Security:

a) The system shall provide up to six levels of security providing varying degrees of access to system operation and configuration functions. If necessary, each operator may be assigned a user profile that defines the following:
- Security Level (1-5)
- Control Level (1-255)
- Operator Identifier
- Unique Password

b) Any actions initiated by the operator shall be logged in the Event database by operator identifier. In addition, any control actions to a given point shall only be allowed if the control level configured in the operator's profile exceeds the level assigned to the controlled point.

c) Utilities shall be provided to allow administration of the operator passwords.

18) Data Exchange:

a) Interfacing to Another System: The BMS shall have the capability to interface to the point database of other similar BMSs (i.e. nodes) on a TCP/IP network. This shall enable both the acquiring of point data and issuing control outputs to other BMS systems.
b) Data Exchange with a Relational Database using ODBC. The system must be able to write data to and read data from:
- Oracle
- Access
- Microsoft SQL

c) It shall be possible to transfer data either periodically (i.e. scheduled), when an event occurs or on demand by the operator.

d) Data Exchange with Microsoft Excel. The system must be capable of exporting bulk data to Microsoft Excel. Windows Dynamic Data Exchange (DDE) is not an acceptable method to use. As a minimum the following shall be supported:
   - allow retrieval of data either periodically or snapshot
   - allow retrieval of data via POINT.PARAMETER requests
   - allow retrieval of tag names, descriptions etc.
   - allow retrieval historical data
   - writing of values from Excel back to the supervisory system

19) General purpose – PLC

a) PLC controllers shall be minimum 32 bit microprocessor based with FLASH base of operating system.

b) The devices shall be programmable and capable of extensive measuring, control and monitoring functions. The GPC's shall be provided at locations shown on the mechanical drawings.

c) All PLCs shall support modular architecture with the following:
   - A CPU with Power Supply Module
   - Distributed I/O modules to accommodate Input / Output points.

d) Energy management programs such as optimum start/stop, load reset, duty cycling, night purge, distributed demand control and others must be resident on each PLC.

e) As a backup, PLC's shall store PLC programs and data files on non-volatile EEPROM or flash memory to allow simple and reliable additions and changes. Each PLC shall have a 72 hours battery backed real-time clock.

f) PLCs shall be provided where shown and specified with capacity to accommodate input/output (I/O) points required for the application plus 20% spare points.

g) Each panel shall be provided with a socket for a Portable Operators Terminal (POT) which can be connected via Bluetooth communication for easy access for testing & trouble shooting and no need to open the panel, and a port for network communications in max. speed of 76Kbps

h) Each panel shall have optional port available for modem remote to central communications.

i) The PLC I/O modules should communication within the BMS network by BACnet MSTP/Modbus/Profinet protocol.

j) Analog inputs shall have a minimum resolution of 12 bits. PLC outputs shall be binary for On-Off control, and true variable voltage (4-20mA, 0-10v) for driving analog or pneumatic transducer devices. Analog outputs shall have a minimum incremental resolution of one percent of the operating range of the controlled device.

k) PLCs shall provide a trend logging feature which can trend and store a minimum of 20 different data point simultaneously.

l) PLCs shall have LEDs for continuous indication of all bus communications, power, and operational status.

20) PLC Software:

Control Software:

a) Control Application Software shall be customized to meet the detailed requirements of the "Sequence of Operation". PLCs and UC network management devices shall be programmable. All PLC control software shall be designed via a graphic programming facility, the output of which shall be provided as system documentation.

b) In addition to Proportional, Proportional-Plus-Integral (PI), and Proportional-Plus-Integral-Plus-Derivative (PID) algorithms, an HVAC enhanced Adaptive Neural PID (ANPID) real time auto tuning algorithm shall be provided and implemented where specified. The ANPID shall be a full PID, but modified and enhanced to minimize overshoot, settling time and actuator travel. The ANPID shall perform as follows:

c) The loop performance is modelled by simulations across various loads, HVAC equipment and process conditions. The performance results of the model are entered into the ANPID as a training function. Subsequently the pre-trained “out of the box” ANPID is applied to the loop. The ANPID then monitors the PID (error, PI and D gains; and output) recognizes certain control loop characteristics and load patterns and continuously auto adjusts the final output to prevent repeating the error learned during the training process.

d) Chilled water/central plant optimization applications including but not limited to:

- Selection and sequencing of up to two chillers of different sizes
- Selection and sequencing of up to two (each) primary and secondary chilled water pumps of varying pumping capacities
- Selection and sequencing of up to two condenser water pumps
- Selection and sequencing of cooling towers and bypass valve, including single speed, multi-speed, and Vernier control
- A proven and documented central cooling plant optimization program that incorporates custom equipment efficiency profiles, without rewriting software code, in order to meet the building load using the least amount of energy as calculated.
- The use of advanced control algorithms that apply equipment specific parameters, including operational limits and efficiency profiles, in order to determine equipment start and runtime preferences
- Identification of the most efficient equipment combination and automatic control of state and speed of all necessary equipment to balance runtime, optimize timing and sequencing and ensure the efficiency and stability of the central cooling plant
- Control definition for the chiller plant in a single FEC, as supported by available memory and point Input/Output (I/O), or capable of being split across multiple FECs

e) Heating central plant applications
f) Built-up air handling units for special applications
g) Terminal & package units
h) Special programs as required for systems control
i) The PLC software tool should be display a graphical representation of the selected module’s logic that will be user friendly.
j) The PLC software should be support auto tuning or re-tuning process that would be attempts to minimize the error by adjusting the process control inputs. The auto tuning or re-tuning process will check whether there is a significant disturbance in terms of either the set point and/or the controlled process.

21) Third party interface system

a) The successful bid vendor will supply all necessary hardware and software (if required), to create a communications interface between the proposed subsystems (i.e. chillers, etc) and that vendor's proposed building management system.

b) For BACnet, MS/TP or IP integration, the BMS system should be support auto discovery to discover the field devices and field points.

c) The BMS system should support a common industrial protocols, such as Modbus RTU, Modbus IP, Lonwork, ARCnet, Profinet etc.

d) The BMS vendor should be provide job references with other proprietary protocols integration.

e) The following functionality must be supported by the proposed interface:

- Read status and analogue value point information from the subsystem at the proposed BMS central.
- Command subsystem points to a digital state or to an analogue value from the proposed BMS central.
- Incorporate all subsystem points within the proposed BMS schedule, trend, energy management routine, or graphic display functionality.
- It is not necessary to support the configuration of subsystem devices on the proposed BMCS central.

22) Data communications:

a) PLC microprocessor failures shall not cause loss of communications of the remainder of any network.
b) Primary and Secondary networks shall be peer-to-peer supporting sensor sharing, global application programs and bus to bus communications in a true peer-to-peer token passing manner.

23) BMS-M&E-SCADA Interfacing Cables

a) Digital input (DI) and Digital output (DO) signals shall be used multi-core FRLS, PVC cables via conduits or cable trays.
b) Analog input (AI) and Analog output (AO) signals shall be used twisted pair with aluminium shield cables via conduits or cable trays.
c) BMS-DCC-SCADA interfacing cables for life safety lifts, fire alarm system and fire pumps shall be used FR cable tested to BS 6387 category CWZ via conduits only.

24) Field Control Wiring

a) If screen is required, aluminium tape laid longitudinally and in contact with the un- insulated drain wire or un-insulated circuit protective conductor (cpc) shall be provided.
b) All field control wiring associated with analogue inputs/outputs shall be run in screened cable with a minimum cross sectional areas of 0.5 mm^2
c) All field control wiring associated with digital inputs/outputs shall be wired in unscreened cable with a minimum cross sectional areas of 1.0 mm^2.
d) All field control wiring shall be wired contained in trunking or conduits.
e) All field control wiring for equipment used for life safety shall be of fire resistant cable.

25) BMS Control and Communication Protocol

a) The International standard open protocol system shall be adopted for various communication links .The communication Protocol can be classified as per following requirements:
   i) The communication between E&M equipment to RPU such as MODBUS, BACnet, Lontalk, ARCNET and etc.
   ii) The communication between RPU to the Workstation such as MODBUS, BACnet, Lontalk, ARCNET and etc over TCP/IP.
   iii) The communication between Multifunction Meters and Energy meters and their communication to RPU/Workstation such as MODBUS, BACnet, Lontalk, ARCNET and etc on RS 232/485 port.
   iv) The communication between Dimming Light Control Panel, Fire Alarm Control Panel, MDB & Electrical panels, Lift Panel, AMF Panel, UPS etc to the RPU/SCR Workstation such as MODBUS, BACnet, Lontalk, ARCNET etc on RS 232/485 port.
   v) Communication between OCC Server and Remote workstations: TCP/IP protocol on optic fiber backbone network supply by other.
   vi) Communication between OCC & BCC servers to various Depot buildings: TCP/IP protocol on optic fiber network (WAN) supplied by Depot contractor.

26) Network Architecture interfacing –

a) The inherent extensibility of the product architecture allows third parties to add functionality into the product at LAN level in the station. This shall allow functions not originally intended to be in the product, to be integrated at a fundamental level and appear as a part of the platform.
b) BMS is extensible in a number of ways, including:
   i) Components can be added to the system (this includes workstation modules and their associated interfaces).
   ii) Many aspects of BMS provide software interfaces, allowing BMS to be a component in a larger system.

27) Installation

All equipment and accessories shall be installed in accordance with the manufacturer's recommendation and in the locations as indicated on the approved Design and Drawings.

28) Testing and Commissioning

There will be five type of tests

a) Factory Acceptance Test for RPU, Workstation and Printer- During the test all logics shall be demonstrated with simulator and sample RPU, Workstation and printer.
b) Installation Test- After delivery of the RPU at the site, this test shall be arranged to check the physical healthiness of the hardware.
c) Functional Test- This test shall be arranged to test the functioning of RPU, workstation and printer and communication network.
d) System Acceptance Test- This test shall be arranged to test all automation and I/O list, with integration of communication network.
e) Integrated Test- This test shall be arranged to test the integration of the BMS workstation Depot and all workstations of different buildings.

However, indicative SAT document shown in this specification, but it is BMS contractor's responsibility to submit the separate test document for each type of test to the Employer for the Notice of No Objection. All tests shall be in sequence and on completion of previous test, next test shall be arranged. Before installation test, all QA/QC document shall be submitted to the Employer for the Notice of No Objection.

Basic monitoring and control functions will be demonstrated on a point-by-point basis. Checking out the software features is much more difficult and many of the programs will only be proved correct or otherwise by closely monitoring the BMS operation over an extended time period. The contractor shall provide necessary support till the time the system is reasonably established.

A re-commission or check out of the operation of the BMS at the end of twelve months shall be carried out.
The following requirements are intended to supplement and explain the General Specification requirements without in any way limiting their application.

a. The testing philosophy for the BMS SYSTEM shall ensure that the equipment functionality is thoroughly verified and validated at the Contractor's premises before delivery and commissioning. The test methodology shall be in line with the design methodology and the two shall be developed in parallel.
b. The principle of testing shall be that, at stages throughout the work, formal tests shall be performed and recorded against written test specifications, to provide a high level of confidence to the Contractor and the Employer that subsequent stages can proceed.
c. The responsibility for specifying, conducting and recording tests shall be with the Contractor, but all aspects must be to the satisfaction of the Employer. The Employer will at his discretion witness any tests.
d. This document does not constitute a Test Specification or Test Procedure for any part of the system, rather it sets out the stages at which tests are required and the subjects, location and purpose of each stage. Inspection of incoming goods and components, and subassembly testing, shall be undertaken by the Contractor in accordance with the procedures set out in the Contractor's own Quality Management Plan and are not described here.

29) Quality Control –

All equipment and accessories shall be installed shall be of industrial grade quality and shall be undertaken in accordance with the procedure's set out in the contractors Quality assurance and Quality management plan.

MUMBAI METRO LINE 3
(COLABA-BANDRA-SEEPZ)

CONTRACT NO: MM 3-CBS-DEM

Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

VOLUME 6 OF 6

PREAMBLE

&
BILL OF QUANTITY (BOQ)

DECEMBER - 2017

Mumbai Metro Rail Corporation Ltd.
Plot No. R-13, 'E' Block,
Namttri Building
Bandra - Kurla Complex,
Bandra (East), Mumbai – 400051, India

Composition of Documents

Volume 1	**Bidding Procedure**
Section I	Notice Inviting Tender (NIT)
Section II	Instructions To Tenderer
Section III	Form of Tenders
Volume 2	**Conditions of Contract and Contract Forms**
Section IV	General Conditions of Contract (GCC)
Section V	Special Conditions of Contract (SCC)
Volume 3	**Employer's Requirement- General Specification**
Volume 4	**Employer's Requirement – Technical Specifications**
Section VI – A	Electrical - HT
Section VI – B	Electrical - LT
Section VI – C	Ventilation & Air Conditioning (VAC)
Section VI – D	Fire Alarm and Detection System (FADS)
Section VI – E	Fire Suppression (Fire Fighting System)
Section VI – F	Building Management System (BMS)
Section VI – G	EOT Cranes (Electric Over Head Travelling Crane)
Section VI – H	Air Compressor (Compressed Air System)
Section VI – I	Plumbing Pumps (Drinking, Treated and Sewer)
Volume 5	**Tender Drawings**
Section VII – A	Electrical - HT
Section VII – B	Electrical - LT
Section VII– C	Ventilation & Air Conditioning (VAC)
Section VII – D	Fire Alarm and Detection System (FADS)
Section VII – E	Fire Suppression (Fire Fighting System)
Section VII – F	Building Management System (BMS)
Section VII – G	EOT Cranes (Electric Over Head Travelling Crane)
Section VII– H	Air Compressor (Compressed Air System)
Section VII – I	Plumbing Pumps (Drinking, Treated and Sewer)
Section VII – J	Civil Tender Drawings (Architectural / Utility)
Volume 6	**Bill of Quantities**

1. PREAMBLE

1.1 General Requirements.

The Tenderer's attention is drawn to the General Conditions of Contract, Special Conditions of Contract, Employer's Requirements (Technical specifications) and Drawings, which are to be read in conjunction with the Bill of Quantities. This Preamble shall serve as a definitive guide to the measurement of quantities and payment.

The Tenderer under this tender's scope of work should quote the rates taking into account the works of *Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3" under this tender document for MM3-CBS-DEM Scope of Work.*

The scope of work under this contract should include but not limited to Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works, Transformer, 33KV Cable, GIS Panel, all Electrical (HT-LT) work including DG sets, Ventilation and Air Conditioning System (VAC), Fire Alarm and Detection System, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT crane, Air-Compressor including compressed air piping works and Plumbing Pumps of Depot cum workshop building including OCC and at grade Aarey Station of Mumbai Metro Line -3 under the contract MM3-CBS-DEM comprising of but not limited to the details mentioned below:

- SITC of Transformer, 33KV Cable, GIS Panel, all the Electrical HT & LT works including battery and battery chargers with DCDB, ACDB works.
- Conduit wiring, supply & fixing of modular type sockets and switches including industrial socket outlets wherever required and as per drawings & BOQ.
- External lighting including its feeder pillar, cabling, poles all complete, High Mast (as applicable.
- Lighting fixture for internal areas (including verification of lux level achievable in various areas) and external areas.
- Fire detection and alarm system including conducting and wiring.
- Safety equipment.
- All panels & DBs including Main Distribution Panel, Essential Power Panel, AC Power Panel, Main workshop panel, and Pit wheel lathe Panel, Fire Pump Panel, Water Pump Panel, Lighting Distribution Boards etc.
- Various distribution boards / panels as required with automatic source transfer system etc.
- DC control supply system as required
- 1.1 kV grade power cables and control cables, cable trays, raceways and ducting.
- Exhaust fans, Air Circulator Fans, Ceiling fans, other Mechanical Ventilation Fans.
- Ventilation of basement & generator rooms, transformer rooms and substation & pump room, air-conditioning of equipment rooms/ office areas rooms. Precision Air Conditioning for System rooms.

- Protective (clean & main) earthing and lightning protection.
- Cabling, Hume pipes, cable termination, Pole foundations etc. for external lighting.
- Uninterrupted power supply system (UPS).
- Protection and interlocks.
- Gas flooding in system rooms, Fire pumps, fire hydrants, sprinklers and fire system piping in station building and PD area.
- CO2 gas based fire trace tube system in electrical panels and fire extinguishers.
- SITC of DG sets of various capacities including AMF panels, earthing and other accessories.
- SITC of EOT cranes and Compressors of various capacities in Depot.
- Interfacing with designated contractors / DDCs as per interface matrix and work requirement.
- Submission of Shop drawing / Study Reports etc. for the Erection, Installation , Testing and commissioning of all the systems
- Verification of Design by the DDC nominated / appointed under this contract for the various E&M systems to be installed, as submitted

In addition the Scope of work shall also include but not limited to the following works mentioned below

The Scope of work shall also include all minor civil works associated with electrical system works as required.

- Obtain the Fire clearance certificate from the Fire authorities and other statutory approvals as applicable.
- Obtain EIG (Electrical Inspector) clearance for energising the Electrical Systems as per statutory requirement.
- Maintenance of the area during implementation stage.
- De-mobilisation, clearing of all temporary works and facilities after completion of job.
- Any other item of work as may be required to be carried out for completing the work under this Contract in all respects in accordance with the provisions of the Contract and/or to ensure the safety of installation during and after execution.
- The contractor shall have a Detailed Design consultants (DDC) approved by the employer under this contract. The scope of work to be done by DDC is given in Clause A 1.5 Section 2 Volume 1.

1.2 Interfaces Work

The DEM contractor shall interface with all civil and system wide contractors as mentioned in Employer's Requirement Volume-3, but not limited to the Depot and Aarey Station Civil contractor, STPT, Track, Rolling Stock, OCS & PSS, AFC, ECS & TVS (TVE), Lifts & Escalator. In addition the contractor shall have a close interface with their Detailed Design consultants (DDC) respectively.

The Contractor shall be required to carry out various miscellaneous works as per interfacing requirements.

The Scope of Work for various interfacing works for other Contractors mentioned above shall be but not limited to as described below:

- Cable ducts/cables/hangers/trays/Raceways for routing all type of cables.
- Earthing and lightning protection as required.

Supply of relevant documentation mainly including:

- Installation, execution, and as-built drawings,
- Test procedures,
- Maintenance & operation manuals

The contractor shall submit soft copies of all the documents,

- On-site and off-site training sessions of MMRC staff.
- Maintenance during DLP.
- The work shall include all activities to make the units fully functional and to meet the requirements of power supply arrangement and other works complete as required.

1.3 Quantities

For the purpose of this Contract, all unit quantities given in the Bills of Quantities are the estimated quantities of the Works and are intended in the first instance to provide a common basis for Tendering and Tender Evaluation. When a contract has been entered into, the function of priced Bills of Quantities is to provide for the valuation of the work executed. No alteration of any rate or price shall be allowed on account of any difference between the quantities billed and the actual quantities measured from the drawings.

The Tenderer shall make himself completely acquainted with all conditions, obligations, specifications, drawings, etc. of the Tender Documents before giving his percentage (above / at par / below). He shall have no right to claim any price revision on the basis of ignorance of the Tender Documents or local conditions, or to make any claims as regards the integrity of the unit prices of the Bills of Quantities.

1.4 Units and Currency.

All sizes and quantities entered in the Bills of Quantities are in metric units.
The Tenderer shall fill in **percentage (above / at par / below). Total contract Cost is in Indian Rupees (INR).**

1.4.1 Tender Price and Sums to be for Work Complete.

Tenderers shall be deemed to have read the Employer's Requirements and other parts of the Tender Documents and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling in the percentage (above / at par / below). The entered percentage (above / at par / below) shall be deemed to include for the full scope of the Contract, including overheads and profits and shall bear a proper relationship to the cost of carrying out the work described.

Notwithstanding any limits that may be implied by the wording of the individual items and/or the explanations in the Preamble, the percentage (above / at par / below), which the Tenderer enters in the Bills of Quantities shall be for the work finished complete in every respect, applicable uniformly to each item of BOQ.

The Tenderer shall be deemed to have taken full account of all requirements, liabilities, obligations and risks, whether expressed or implied, and to have accessed the items accordingly. The Items in the Bills of Quantities are the only items against which payment will be made. The rates percentage (above / at par / below) shall therefore include for all incidental and contingent expenses and risks of every kind necessary to

supply, install, test and commission (including Integrated Testing and Commissioning) complete, and remedying any defects in the whole of the Works in accordance with the Contract.

The tenderer is required to note clause – 24 of SCC & Clause 11.1.1 of GCC while quoting his percentage (above / at par / below). This tender is NON JICA funded.

The tenderer shall be solely responsible for obtaining the benefits that have considered in their tender and in case of failure to receive such benefits, the employer shall not compensate the tenderers. It will be the responsibility of the contractor to avail maximum benefits available to MMRC in terms of above provisions.

This tender is a DDC based Percentage Rate BOQ contract for the works mentioned in the scope of work in this document and as per the Employers Requirement's

All the prices shown in the schedules shall include all the taxes & duties including but not limited to GST (CGST, SGST, IGST, and UTGST), Custom Duties, royalties, levies, cess etc. which constitute the contract price and will be the total amount to be paid to the contractor for executing the works and performing all other obligations under this tender document.

The schedules and the contract prices shall not be subject to adjustment by the contractor in respect of any error or oversight in Volume 6 –BOQ. Volume-6 represents the full extent of the contractor's entitlement to receive payment as per the Schedules, Arithmetical Errors, if any are found in the Contractor's submission, will be corrected by the Employer as indicated in the Instruction to Bidders.

The rate for each item detailed herewith in Volume-6 BOQ shall include but not limited to the preliminary and detailed design, supply of all the materials, equipment, cables, landing charges, shipping costs for transport by air, sea or land (or any combination thereof), insurance charges, taxes and duties including but not limited to GST (CGST,SGST,IGST,UTGST) , Custom Duties, royalties, levies, cess etc, unloading, storage, installation, factory testing, field testing and commissioning, supply of spare parts and special tools, training of employer's O&M staff, provision of as-built drawings, provision of O&M manuals, and all type of clearances / approvals required from government authorities. The rate also includes the contractor's profit and establishment overhead, all general risks, insurance liabilities, compliance with labour laws as per statutory obligations set out or implied in the tender, attending to defects list prepared by the Employer prior to handover of works and facilities, and any other requirements to fulfil the tender and employer requirements stated within this tender scope of work for the period of completion of the scope of work including Defect Liability Period of two years from the handover of the project by the nominated tenderer.

1.4.2 Allowances in total contract price

Full allowance shall be made in the total contract price and sums against the various items in the Bills of Quantities for all costs involved in performing the following except to the extent that work is specifically described and paid for in the Bills of Quantities. The list below is not exhaustive, and the Tenderers are expected to take all costs

involved while quoting the percentage (above / at par / below) that will not be subject to variation on any account.

a) all setting out and survey work;
b) temporary access roads and bridges, fencing, watching and security , lighting;
c) paying fees and giving notices to Authorities;
d) payment of all patent rights and royalties;
e) reinstatement of the Site;
f) safety precautions and all measures to prevent erosion and suppress fire and other hazards;
g) interference to the Works by persons, vehicles, and the like being legitimate users of the facilities on or in the vicinity of the Site;
h) the protection and safety of MMRC trains and services;
i) the protection and safety of Railway trains and services on adjacent tracks;
j) supplying, maintaining and removing on completion, the Contractors own accommodation, offices, depots, stores, workshops, transport, welfare services and other facilities including telephones and facsimile machines and all charges in connection therewith;
k) the supply, inspection, testing, packaging and transportation of materials and of the Works as specified including the provision and use of equipment and arrangements for the Engineer's Inspectors and others;
l) maintaining public thoroughfares and footpaths, and maintaining access upon existing recognised routes;
m) providing, transporting to the Site, setting to work, operating (including all fuel and consumable stores), maintaining and removing from the Site upon completion all Construction Plant and Contractor's Equipment necessary for the execution of the Works and including the cost of all tests and other requirements in respect of such; plant and equipment;
n) working adjacent to or across existing services and installations;
o) complying with the requirements of the Employer in regard to Safety and Health, Quality Assurance, Environmental, and project implementation plans and making periodical submissions;
p) co-ordination and interference to the Works by the works of Designated Contractors and others employed by MMRC being legitimate users of the facilities on or in the vicinity of the Site;
q) remedying of defects and shrinkage, and works of amendment, reconstruction, replacement of other faults, fair wear and tear excepted, during Defects Liability Periods;
r) Protections to be implemented against Electromagnetic interference effects following line energisation
s) Insurance, including all risks in supply, erection, storage, transit, third party, Workmen's Compensation and others;
t) All tools, and equipment required for all tests prior and after delivery, and for testing and commissioning installed systems;
u) Carrying out all modifications to the given drawings, preparing construction detailed drawings and supplying originals, copies, and electronic files in accordance with employer's requirement.
v) Marine Insurance

w) All risk Insurance after arrival of goods in India & all workers (third party) insurance and Motor Vehicle insurance.
x) Custom clearance / Port Clearance
y) Handling at Port of arrival in India
z) Inland transportation from port of arrival to site of work
aa) Various bank guarantees/warranties/undertakings

1.4.3 Deleted

1.4.4 Tender Pricing

Tenderers shall quote for the entire work on a "single responsibility" basis such that the total tender price covers all Contractor's obligations mentioned in or to be reasonably inferred from the Tender Documents in respect of the design, manufacture, including procurement and subcontracting (if any), delivery, construction, installation, completion of the whole of Works. This includes all requirements under the Contractor's responsibilities for testing and commissioning of the works including integrated testing and commissioning, the acquisition of all permits, approvals and tender licenses, etc.; the operation, maintenance and training services and such other items and services as are specified in the tender documents. The Tenderer shall take regard of the actual site conditions and the items entered in the various Statements. The Tenderer shall price his tender accordingly and the unit prices against a line item shall be the full and only price paid for all work performed against that item except as described in the Tender Documents.

Tenderers are required to quote the price for the commercial, contractual and technical obligations outlined in the tender documents. If a Tenderer wishes to make deviations or wants to put conditions, qualifications, etc., such deviations, conditions, qualifications etc. shall be listed **in Annexure-4 of ITT**. The Tenderer shall also provide in this statement the additional price, if any, for the unconditional withdrawal of the deviations, qualifications, conditions etc. This additional price for the unconditional withdrawal has to be given separately for each deviation, qualification, condition, etc. Any deviation/ qualification/ condition that is not priced for unconditional withdrawal shall not be considered.

The Tenderer shall submit its price Statements of Prices in Indian Rupees.

1.4.5 The Stage Payment:

For Stage Payment against BOQ items, Refer SCC Clause 47. (Additional Clause Stage Payment.)

1.4.6 Important Notes related to the works are mentioned in table below:

1	Contractor shall be responsible for providing a complete workable E&M, Fire Fighting and Fire Suppression system, VAC system, EOT crane & Air compressor system as per BOQ and detailed technical specifications enclosed, including necessary Interfacing with the other contractors (Civil works, S&T, DG, OHE and Rolling Stock etc.).
2	Contractor shall be responsible for the detailed design and verification of designs, based on our preliminary designs, preparation of Shop drawings, co-coordinating with various contractors for preparing and finalizing the co-ordinated services drawings.
3	Obtaining various statutory approvals viz. EIG (Electrical Inspector to Govt. of India) approval for various Electrical Installations for energizing the system, DFS clearance and No Objection Certificate for energizing Fire detection and Fire suppression systems.
4	The work includes providing training of not less than 60 trainer days to MMRC staff for various E&M Systems , Fire Fighting , Fire Alarm Annunciation system ,Air-conditioning system, EOT cranes & Air compressors system etc. along with training documents / soft copies of training manuals .
5	Contractor shall maintain all the systems in a comprehensive manner including all kinds of spares and consumables without any extra cost during Defect Liability period of 2 years from the date of taking over. Scope of maintenance will include all consumable e.g. lamps, chokes, fuses, etc and all preventive and breakdown maintenance spares and round the clock maintenance as per requirement.
6.	Vendors/ Product Make approval proposals shall be supported with the compliance of Specifications, Standards & BOQ by the manufacturer. The proposals shall be submitted with the G.T.P (Guaranteed Technical Parameter) of the product along with the Type test certificates (not more than 5 years old from the date of tender submission) of the various products, as per requirement.
7.	MMRC reserves the right for Inspection and Testing of Equipment's and Materials at Manufacturer's works in the presence of Contractor's and Manufacturer's representatives prior to dispatch of material. However, the contractor will be fully responsible for compliance of tender specifications and performance of equipment's/systems as per tender conditions.
8	The contractor has to maintain separate record of the taxes & duties including but not limited to GST (CGST, SGST, IGST, UTGST), Custom Duties, royalties, levies, cess etc.
9	For payments made for items of BOQ against delivery of equipment to MMRC site, Indemnity Bond shall be submitted as per clause 46 of SCC.

Percentage Rate Tender Form (Envelop B1)

(Date and Reference)

To,
The Executive Director (Electrical)
Mumbai Metro Rail Corporation,
MMRDA Building, 5th Floor,
Bandra –Kurla Complex, Bandra (E)

Sub: CONTRACT NO: MM3-CBS-DEM for Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

Dear Sir\Madam,

With reference to your RFP dated --------- for above cited work, our Offered Price is as under-

Sr. No.	Description	Bid Estimated Amount (Rs.)	Quoted % (Percentage)
1	Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"	61,99,92,389/- (Rupees Sixty One crores Ninety Nine lakhs Ninety Two thousand and Three Hundred Eighty Nine only)	_____% (Percentage) above / at par/ below in Figure & Words
The final offer Quoted above amounting to RS. _____ (In Words Rupees _____ _____ Total Offered price above will be considered for evaluation for awarding the Contract and shall be inclusive of all the taxes & duties including but not limited to GST (CGST, SGST, IGST, UTGST), Custom Duties, royalties, levies, cess etc.,			

Yours Faithfully,

Authorized Signatory

2. Bill of Quantities. (BOQ): Detailed BOQ from page number 1 to 326

(Attachment No-11 to Addendum No-5)
Project Sum - Cost Estimate For - Aarey Station and Depot with OCC Building

Sub Head No.	ITEMS	Amount (Rs)
	PART-A (Depot Substation & HT)	
A.1	**ELECTRICAL HT**	**5,69,02,677**
	PART-B (Aarey Depot Building)	
B.1	ELECTRICAL LT (DEPOT)	15,05,43,426
B.2	FIRE DETECTION AND FIRE FIGHTING SYSTEM	3,71,57,784
B.3	EOT CRANE /COMPRESSOR	4,16,63,681
B.4	VAC SYSTEM	1,60,89,165
B.5	BUILDING MANAGEMENT SYSTEM	2,00,86,104
B.6	DEPOT PLUMBING PUMPS	7,44,757
	TOTAL	**26,62,84,918**
	PART-C (OCC Building)	
C.1	ELECTRICAL LT (OCC)	9,98,16,622
C.2	FIRE DETECTION AND FIRE FIGHTING SYSTEM	3,42,19,778
C.3	VAC SYSTEM	6,34,42,779
C.4	EOT CRANE /COMPRESSOR	1,03,56,816
C.5	WTP FOR VAC SYATEM	13,30,561
C.6	SPARES (CABLES & LIGHT FIXTURE)	39,41,501
	TOTAL	**21,31,08,056**
	PART-D (Aarey Station)	
S.1	ELECTRICAL LT (STATION)	4,62,13,240
S.2	FIRE DETECTION AND FIRE FIGHTING SYSTEM	2,33,17,891
S.3	BUILDING MANAGEMENT SYSTEM	92,65,883
S.4	PLUMBING PUMP STATION	6,96,808
S.5	BASEMENT VENTILATION	42,02,917
	TOTAL	**8,36,96,739**
	GRAND TOTAL FOR AAREY STATION, DEPOT AND OCC	**61,99,92,389**

(Attachment No-11 to Addendum No-5)
DEP-SUM Part-A(HT-System) & Part-B (Aarey Depot Buildings)

Sub Head No.	ITEMS	Amount (INR)
A.1	**PART-A (Depot Substation & HT works)**	
A.1.1	GIS	2,64,97,575
A.1.2	Transformers	94,44,503
A.1.3	HT Cable	2,01,39,120
A.1.4	Battery & Battery Charger	8,21,479
	A.1	**5,69,02,677**
	PART-B (Aarey Depot Building)	
B.1	**PART-B - ELECTRICAL LT SYSTEM**	
B.1.1	MV Switchgear	2,16,55,046
B.1.2	Distribution Boards	36,69,090
B.1.3	Distribution Cable	3,70,07,882
B.1.4	Conduit Wiring	2,21,93,106
B.1.5	Indoor Lighting and Fans	3,32,23,447
B.1.6	Highmast & Street light pole	47,75,936
B.1.7	Protective Earthing System	95,12,553
B.1.8	Lightning Protection	31,57,342
B.1.9	External Piping System for HUME, TRENCHING & UNDERGROUND	39,44,040
B.1.10	Compact Sandwich BusDuct	15,99,031
B.1.11	Uninterupted Power Supply system	16,40,580
B.1.12	DG Set	65,78,709
B.1.13	OHE On Off Indicator	11,55,743
B.1.14	Conduiting and GI Sleeves for Telephone, Lan & PA System	4,30,919
	B.1	**15,05,43,426**

(Attachment No-11 to Addendum No-5)
DEP-SUM Part-A(HT-System) & Part-B (Aarey Depot Buildings)

Sub Head No.	ITEMS	Amount (INR)
B.2- FIRE DETECTION AND FIRE FIGHTING SYSTEM (DEPOT)		
B.2.1	Fire Detection and Alarm System	33,79,989
B.2.2	Fire Fighting System	2,44,25,587
B.2.3	Clean Agent Based Panel Flooding System for Electrical Panels	29,73,998
B.2.4	Clean Agent based Fire Supression System- Total Flooding	30,81,159
B.2.5	Fire Protective Clothing & Breathing Apparatus	4,07,936
B.2.6	TRANSFORMERS PROTECTION SYSTEM :	3,75,506
B.2.7	VESDA SYSTEM FOR SER,TER & UPS ROOM:	25,13,608
	B.2	**3,71,57,784**
B.3 -EOT CRANE/COMPRESSOR		
B.3.1	EOT CRANE	2,57,11,913
B.3.2	AIR COMPRESSOR WITH ACCESSORIES & COMPRESSED AIR PIPING	1,59,51,768
	B.3	**4,16,63,681**
B.4- VAC SYSTEM (AC SYSTEMS WITH VRV / VRF, SPLIT AC)		
B.4.1	Air Cooled VRV System and Split Units	1,42,45,775
B.4.2	VENTILATION	7,43,968
B.4.3	AIR DISTRIBUTION	10,99,422
	B.4	**1,60,89,165**
B.5- BUILDING MANAGEMENT SYSTEM(BMS)		
B.5.1	BMS- DEPOT	**2,00,86,104**
B.6- DEPOT PLUMBING PUMPS		
B.6.1	PLUMBING PUMPS DEPOT	**7,44,757**

(Attachment No-11 to Addendum No-5)
PART-A - Depot Substation & HT works

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
A.1	**Depot Substation & HT works**				
	Sub Section - 1 - GENERAL				
1.1	The BOQ specified below include the latest relevant standards, specifications, drawing details and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval before use as the Employer's representative may opt.				
1.2	The description as mentioned in BOQ, Specifications, Special Conditions GCC, Drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.				
1.3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.				
1.4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.				
1.5	Bus Bar Sizing calculations shall be submitted for approval of Employer or his representative.				
A.1.1	**Sub Section - 2 - GIS.**				
	In compliance to technical specifications the three way 33kv-GIS shall be installed inside auxiliary substations. The ring main units shall be installed on a super-elevated base to permit the entry of 33kV cable at the bottom. 33 kV GIS shall be SF6 insulated, extensible, indoor type with protective relays. (33kv/ 1250amps/ 25kA-1sec/ GIS panel).	Set	4	6624394	26497575
	Total of Sub section 2 - GIS				**2,64,97,575**

(Attachment No-11 to Addendum No-5)
PART-A - Depot Substation & HT works

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
A.1.2	**Sub Section - 3 -Transformers**				
	Transformers (Indoor Dry type -33KV/433V)				
	Supply, installation, testing & commissioning of indoor type following rating AN type Transformer with copper winding, and +5 to -5% in steps of 2.5%, 33/0.433 KV, 3 phase, 50 Hz, Vector Group Dyn-11 having cable end box on HV side and busbar arrangement on L.T. side with all fittings and accessories, Winding Temperature Indicator, weather proof marshalling box etc. complete as per specifications. The transformer shall be designed for minimum losses. Maximum permitted Total Losses (Percent of Transformer's ONAN rating) shall not be more than 1%.				
	Note:- All instruments / Relays / CT / terminals / Contact wiring to be done up to Marshalling box. Installation shall be done by the contractor in the presence of engineer deputed by the supplier.				
	2000 KVA Transformer	Nos	4	23,61,126	**94,44,503**
	Total of Sub section-3 Transformers				**94,44,503**
A.1.3	**Sub Section - 4 -HT Cables**				
A.1.3.1	Supply of 33 KV, 1C per phase x 120 Sq. mm XLPE Copper cable Earthed armoured HT cable in cable trenches with cover complete as required.	Mtrs	6666	2,420	1,61,30,107
A.1.3.2	Laying of item under A.1.3 in trench, duct banks, etc.as required.	Mtrs	6666	484	32,26,021

(Attachment No-11 to Addendum No-5)
PART-A - Depot Substation & HT works

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
A.1.3.3	Supplying and making indoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for cables mentioned under A.1.3.1 complete and combined as required. Cable termination shall be inner cone plug in type in accordance with EN 50181.	Kit	54	3114	168145
A.1.3.4	Supplying, installation & commisioning of Single core straight though termination with heat shrinkable jointing kit complete with all accessories for cables mentioned under A.1.3.1 complete.	Kit	36	17079	614847
	Total of Sub section 4. HT Cables				**2,01,39,120**
A.1.4	**Sub Section-5 - DCDB with Battery Charger**				
A.1.4.1	1 set of 110V DC Battery and 2 Battery Charger consisting of Dual Float cum Boost Charger and Ni Cadmium battery (Minimum 120 AH) with backup time of 8 hours and DCDB (with 10 feeders minimum) as per “Technical Specification for 110V Battery, Battery Charger cum DCDB”,. The battery charger and battery will be located in ASS-1 & ASS-2 building.	Set	2	4,10,740	8,21,479
	Total of Sub section 5. HT Cables				**8,21,479**
	Total of Sub Section 2, 3, 4 & 5.				**5,69,02,677**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.1	The BOQ specified below include the latest relevent standards (unless otherwise specified), specifications, drawing details and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval before use as the Employer.				
1.2	The description as mentioned in this BOQ including details as metntioned in GCC, SCC, Employers Requirement General specifications & Technical specificatios , Drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.				
1.3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.				
1.4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.				
1.5	Bus Bar Sizing calculations shall be submitted for approval of Employer or his representative.				
1.6	Contractor's shall quote reasonable rates against each item of BOQ.				
1.7	Steel structure/pipe shall be earthed.				
E.01	**M V SWITCHGEAR**				
1	**General**				
	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty floor / wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with neoprene gaskets, fabricated from CRCA sheet steel of thickness not less than 2mm in general and load bearing members with 2.5mm and shall be folded and braced as necessary to provide a rigid support for all components with powder coated finish (minimum thickness 50 micron) suitable for 415 volts 3 phase 4 wire 50 Hz system to withstand symmetrical fault level of 50 kA for ASS - I & ASS - II at 415 V, including interconnections, bonding to earth etc. and flush doors conforming to relevant IEC/IS (viz. IEC 61439, IS 8623 etc.) standard including the earth leakage protection complete as per specification & drawings as required and as given below. All internal wiring in the panels shall be carried out using FRLS wires.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	The Switchboards shall be provided with detachable gland plates for entry of cables from the top/bottom as required.				
b)	All live accessible parts shall be shrouded and all equipment shall be finger touch proof. The busbars shall be insulated with heat shrinkable sleaves. SMC/DMC (Double Moulding Compound) shrouds and busbar supports suitably spaced shall be used. Hinged doors with padlocking facility shall be provided on all outgoing feeders with switch handles lockable in OFF position.				
c)	The panel shall have Copper busbars (phases, neutral & earth) with bar type feeder connections, spacers etc.and phases & neutral busbar shall be of 100% capacity and Earthing Busbar shall be 50% of Phase.				
d)	All accessories & supporting structures such as channels, ISMC base frame, mounting brackets, lifting lugs, panel heaters, ventilation arrangement etc as required.				
e)	Each incomer and outgoing feeder shall be provided with multiple LED/neon type status indication lamps suitable for 230 V AC as approved.				
f)	Overall Space provision shall be @ 25% for future expansion				
g)	The makes of components and accessories shall, to the extent practically feasible, be same for panels and boards for uniformity, standardisation and replaceability and shall be applicable to all panels/ boards under the scope of work				
h)	Switchboard including interconnections, labeling, earthing,associated foundation / masonary work & erection etc. complete as required.				
i)	All MCCBs shall be current limiting type microprocessor based, rated for requisite specified Service short circuit breaking capacity (Ics suitable for isolation conforming to latest IEC60947-2 duly marked on MCCB, at operating voltage (Ue) of 415 V, insulation voltage (Ui) 750 V and with trip free mechanism, handle indicating ON/OFF/tripped position. The breaking capacity as mentioned shall be Ics values.				
j)	MCCBs shall be compact (As the Engineer may decide), suitably designed to provide protection of motors, cables, busbars to suit rated current, unbalanced power distribution as required and with front adjustable overload and short circuit releases and minimum electrical endurance of the order of 7000-8000 operation cycles (higher shall be preferred) for capacity of 100-250 amps..				
k)	All the MCCBs shall be provided with potential free contacts for connectivity to PLC for ON/OFF status and control, as required.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
l)	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 9/10 kA at 415 V AC, current limiting type, lower power loss approx 40 -70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for motor application duty, with minimum Electrical endurance of the order of 20000 operation cycles.				
m)	Panel/board design shall be compact and components / accessories of compact sizes are used to economise the room space available. Employer reserve the right to seek compact items in place of larger ones				
n)	All incomer ACB's shall be provided with minimum 2 NO + 2 NC auxiliary contacts and all MCCBs shall be provided with 2 NO+ 2NC auxiliary contacts, and there should be provision to add min. 6 Auxiliary contacts.				
o)	All 4-pole ACBs shall have fully rated neutral pole. All 4-pole ACBs & MCCBs shall be provided earth fault protection.				
p)	The panel shall be fitted with fire trace tube system. Scheme of fire trace tube system shall be got approved by Engineer before proceeding with manufacturing and assembly.				
q)	All internal wiring to be FRLS				
r)	Various panels/boards as given below:				
1	**MAIN DISTRIBUTION BOARD (MDB) @ ASS-2**	No	1	55,42,544	**55,42,544**
A.	**INCOMER - TRANSFORMER - 1**				
	3200 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 50 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 0.5 with MFM with Voltage, Current, Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCBs				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
iv	1- set Red/Green ON/OFF indicating lamps				
v	1- set of three phase (red, yellow, blue) indicating lamps				
vi	Amber healthy/ trip indicating lamps				
vii	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden & Class 5P10 for protection.				
viii	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x	Terminals to receive copper sandwich bus duct				
xi	TNC Switch				
xii	Auto/local/remote selector switch key operated				
B	**BUSBAR**				
a)	Electro-tin plated, hard drawn, high conductivity, 99% Copper bars three phase and neutral busbars rated at 3200 A having a maximum current density as as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA for 1 sec. at 415 V. The neutral busbar is to be of same size as phases. A ground bus, 50% size of phase bus, shall be provided along the entire length of the panel.				
C	**OUTGOING**				
a)	3 Nos. 1000 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps.				
ii	3 nos. cast resin current transformers of 1000/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
iii	TNC Switch.				
iv	Auto/local/remote selector switch key operated.				
b)	3 nos. 630 Amps, , 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
c)	1 no. 250 Amps, , 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
d)	1 nos. 63 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**BUS COUPLER**				
a)	3200 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage with adjustable setting with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps				
ii	1- set of three phase (red, yellow, blue) indicating lamps				
iii	Amber /healthy trip indicating lamps				
iv	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
v.	TNC Switch.				
vi.	Auto/local/remote selector switch key operated.				
E.	**INTERLOCKING**				
	Two incomers & one Bus Coupler shall be interlocked electrically & mechanically so that only two out of three shall be switched on at a time.				
F.	**INCOMER - TRANSFORMER - 2**				
	3200 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 50 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting and with the following accessories :				
i.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
ii.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCBs.				
iv	1- set Red/Green ON/OFF indicating lamps				
v	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/trip indicating lamps.				
vii	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 5P10 for protection.				
viii	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x.	Terminals to receive copper sandwich bus duct				
xi.	TNC Switch				
xii	Auto/local/remote selector switch key operated				
G	**BUSBAR**				
	Electrolytic high conductivity Copper three phase and neutral busbars rated at 3200 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA at 415 V. The neutral busbar is to be of same size as phases.				
H	**OUTGOING**				
a)	3 Nos. 1000 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps				
ii	3 nos. cast resin current transformers of 1000/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	TNC Switch				
iv	Auto/local/remote selector switch key operated				
b)	1 no. 630 Amp, 415V, Ics=50 kA , TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
c)	2 nos. 400 Amp, 415V, Ics= 50 kA , TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
d)	2 nos. 250 Amp,, 415V, Ics= 50 kA , TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
I	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
2	**EMERGENCY POWER PANEL(EPP) @ ASS-2**	No	1	24,52,274	**24,52,274**
A	**INCOMER - 1**				
	1 no. 630 Amps, 415V, Ics=50kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 630/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
iv	1- set Red/Green ON/OFF indicating lamps.				
v	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B.	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 630 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to withstand symmetrical fault level of 50kA at 415 V. The neutral busbar is to be of same size as phases.				
C.	**OUTGOING**				
a)	2 nos. 250 Amp, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	2 nos. 160 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	1no. 100 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	1 no.40 Amp, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D.	**BUSCOUPLER**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	1 no. 630 Amps, 415V, Ics=50kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i	3 nos. cast resin current transformers of 630/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
ii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iii.	1- set Red/Green ON/OFF indicating lamps.				
iv	1- set of three phase (red, yellow, blue) indicating lamps.				
v	Amber healthy/ trip indicating lamps.				
E.	**INTERLOCKING**				
a)	Three incomers & one Bus Coupler shall be interlocked electrically & mechanically so that only two out of three shall be switched on at a time and only one out of three in DG case.				
F.	**INCOMER - 2**				
	1 no. 630 Amps, 415V, Ics=50kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 630/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv	1- set Red/Green ON/OFF indicating lamps.				
v	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
G.	**INCOMER - 3 for DG Supply**				
	1 no. 630 Amps, 415V, Ics=50kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
ii.	3 nos. cast resin current transformers of 630/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv	1- set Red/Green ON/OFF indicating lamps.				
v	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
H.	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 630 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to withstand symmetrical fault level of 50kA at 415 V. The neutral busbar is to be of same size as phases.				
I.	**OUTGOING**				
a)	2 nos. 160 Amp, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	2 nos. 100 Amp, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	2 nos. 63 Amp, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
J	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3	**Maintenance inspection & workshop Control store**				
3.1	**MDB-1 (Maintenance inspection & workshop Control store)**	No	1	885936	**8,85,936**
A	**INCOMER**				
a)	1 Nos. 1000 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50KA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i.	3 nos. cast resin current transformers of 1000/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	1- set Red/Green ON/OFF indicating lamps				
iii.	3 nos. cast resin current transformers of 1000/5 with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
iv.	TNC Switch				
v.	Auto/Local/Remote Selector Switch Key operated				
vi.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
vii.	1- set of three phase (red, yellow, blue) indicating lamps.				
viii	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 1000 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	4 nos. 250 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	1no. 125 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 125/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	9 nos. 100 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	2 nos. 63 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
3.2	**MDB-2 (Maintenance inspection & workshop Control store)**	No	1	1496145	**14,96,145**
A	**INCOMER**				
a)	1 Nos. 1000 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50KA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i.	3 nos. cast resin current transformers of 1000/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
ii.	1- set Red/Green ON/OFF indicating lamps				
iii.	3 nos. cast resin current transformers of 1000/5 with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
iv.	TNC Switch				
v.	Auto/Local/Remote Selector Switch Key operated				
vi.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
vii.	1- set of three phase (red, yellow, blue) indicating lamps.				
viii	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 1000 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	2 nos. 630 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	2 nos. 160 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	11 nos. 100 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	3 nos. 40 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
e)	1 nos. 32 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
f)	2 nos. 32 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
3.3	**SDB-1 -POWER**	No	1	726455	**7,26,455**
A	**INCOMER**				
	1 no. 630 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 630/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 630 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	2 nos. 320 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 320/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	1 nos. 250 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	4 nos. 200 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	2 nos. 160 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	6 nos. 63 Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3.4	**SDB-2 - LIGHTING**	No	1	540906	**5,40,906**
A	**INCOMER**				
	1 no. 250 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 250/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 250 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	19 nos. 32 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	2 nos. 40 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
3.5	**VAC PANEL**	No	1	540906	**5,40,906**
A	**INCOMER**				
	1 no. 250 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 250/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 250 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	7 nos. 25 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 25/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	8 nos. 32 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	4 nos. 40 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	2 nos. 63 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
3.6	**EPP - (Maintenance inspection & workshop Control store)**	No	1	333308	**3,33,308**
A	**INCOMER**				
	1 no. 250 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 250/5A ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 250/5A ratio 15 VA burden with Ammeter and Ammeter Selector Switch				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 250 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	4 nos. 100 Amp, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	3 nos.63 Amp, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	3 nos. 40 Amp, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	1 nos. 32 Amp, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
e)	1 nos. 25 Amp, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 25/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
3.7	**ESDB - LIGHTING (Maintenance inspection & workshop Control store)**	No	1	507587	**5,07,587**
A	**INCOMER**				
	1 no. 100 Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 100/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 100 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 25 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	13 nos. 32 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
4	**UNDER FLOOR WHEEL LATHE BUILDING**				
4.1	**MDB (UNDER FLOOR WHEEL LATHE BUILDING)**	No	1	558811	**5,58,811**
A	**INCOMER**				
	1 no. 630 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 630/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 630 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	2 nos. 400 Amp, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	3 nos. 63 Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	2 nos. 40 Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	5 nos. 32 Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
4.2	**EPP (UNDER FLOOR WHEEL LATHE BUILDING)**	No	1	268880	**2,68,880**
A	**INCOMER**				
	1 no. 100 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 100/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 100 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	3 nos. 63 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	2 nos.40 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	2 nos.32 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	2 nos.25 Amp, 415V, Ics=25kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 25/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
5	**AUTO WASH PLANT**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
5.1	**MDB (AUTO WASH PLANT)**	No	1	231221	**2,31,221**
A	**INCOMER**				
	1 no. 250 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii	3 nos. cast resin current transformers of 250/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy /trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 250 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	2 nos. 250 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	2 nos.32 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	2 nos.25 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 25/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
6	**UPS PANEL @ ASS-2**	No	1	220155	**2,20,155**
A	**INCOMER**				
	1 no. 100 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
i.	3 nos. cast resin current transformers of 250/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
ii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iii.	1- set Red/Green ON/OFF indicating lamps.				
iv.	1- set of three phase (red, yellow, blue) indicating lamps.				
v.	Amber healthy /trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 100 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	2 nos. 63 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	2 nos.40 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	3 nos.32 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
7	**FIRE PUMP PANEL - FPP**	No	1	467441	**4,67,441**
A	**Incomer -1 - from ASS -1 LT Panel**				
	1 no. 400 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
vi.	Amber healthy/ trip indicating lamps.				
vii	Auto / Manual selector switch				
viii.	3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 5P10 for protection				
ix.	230 V AC shunt trip coil				
x	230 V, AC Motor wound spring closing mechanism				
xi	Terminals to receive **fire survival** cables.				
B	**Incomer - 2 - from ASS -2 LT Panel**				
	1 no. 400 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi.	Amber healthy /trip indicating lamps.				
vii	Auto / Manual selector switch				
viii.	3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 5P10 for protection				
ix.	230 V AC shunt trip coil				
x	230 V, AC Motor wound spring closing mechanism				
xi	Terminals to receive **fire survival** cables.				
C	**Incomer - 3 - from DG Panel**				
	1 no. 400 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi.	Amber healthy/ trip indicating lamps.				
vii.	Auto / Manual selector switch				
viii.	3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 5P10 for protection				
ix.	230 V AC shunt trip coil				
x	230 V, AC Motor wound spring closing mechanism				
xi	Terminals to receive **fire survival** cables.				
	Incomer shall have electrical and mechanical interlocking through base plate for fail safe operation to ensure that 2 MCCB's shall not be ON simultaneously.				
D	**BUSBAR**				
i	Electrolytic high conductivity Copper three phase and neutral busbars rated at 400 A having a maximum current density per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA at 415 V. The neutral busbar is to be of same size as phases.				
E	**OUTGOING**				
i	**Main Fire pump: 4 Nos**				
	4 x 160A TP MCCB 35 KA with 60 kW fully automatic star/delta starter with over load protection, current sensing type single phase preventer complete with all accessories. and internal wiring required for automatic operation, and following points (One outgoing set shall be for each main Fire pump and for 4 main fire pumps, the outgoing shall have 4 identical sets). (2 working & 2 Standby)				
	1- set Trip, ON & Run indicating lamps.				
	Start, Stop push button				
	Auto / Manual selector switch				
	3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
ii	**Jockey pump: 2 Nos**				
	2 x 32A TP MCCB 35 KA with 5.0 kW fully automatic star/delta starter with over load protection, current sensing type single phase preventer complete with all accessories and internal wiring required for below points				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	1- set Trip, ON & Run indicating lamps.				
	Start, Stop push button				
	Auto / Manual selector switch				
	3 nos. cast resin current transformers of 32/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
	The panel shall be complete in all respects as per specification having incomer and outgoing for operating 4 nos main fire pumps and 2 no jockey pump and rate of all the items are included in this.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
F	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
8.0	**FEEDER PILLAR - EXTERNAL LIGHTING**				
8.1	**FEEDER PILLAR - EXTERNAL LIGHTING - HIGH MAST (OUTDOOR TYPE IP-65 WITH STAINLESS STEEL OUTER ENCLOSURE AS PER SPECIFICATIONS)**	SET	4	264419	**10,57,677**
A	**INCOMER**				
	1 no.63 A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases				
	1 Set of (0-500 volts) digital voltmeter with selector switch with MCB's, and one set of Digital Ammeter with 3 nos. 63/5 Amps, 15 VA, CT				
	1 Nos. 0-24 Hrs double dial timer				
	3 Nos. Auto / manual selector switch				
	6 Nos. 16 A TPN contactor with necessary NO& NC auxilliary contacts of 2 Sets.				
	1 Job control flexible cabling from contactor to Timer				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
B	**BUSBAR**				
	63 amps TPN Copper bus bars with heat shrinkable insulation sleeve.				
C	**OUTGOING**				
	16 amps TP+N MCBs 5 Nos				
	25 amps TP+N MCBs 4 Nos				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
9.0	**APFC PANEL**				
9.1	**400 KVAR APFC PANEL @ ASS-2**	SET	2	1195292	**23,90,584**
A	**INCOMER**				
	1 No. 1000 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
	1- set Red/Green/Amber -ON/OFF/Alarm indicating lamps				
	1- set of three phase (red, yellow, blue) indicating lamps				
	1 Set of (0-500 volts) digital voltmeter with selector switch with MCB's, and one set of Digital Ammeter with 3 nos. 1000/5 Amps, 15 VA, CT				
	TNC Switch.				
	Auto/local/remote selector switch key operated.				
	1 set of suitable rating of Current Transformer for incomer in main panel for APFCR relay				
	1- set of three phase (red, yellow, blue) indicating lamps.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	1 Set - Automatic microprocessor based digital type power factor compensating relay (including power factor meter) in 14 steps for automatic cut off or add on capacitor units to keep the power factor at 0.95 with variation of loads. All associated auxiliary contactors/relays to be provided. Visual alarms, to display shortfall of P.T., automatic lockout of faulty Step, over temperature protrections. Auto manual selection and indications.				
B	**BUSBAR**				
	Electrolytic high conductivity Copper three phase and neutral busbars rated at 1000 A having a maximum current density of 1.4 A per sq mm with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA at 415 V.The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
	Outgoing feeders consisting of following accessories.				
	1 nos. 250 amps, 35kA TP MCCB with backup fuses of suitable capacity				
	4 nos. 160 amps, 35kA TP MCCB with backup fuses of suitable capacity				
	4 nos.80 amps, 35kA TP MCCB with backup fuses of suitable capacity				
	1 nos. 250 amps 415 volts 50Hz heavy duty contactors				
	4 nos.160 amps 415 volts 50Hz heavy duty contactors				
	4 nos. 80 amps 415 volts 50Hz heavy duty contactors				
	11 nos “ON” /”OFF” push buttons and indicating lamps				
	1 nos. 250 amps rating TP terminal blocks				
	4 nos. 160 amps rating TP terminal blocks				
	4 nos. 80 amps rating TP terminal blocks				
	1 nos. 100 KVAR capacitor units in bank form				
	4 nos. 50 KVAR capacitor units in bank form				
	4 nos. 25 KVAR capacitor units in bank form				
	The switchboard shall be complete with all interbconnections, risers, internal wiring, labels etc complete as required.				
10	**Other Accessories**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
10.1	**Safety equipments in Aux. Substation/MDB room**	Set	1	250329	**2,50,329**
	Supply and fixing of the following safety equipments in Aux. Sub. Station /MDB room as per detailed descriptions given below and as per relevant IE rules & code of standard practice:-				
a)	1000 mm wide Insulating mat,confirming to IS 15652-2006 suitable to withstand LT & HT Panel Requirements in front of all panels in ASS building.				
b)	Laminated standard shock treatment charts in English & Hindi in ASS, DG room and Pump room.				
c)	Danger plate as per approved Style & sample written in English & Hindi for MV installations as required as per IE rules, IES and IS 2551 (latest) - 10 nos.				
d)	10 nos. First Aid Box Complete as approved by St. John ambulance or Indian Red Cross				
e)	Fire Buckets (Quantity will be in fire fighting BOQ)				
f)	Two Tool kit comprising 1 set of flat spanner (Taparia / Jalan), 1 set of box spanner, 1 no. Hacksaw frame with 10 No. blades, 1 no. large, medium, small screw drivers, 1 no. insulated plier, 1 no nose plier, 1 no. hand crimping tool upto 16 sqmm, 1 no. digital multimeter, 1 no. test lamp and 1 no. tester. Screw driver set for all types of screw heads also to be provided.				
11	**Adjustment Rate for Addition/Deletion**				
	Adjustment rates for addition/deletion of compartmentalised switchgear in above panels/boards of following rating including the supply, fabrication, extension, modification of the enclosure or in a separate enclosure, earthing, basbar, other sub-systems, accessories etc complete as required and as per specifications.				
11.1	**3200 Amps, 415 V, 50 kA, 4 Pole, ACB**	No	1	607289	**6,07,289**
	3200 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 65 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 0.5 with MFM with Voltage, Current, Energy, Power Factor, KVAr, with communication port RS485 etc.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
ii.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCBs				
iv	1- set Red/Green ON/OFF indicating lamps				
v	1- set of three phase (red, yellow, blue) indicating lamps				
vi	Amber healthy/ trip indicating lamps				
vii	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden & Class 5P10 for protection.				
viii	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x	Terminals to receive copper sandwich bus duct				
xi	TNC Switch				
xii	Auto/local/remote selector switch key operated				
11.2	**2000 Amps, 415 V, 50 kA, 4 Pole, ACB**	No	1	448678	**4,48,678**
	2000 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 65 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 2000/5 ratio with 15 VA Burden and Class 0.5 with MFM with Voltage, Current, Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 2000/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCBs				
iv	1- set Red/Green ON/OFF indicating lamps				
v	1- set of three phase (red, yellow, blue) indicating lamps				
vi	Amber healthy/ trip indicating lamps				
vii	3 nos. cast resin current transformers of 2000/5 ratio with 15 VA Burden & Class 5P10 for protection.				
viii	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x	Terminals to receive copper sandwich bus duct				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
xi	TNC Switch				
xii	Auto/local/remote selector switch key operated				
11.3	**1600 Amps, 415 V, 50 kA, 4 Pole, ACB**	No	1	393192	**3,93,192**
	1600 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 50 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 1600/5 ratio with 15 VA Burden and Class 0.5 with MFM with Voltage, Current, Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 1600/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCBs				
iv	1- set Red/Green ON/OFF indicating lamps				
v	1- set of three phase (red, yellow, blue) indicating lamps				
vi	Amber healthy/ trip indicating lamps				
vii	3 nos. cast resin current transformers of 1600/5 ratio with 15 VA Burden & Class 5P10 for protection.				
viii	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x	Terminals to receive copper sandwich bus duct				
xi	TNC Switch				
xii	Auto/local/remote selector switch key operated				
11.4	**1 no. 1250 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:**	No.	1	3,58,090	3,58,090
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase (red, yellow, blue) indicating lamps				
c)	Amber healthy trip indicating lamps				
d)	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden & Class 5P10 for protection.				
e)	3 nos. cast resin current transformers of 1250/5 ratio with 15VA burden and Class 1.0 for measurement				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
f)	Microprocessor based release having variable range of overcurrent, short circuit,UVR and earth fault protection with time log facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.				
g)	230 V AC shunt trip coil				
h)	230 V, AC Motor wound spring closing mechanism				
i)	Terminals to receive alum. XLPE armoured cables				
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol				
11.5	**1 no. 1000 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:**	No.	1	3,31,136	3,31,136
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase (red, yellow, blue) indicating lamps				
c)	Amber healthy trip indicating lamps				
d)	3 nos. cast resin current transformers of 1000/5 ratio with 15 VA Burden & Class 5P10 for protection				
e)	3 nos. cast resin current transformers of 1000/5 ratio with 15VA burden and Class 1.0 for measurement				
f)	Microprocessor based release having variable range of overcurrent, short circuit,UVR and earth fault protection with time log facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.				
g)	230 V AC shunt trip coil				
h)	230 V, AC Motor wound spring closing mechanism				
i)	Terminals to receive alum. XLPE armoured cables				
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol				
11.6	**1 no. 800 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:**	No.	1	3,11,682	3,11,682
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase (red, yellow, blue) indicating lamps				
c)	Amber healthy trip indicating lamps				
d)	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden & Class 5P10 for protection.				
e)	3 nos. cast resin current transformers of 800/5 ratio with 15VA burden and Class 1.0 for measurement				
f)	Microprocessor based release having variable range of overcurrent, short circuit,UVR and earth fault protection with time log facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.				
g)	230 V AC shunt trip coil				
h)	230 V, AC Motor wound spring closing mechanism				
i)	Terminals to receive alum. XLPE armoured cables				
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
11.7	630 A, 415V, Ics=65 kA, 4P, MCCB with variable overcurrent and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue).	No	1	75068	**75,068**
11.8	630 A, 415V, Ics=50 kA, 4P, MCCB with variable overcurrent and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue).	No	1	70501	**70,501**
11.9	400/320 Amps, 415V, Ics=35 KA, 4P, MCCB with variable overcurrent and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue).	No	1	57042	**57,042**
11.10	400/320 Amps, 415V, Ics=25 KA, 4P, MCCB with variable overcurrent and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue).	No	1	57042	**57,042**
11.12	250/200 Amps, 415V, Ics=50 kA, 4P, MCCB with variable overcurrent and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue).	No	1	44607	**44,607**
11.13	250/200 Amps, 415V, Ics=35 kA, 4P, MCCB with variable overcurrent and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue).	No	1	44607	**44,607**
11.14	160/125 Amps, 415V, Ics=35 or 25 kA, TPN, MCCB with variable overcurrent and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps.	No	1	29345	**29,345**
11.15	100/63 Amps, 415V,Ics=35 or 25 kA, FP, MCCB with variable overcurrent and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps.	No	1	27487	**27,487**
11.16	100/63 Amps, 415V, ,Ics=35 or 25 kA, TPN, MCCB with variable overcurrent and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps.	No	1	24870	**24,870**
11.17	Less than 63 Amps to 25 Amps, 415V, Ics=25 kA, TPN, MCCB with variable overcurrent and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps.	No	1	23855	**23,855**
11.18	5-32 Amps, 4P, MCB, 9/10 kA	No	1	3459	**3,459**
11.19	40-63 Amps, 4P, MCB, 9/10 kA	No	1	4067	**4,067**
11.20	5-32 Amps, TP, MCB 9/10 kA	No	1	3215	**3,215**
11.21	40-63 Amps, TP, MCB, 9/10 kA	No	1	3797	**3,797**
11.22	5-32 Amps, DP, MCB, 9/10 kA	No	1	1691	**1,691**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
11.23	40-63 Amps, DP, MCB, 9/10 kA	No	1	2051	**2,051**
11.24	5-32 Amps, SP, MCB, 9/10 kA	No	1	778	**778**
11.25	40-63 Amps, SP, MCB, 9/10 kA	No	1	1032	**1,032**
11.26	16-32 Amps, DP, RCCB, 30 mA	No	1	2998	**2,998**
11.27	16-32 Amps, DP, RCBO, 30 mA	No	1	3430	**3,430**
11.28	16-32 Amps, TP, RCBO, 30 mA	No	1	5505	**5,505**
11.29	Multiple LED/neon type indications	No	1	1373	**1,373**
11.30	Timer (ASTRO)	No	1	3449	**3,449**
11.31	Timer (Manual operated)	No	1	1216	**1,216**
11.32	Ammeter/Voltmeter (3.5 digit display)	No	1	3659	**3,659**
11.33	TP Contractors - 40/32 Amps	No	1	4018	**4,018**
11.34	Aux. Contact 1 NO + 1NC for MCB	No	1	932	**932**
11.35	**32-63 Amps, TPN, MCCB (25/35 kA)**	No	1	22815	**22,815**
	Supply, installation, testing and commissioning of 32-63 Amps, TPN, MCCB (25/35 kA) in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection with RYB indicating lamps at incoming with trip indications.				
11.36	**100 Amps, TPN, MCCB (25/35 kA)**	No	1	24385	**24,385**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supply, installation, testing and commissioning of 100 A, TPN, MCCB (25/35 kA) in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection of suitable size with RYB indicating lamps at incoming with trip indications.				
11.37	**125/160 Amps, TPN, MCCB (35 kA)**	No	1	38434	**38,434**
	Supply, installation, testing and commissioning of 125 A, TPN, MCCB (35 kA) in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection of suitable size with RYB indicating lamps at incoming with trip indications.				
11.38	**200 Amps, TPN, MCCB (35/50 KA)**	No	1	42842	**42,842**
	Supply, installation, testing and commissioning of 200 A, TPN, MCCB (35/50 KA) in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection of suitable size with RYB indicating lamps at incoming with trip indications.				
11.39	**250 Amps, TPN, MCCB (35/50 KA)**	No	1	44253	**44,253**
	Supply, installation, testing and commissioning of 250 A, TPN, MCCB (35/50 KA) in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection of suitable size with RYB indicating lamps at incoming with trip indications.				
11.40	**400 Amps, TPN, MCCB (35/50 KA)**	No	1	51842	**51,842**
	Supply, installation, testing and commissioning of 400 A, TPN, MCCB (35/50 KA) in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection of suitable size with RYB indicating lamps at incoming with trip indications.				
11.41	**32 Amps, TPN, MCB (10 KA)**	No	1	3518	**3,518**
	Supply installation, testing and commissioning of 32 A, TPN, MCB (10 KA) in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection complete as required.				
11.42	**63 Amps, TPN, MCB (10 KA)**	No	1	4632	**4,632**
	Supply installation, testing and commissioning of 63 A, TPN, MCB (10 KA) in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection complete as required.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	TOTAL FOR E.01 (M V SWITCHGEAR)				**2,16,55,046**
E.02	**DISTRIBUTION BOARDS**				
	General				
	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty dead front wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with foamed-in neoprene gasketted hinged doors, fabricated from 2 mm thick CRCA with powder coated finish suitable for 415 V, 3-phase, 4 wire, 50 Hz system including suitably rated insulated copper busbars, interconnections, neutral bus bar assembly, phase segregating barriers, LED indicating lamps for incoming feeders,15% spare space for future expansion, knockouts and gland plates for entry of cables and conduits, all internal wiring using high temperature range as per IS 694 FRLS PVC wires, independant terminals for each phase, earthing terminals and including the cost of providing Master key lock on the door and pad locking facility on door as well as at incomer, bonding to earth etc. complete as per specification, drawings as required and as under:				
a)	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 9/10 kA at 415 V AC, current limiting type lower powerloss approx 40 -70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for motor application duty, with minimum Electrical endurance of the order of 20000 operation cycles.				
b)	Residual current circuit breaker (RCCB) conforming to IS 12640 shall be provided with 30 mA sensitivity and electrically connected rated current capacity MCB for short circuit and over load protection as required				
c)	The LDBs may be required to accommodate Dimming Control equipment mountable on DIN rail. Contractor should refer to relevant specifications and drawings in this regard and submit his scheme for approval by Engineer in Charge.				
d)	All the contactors shall be provided with potential free contacts for remote monitoring and control.				
e)	Various distribution boards as given below:				
1	**Lighting distribution boards (LDB) Type-1**	No.	8	15969	**1,27,750**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	1 no. 25 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-25 amp DP 30 mA RCBO incoming and 4 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
2	**Lighting distribution boards (LDB) Type-2**	No.	2	15969	**31,937**
	1 no. 32 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-32 amp DP 30 mA RCBO incoming and 4 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
3	**Lighting distribution boards (LDB) Type-3**	No.	6	19907	**1,19,443**
	1 no. 25 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-25 amp DP 30 mA RCBO incoming and 6 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
4	**Lighting distribution boards (LDB) Type-4**	No.	5	19907	**99,536**
	1no. 32 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-32 amp DP 30 mA RCBO incoming and 6 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
5	**Lighting distribution boards (LDB) Type-5**	No.	16	21464	**3,43,424**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	1 no. 32 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-32 amp DP 30 mA RCBO incoming and 8 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
6	**Lighting distribution boards (LDB) Type-6**	No.	6	21464	**1,28,784**
	1no. 25 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-25 amp DP 30 mA RCBO incoming and 8 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
7	**Lighting distribution boards (LDB) Type-7**	No.	8	24578	**1,96,621**
	1 no. 32 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-32 amp DP 30 mA RCBO incoming and 12 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
8	**Power distribution boards (PDB) Type-8**	No.	2	15969	**31,937**
	1 no. 32 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-25 amp DP 30 mA RCBO incoming and 4 nos 16 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
9	**Power distribution boards (PDB) Type-9**	No.	2	21464	**42,928**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	1 no. 32 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-32 amp DP 30 mA RCBO incoming and 8 nos 16 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
10	**Power distribution boards (PDB) Type-10**	No.	6	23004	**1,38,026**
	1 no. 63 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 63 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-63 amp DP 30 mA RCBO incoming and 8 nos 16 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
11	**VTPN Power distribution boards (LPDB) Type-11**	No.	2	315896	**6,31,791**
	1 no. 320 Amps, 4P, 25 kA, MCCB with thermal magnetic protective releases incoming with 4 pole 320 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 12nos 32A TP MCB with thermal magnetic protective releases out goings with neutral link				
12	**VTPN Power distribution boards (LPDB) Type-12**	No.	2	246793	**4,93,587**
	1 no. 250Amps, 4P, 25 kA, MCCB with thermal magnetic protective releases incoming with 4 pole 250amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 32A TP MCB-12 Nos with thermal magnetic protective releases out goings with neutral link				
13	**VTPN Power distribution boards (LPDB) Type-13**	No.	4	197435	**7,89,739**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	1 no. 200Amps, 4P, 25 kA, MCCB with thermal magnetic protective releases incoming with 4 pole 200amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 32A TP MCB-12 Nos with thermal magnetic protective releases out goings with neutral link				
14	**VTPN Power distribution boards (LPDB) Type-14**	No.	2	148076	**2,96,152**
	1 no. 160Amps, 4P, 25 kA, MCCB with thermal magnetic protective releases incoming with 4 pole 160 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 32A TP MCB - 12 Nos with thermal magnetic protective releases out goings with neutral link				
15	**VTPN Emergency Power distribution boards (LPDB) Type-15**	No.	2	98717	**1,97,435**
	1 no. 100Amps, 4P, 25 kA, MCCB with thermal magnetic protective releases incoming with 4 pole 100amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 4 nos 32A TP MCB with thermal magnetic protective releases out goings with neutral link				
	TOTAL FOR E.02 (DISTRIBUTION BOARDS)				**36,69,090**
E.03	**DISTRIBUTION CABLES**				
	General				
	The Cable and Cable Containment System specified herein, must confirm to technical Specifications, in addition to the description given in respective items of BOQ , whether explicity specified or not. In case of contradiction between specifications and description in BOQ, the most stringent of the condition will apply				
	"All the items / parts mentioned in relevent clauses of the technical specifications and not specifically mentioned in BOQ shall be deemed to be included in the quoted rates, unless specifically excluded."				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	The cable runs shall be measured upto the outer end of the boxes without any allowances for over lap in joints. The rate shall include all the above mentioned material, labour, etc. for laying as required.				
	It may be noted that the Contractor will be required to carry out cable sizing based on actual cable lengths, as per working Drawings developed by him and after incorporating any changes in load requirements from the tendering stage. Optimization must be carried out during cable sizing to reduce the cable requirement and size. Further, Contractor must obtain Engineer's approval on the Cable Sizing Calculation.				
1	**Cable Supply and Laying (FRLS)**				
	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured, FRLS, XLPE, aluminium (AL) / Copper (CU) conductor cables on existing trays / walls/ columns/ indoor including the cost of supply and fixing, crimping lugs, double compression and weather proof brass glands, Earthing lugs and shrouds, supports with suitable clamps, saddles, hooks, bolts etc. & in ground/ trenches including the cost of proper dressing of cables, markers providing identification tags, sand filling etc. (cost of excavation, sand & bricks, included here) earthing of glands armouring etc. complete as per specifications as required and as below.				
	Note 1: All cables 25 sqmm and above are AL conductors unless specified otherwise.				
1.1	4 core 400 sq mm AL conductor cable	M	4,015	1409	**56,57,543**
1.2	4 core 300 sq mm AL conductor cable	M	2,888	1130	**32,63,302**
1.3	4 core 240-sqmm AL conductor cable	M	894	929	**8,30,721**
1.4	4 core 185-sqmm AL conductor cable	M	598	744	**4,45,151**
1.5	4 core 150-sqmm AL conductor cable	M	309	615	**1,90,340**
1.6	4 core 120-sqmm AL conductor cable	M	1,086	531	**5,77,282**
1.7	4 core 95 sq mm AL. Conductor cable	M	1,265	475	**6,01,145**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.8	4 core 70-sqmm AL conductor cable	M	1,437	350	**5,02,215**
1.9	4 core 50 sq mm AL. Conductor cable	M	1,121	278	**3,11,367**
1.10	4 core 35 sq mm AL Conductor cable	M	1,100	246	**2,70,464**
1.11	4 core 25 sq mm AL Conductor cable	M	1,100	207	**2,28,014**
1.12	4 core 16 sq mm CU Conductor cable	M	2,167	528	**11,44,474**
1.13	4 core 10 sq mm CU Conductor cable	M	1,760	372	**6,53,964**
1.14	4 core 6 sq mm CU conductor cable	M	10,095	267	**26,93,667**
1.15	4 core 4 sq mm CU conductor cable	M	963	204	**1,96,329**
1.16	3 core 4 sq mm CU conductor cable	M	1,375	264	**3,62,336**
1.17	3 core 6 sq mm CU conductor cable	M	550	169	**92,782**
1.18	3 core 2.5 sq mm CU conductor cable	M	3,438	127	**4,35,865**
2	**Cable Supply and Laying (Fire Survival)**				
	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured, **FIRE SURVIVAL CABLE, XLPE, Copper (CU)** conductor cables on existing trays / walls/columns/ indoor including the cost of supports with suitable clamps, saddles, hooks, bolts etc. & in ground/ trenches including the cost of supply and fixing, crimping lugs, double compression weather proof flame proof brass glands, Earthing lugs and shrouds, proper dressing of cables, markers providing identification tags, sand filling etc. (cost of excavation, sand & bricks, included here) earthing of glands armouring etc. complete as per specifications as required and as below.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	FIRE SURVIVAL cables are manufactured and tested in accordence with BS 7846, IS 7098 (Part-1), IEC 69331 and BS 6387 for required temperatures and duration based on the application and site conditions.				
i	4 core 35 sq mm Cu. Conductor cable	M	275	4482	12,32,550
ii	4 core 10 sq mm CU Conductor cable	M	344	410	1,41,097
iii	4 core 6 sq mm CU conductor cable	M	138	289	39,700
3	**Cable Trays & Racewayas**				
	"Supply, fabrication & installation of perforated hot dipped galvanised double bended cable trays from 2 mm thick GI sheets continuously connected including horizontal and vertical bends, reducers, tees, and other accessories and duly suspended from the ceiling with 12 mm dia vertical GI rods supported by 40mm x 40 mm 5 mm GI angle etc. (or installed on wall supported on suitable brackets as required) complete as per specifications, as required and as below."				
	Note: Trays shall be supported adequately at minimum 1 m distance from the building structure / ceiling by means of galvanized (as specified) MS structural members secured to the structure by dash fasteners or by grouting. This support should be capable of withstanding the weight equivalent of 3m length of the cables that can be laid in the trays. At turns the support has to be double and at both ends of the bend.				
3.1	**Cable Trays - For E&M, Systemwide contractors**				
3.1.1	900 mm wide x 50 mm deep cable tray	M	220	2028	**4,46,083**
3.1.2	600 mm wide x 50 mm deep cable tray	M	2,200	1419	**31,21,854**
3.1.3	300 mm wide x 50 mm deep cable tray	M	2,750	848	**23,31,688**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3.1.4	150 mm wide x 50mm deep cable tray	M	2,750	572	**15,73,662**
4	**Raceways in floor**				
	Supply, installation and testing of sheet steel raceways in floor, fabricated from 2.0 mm thick GI with minimum coating thickness 260 gm / sqm on both sides with removable cover plate complete with counter sunk cadmium plated brass screws, bends, tee-junctions, cross junction etc. rendered electrically continuous as approved and of following sizes. Necessary repair of floor shall be done after completion of work.				
4.1	200 mm wide & 50 mm deep Raceway	M	440	912	**4,01,208**
4.2	150 mm wide & 50 mm deep Raceway	M	440	796	**3,50,269**
5	**Ladder type cable trays**				
	Supply and fixing pre-galvanized factory fabricated GI ladder type cable trays, with radial bends, supports of the following sizes as per specifications.				
5.1	1000 mm wide Runners 25 x 100 x 25 x 3 mm Rungs 20 x 40 x 20 x 3 mm 250 mm Centre to Centre (C/C) Suspenders 50 x 50 x 5 mm angle 1500 mm Centre to Centre (C/C)	M	110	1799	**1,97,936**
5.2	750 mm wide Runners 20 x 75 x 20 x 2.5 mm Rungs 20 x 30 x 20 x 2.5 mm 250 mm Centre to Centre (C/C) Suspenders 50 x 50 x 4 mm angle 1800 mm Centre to Centre (C/C)	M	1,375	1153	**15,85,790**
5.3	600 mm wide Runners 20 x 75 x 20 x 2.5 mm Rungs 20 x 30 x 20 x 2.5 mm 250 mm Centre to Centre (C/C) Suspenders 40 x 40 x 4 mm angle 1800 mm Centre to Centre (C/C)	M	3,850	1057	**40,70,903**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
5.4	450 mm wide Runners 20 x 75 x 20 x 2.5 mm Rungs 20 x 30 x 20 x 2.5 mm 250 mm Centre to Centre (C/C) Suspenders 40 x 40 x 4 mm angle 1800 mm Centre to Centre (C/C)	M	1,650	970	**16,00,951**
5.5	300 mm wide Runners 20 x 75 x 20 x 2.5 mm Rungs 20 x 30 x 20 x 2.5 mm 250 mm Centre to Centre (C/C) Suspenders 40 x 40 x 4 mm angle 1800 mm Centre to Centre (C/C)	M	1,650	**883**	**14,57,229**
	TOTAL FOR E.03 (DISTRIBUTION CABLES)				**3,70,07,882**
E.04	**CONDUIT WIRING**				
	General				
	Whether explicitly stated in the schedules below or not, the following must be complied with:-				
a	For supply and installation of conduits, flexible conduits and wiring, relevant clauses of Technical Specifications must be followed.				
b	"Wires supplied must conform to relevant clauses of Technical Specifications".				
c	Wiring accessories must conform Technical Specifications.				
d	In case of any contradiction between BOQ and Technical specifications, the most stringest condition of the two will apply.				
e	All final connections specially to vibrating equipments shall be made through steel flexible conduits.				
f	Recovery of conduit & fan boxes laid by Civil contractor will be made as per item no. 3 & 4.				
	"All the items / parts mentioned in relevant clauses of the Technical specifications and not specifically mentioned in BOQ shall be deemed to be included in the quoted rates, unless specifically excluded."				
1	**Light and Fan Wiring**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supply, all materials, storing, handling, fixing, laying wiring and testing for light, fan, exhaust fan and 6A Socket points etc starting from the point control box to the point by using 2.5 sq.mm 1100 volts grade FRPVC stranded copper conductor in concealed GI Stove enamelled 16 gauge conduit including 2mm thick GI boxes, fan regulator boxes, together with wiring accessories such as 6A moulded flush mounted modular switches, sockets in boxes of suitable sizes including circuit wiring with 2 x 2.5 sqmm 1100 volts grade FR PVC insulated stranded copper conductor along with one run of 2.5 sq.mm PVC insulated (green colour) stranded earth wire complete with earthing of fixtures, sockets and boxes. PVC bushes for conduits ends, chrome-plated brass screws, identification ferrules at either ends complete in all respects as per standard specifications. (Lights, fans and 6 amps socket outlets may be wired on a common circuit and circuit shall not have more than ten points of light, fans and 6 amps sockets or a load of 800 watts whichever is less).				
1.1	**Primary Light Points**				
1.1.1	**Switch Control**	Nos	613	**3827**	**23,47,370**
	"Point wiring for switch controlled primary light points with 3 x 2.5 sq mm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25mm dia GI recessed and/or surface conduiting system including cost of providing saddles/ hangers etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting and including the cost of Supply and fixing modular grid plate mounted flush mounted 240 volt 6 amp control switch of approved quality & colour housed in zinc chromate passivated GI boxes with moulded cover plate and including cost of circuit wiring (from DB to first switch in the sub circuit) complete as per specifications and as required."				
1.1.2	**MCB Control with 3 x 2.5 sq. mm wire**	Nos	167	5728	**9,56,448**
	Point wiring for DB/MCB controlled primary light points with 3 x 2.5 sq mm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25mm dia GI recessed and/or surface conduiting system including cost of providing saddles/ hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications Including cost of circuit wiring (From DB to first light point) complete as per specifications & as required (cost of MCB not included)				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.1.3	**MCB Control with 3 x 4 sq.mm wire**	Nos	323	8254	**26,66,600**
	"Point wiring for LED high/medium bay light fixtures MCB controlled primary light points with 3 x 4.0 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 32mm dia GI recessed and/or surface conduiting system including cost of providing saddles/ hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications Including cost of circuit wiring (From DB to first light point) complete as per specifications & as required (cost of MCB not included)."				
1.2	**Secondary Light Points**				
1.2.1	**Secondary Light Points with 3 x 2.5 sq. mm wires**	Nos	1,751	1957	**34,26,602**
	"Point wiring for Secondary light points with 3 x 2.5 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications and as required."				
1.2.2	**Secondary light points with 3 x 4 sq. mm wires.**	Nos	778	2808	**21,84,926**
	Secondary light points for high/medium bay light fixtures with 3 x 4.0 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 32mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications and as required.				
1.3	**Point Wiring for Ceiling Fan Points**	Nos	92	2086	**1,91,837**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	"Point wiring for ceiling fan points with 3 x 2.5 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting and including the cost of Supply and fixing modular grid plate mounted flush mounted 240 volt 6 amp control switch and 240 volt 300 watt 5 Step electronic speed regulator of approved quality & colour housed in zinc chromate passivated GI boxes with moulded cover plate and with interconnections complete as per specifications and as required."				
1.4	**Point wiring for air circulator fan**	Nos	117	6224	**7,30,521**
	Point wiring for air circulator fan with 3 x 4 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 25 mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hangers etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting and including the cost of Supply and fixing modular grid plate mounted 240 volt 16 Amps, 3 pin combined shuttered socket outlets along with 240 volt 16 Amps, control switch of approved quality and colour housed in zinc chromate passivated GI boxes with moulded cover plate with interconnections complete & supply & fixing of the fan electronic speed regulator as provided with air circulator fan complete as required. (Swiutch & Socket at diffrent location)				
1.5	**Wiring for Socket Outlets**				
1.5.1	**Point wiring for 6 amp socket outlets**	Nos	378	2239	**8,45,398**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Point wiring for 6 amp socket outlets with 3 x 2.5 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25 mm dia GI recessed and/or surface conduiting system including the cost of providing saddles/hangers etc as required and including the cost of cutting/making good chases in brick work and including the cost of Supply and fixing modular grid plate mounted 240 volt 6 amp 5 pin combined shuttered socket outlets alongwith 240 volt 6 amp control switch of approved quality and colour housed in zinc chromate passivated GI boxes with moulded cover plate and interconnections and including the cost of loop earthing with 2.5 sqmm FR PVC insulated 1100 volt grade stranded copper conductor wires complete as per specifications and as required.				
1.5.2	**Point wiring for 16 Amps, socket outlets (1 outlet wired on 1 circuit)**	Nos	450	7129	**32,09,042**
	"Point wiring for 16 Amps, socket outlets (1 outlet wired on 1 circuit) with 3 x 4 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 25 mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hangers etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting and including the cost of Supply and fixing modular grid plate mounted 240 volt 16 Amps, 3 pin combined shuttered socket outlets along with 240 volt 16 Amps, control switch of approved quality and colour housed in zinc chromate passivated GI boxes with moulded cover plate with interconnections complete as per specifications and as required.				
1.5.3	**Point wiring for 3 phase 32 amp socket outlets**	Nos	23	22664	**5,21,036**
	"Point wiring for 3 phase 32 amp socket outlets with 6 x 6.0 sqmm (3P+N+2E) FRLS PVC insulated 1100 volt grade flexible stranded (84 strands of 0.3 mm dia) copper conductor wires in IS embossed 50 mm dia GI recessed and/or surface conduiting system including the cost of providing saddles/hangers etc. as required and including the cost of cutting/ making good chases in brick work and including the cost of Supply and fixing industrial type 32 amp 10 kA "C" 4P MCB and 415 volt 32 amp industrial metal clad socket outlet in 16 SWG powder coated GI box with interconnections and including the cost of 415 volts 32 amp 4P plug top complete as per specifications and as required."				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.5.4	**Point wiring for 3 phase 63 amp socket outlets**	Nos	11	34784	**3,78,801**
	"Point wiring for 3 phase 63 amp socket outlets with 6 x 10.0 sqmm (3P+N+2E) FRLS PVC insulated 1100 volt grade flexible stranded (140 strands of 0.3 mm dia) copper conductor wires in IS embossed 50 mm dia GI recessed and/or surface conduiting system including the cost of providing saddles/hangers etc. as required and including the cost of cutting/ making good chases in brick work and including the cost of Supply and fixing industrial type 63 amp 10 kA "C" 4P MCB and 415 volt 63 amp industrial metal clad socket outlet in 16 SWG powder coated GI box with interconnections and including the cost of 415 volts 63 amp 4P plug top complete as per specifications and as required. "				
1.5.5	**Point wiring for weather proof 16 Amps, outlets**	Nos	113	11561	**13,00,913**
	Point wiring for weather proof 16 Amps, outlets with 3 x 4 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (84 strands of 0.3 mm dia) copper conductor wires in IS embossed 25 mm dia GI recessed and/or surface conduiting system including the cost of providing saddles/hangers etc. as required and including the cost of cutting/making good chases in brick work and including the cost of providing and fixing 2 pole 16 Amps, switch with 16 Amps, 240 volts socket outlet and plug top mounted and including a IP 56 rated surface/recessed box with the total unit having IP 56 ingress protection complete as required.				
1.5.6	**Point wiring for weatherproof 3 phase 32 amp socket outlets**	Nos	12	25398	**3,07,316**
	Point wiring for weatherproof 3 phase 32 amp socket outlets with 6 x 6.0 sqmm (3P+N+2E) FRLS PVC insulated 660/1100 volt grade flexible stranded (84 strands of 0.3 mm dia) copper conductor wires in IS embossed 50 mm dia GI recessed and/or surface conduiting system including the cost of providing saddles/hangers etc. as require and including the cost of cutting/ making good chases in brick work and including the cost of Supply and fixing 4 pole 32 amp switch with 32 amp 240 volts socket outlet and plug top mounted and including a IP 56 rated surface/recessed box with the total unit having IP 56 ingress protection complete as required.				
2	**Modular Grid Plat Mounted Switch/es and Socket/s**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supply & installation of following modular grid plate mounted switch/ (es) and socket/(s) etc. on a suitable size mild steel electrogalvanised switch boxes complete in single or combination on prorate basis complete with the connections, earthing and testing as per specifications and as required: (Note the grid plate and MS BOX shall be selected suitably as per the requirement to fix the switches and sockets.				
2.1	6/10A modular switches.	Nos	12	249	**3,015**
2.2	6 Amp Universal socket with 6 amp modular switch.	Nos	12	282	**3,415**
2.3	6/16 Amps, Universal socket with 16 Amps, modular switch.	Nos	12	351	**4,243**
2.4	**20/25/32 Amps, 1-Phase Industrial Socket Outlet**	Nos	123	1461	**1,80,307**
	20/25/32A 1-Phase industrial socket outlet with 20/25/32A SP MCB in a GI enclosure with IP56 protection rating with all mounting & fixing accessories & terminations with separately lockable facility complete as required.				
2.5	**20/25/32 Amps, 3-Phase Industrial Socket Outlet**	Nos	189	3904	**7,36,966**
	20/25/32 Amps, 3-Phase industrial socket outlet with 20/25/32 Amps, TP MCB in a GI enclosure with IP 56 protection rating with all mounting & fixing accessories, terminations & Cable glands for cable entry with separately lockable facility complete as required.				
2.6	**40/63 Amps, 3- Phase Industrial Socket Outlet**	Nos	92	10876	**10,00,146**
	40/63 3-Phase industrial socket outlet with 40/63A TP MCB in a GI enclosure with all mounting & fixing accessories , terminations & Cable glands for cable entry with separately lockable facility complete as required.				
2.6	**125 Amps, 3- Phase Industrial Socket Outlet**	Nos	24	17598	**4,25,880**
	125 3-Phase industrial socket outlet with 125A TP MCB in a GI enclosure with all mounting & fixing accessories , terminations & Cable glands for cable entry with separately lockable facility complete as required.				
3	**GI Conduiting**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supply and installation of GI conduiting complete with GI junction and pull boxes, GI fish wires as specified and as shown below.				
	Note: Conduiting has been assumed for Telephone/Data Points through out the Depot. Requirement shall be confirmed by S & T Contractor.				
3.1	25 mm inner dia 1.6 mm thick	M	4,840	132	**6,40,380**
3.2	32 mm inner dia 1.6 mm thick	M	121	193	**23,347**
3.3	50 mm inner dia 2.0 mm thick	M	121	345	**41,758**
4	Providing and fixing circular/ Hexagonal cast iron or M.S. sheet box for ceiling fan clamp, of internal dia 140 mm, 73 mm height, top lid of 1.5 mm thick M.S. sheet with its top surface hacked for proper bonding, top lidshall be screwed into the cast iron/ M.S. sheet box by means of 3.3 mm dia round headed screws, one lock at the corners. Clamp shall be made of 12 mm dia M.S. bar bent to shape as per standard drawing.	each	363	184	**66,840**
	TOTAL FOR E.04 (CONDUIT WIRING)				**2,21,93,106**
E.05	**INDOOR LIGHTING AND FANS**				
	General				
	"The Lighting System specified herein, must conform to the technical Specifications, in addition to the description given in respective items of BOQ, whether explicitly specified or not. In case of contradiction between specifications and description in BOQ, the most stringent of the condition will prevail."				
	Supply, installation, testing & commissioning of light fittings including all accessories e.g. ballast, HPF condensors, lamps, holders, surface/recess mounting arrangement etc. including necessary supports, accessories and hardware as per specifications & as required at site and as below:-				
A)	**Luminaire minimum specifications and requirements**				
a.	Luminaires should operate at +/- 10% voltage fluctuation for continuous use to comply to IEC.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b.	All the components including the internal wiring of the luminaries to be used shall be manufactured of material, which are of low smoke and zero halogen type. All luminaires shall be manufactured to relevant sections of IEC60598 or other approved international standards and the type tests for all luminaries shall be provided.				
c.	All internal wiring within the lighting fixtures shall be heat-resisting cables.				
d.	Light fixtures to be controlled by the suitable sensors for desired switching sequence / pattern and to contribute in making of an energy efficient system				
1	**Indoor Light Fixture**				
1.1	Supply, installation, testing and commissioning of 2 x 2 recess mounting luminaires with mid flux LED using efficient optics enclosed in a mettallic CRCA powder coated housing with high efficiency Lumin diffuser. It has a system lumen efficact > 80 lumens/watt system level luminous flux of 3100 lumens and system wattage of 40 W, 50,000 hours burning life for the system at 70 % lumen maintenance with a color rendering index > 80 and color temparature 6500 K. PF > 0.9 and THD < 33 %. Luminaire is sealed from bottom and has inbuilt gear. The luminaire is IP20 protected. Similar as per approved make list.				
a)	**Supply of above given items**	Nos	892	3619	**32,28,223**
b)	**installation, testing, commissioning of above given items**	Nos	892	164	**1,46,559**
1.2	Supply, installation, testing and commissioning of 135 mm dia. recessed 18 W LED downlighter with 1200 lumens output at 6500K color temparature and > 70 CRI. The fixture should be DLED comptact LED Engine with a die cast aluminium heat sink, a high efficacy diffuser and a PC reflector with steel clip. The fixture should have an integrated constant color driver. Fixture should be IP 20. or as per approved equivalent make list.				
a)	**Supply of above given items**	Nos	255	1460	**3,72,546**
b)	**installation, testing, commissioning of above given items**	Nos	255	132	**33,766**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.3	Supply, installation, testing and commissioning of 4', 28 W LED luminaire or superior as per approved make list. Luminaire should be suitable for surface mounting/suspended made of extruded aluminium housing and CRCA front frame. High efficiency covered luminiaire with opal diffuser. With minimum lumen output of 3250 lumens and efficacy > 60 Lm/W and CCT of 4000 K. Electronic driver should have a PF> 0.9 and THD < 25 %.				
a)	Supply of above given items	Nos	439	3403	**14,93,389**
b)	installation, testing, commissioning of above given items	Nos	439	164	**72,105**
1.4	Supply, installation, testing and commissioning of linear LED batten. The fixture should be a system wattage of 28 W and a high CRI of 85. System efficacy of 85 lumens/W and a system lumen output of 3250 lumens. The fixture should have a metal frame design and is protected to IP20. The fixture should be as per approved make list.				
a)	Supply of above given items	Nos	516	2935	**15,14,206**
b)	installation, testing, commissioning of above given items	Nos	516	164	**84,755**
1.5	Supply, Installation, Testing & commissioning of 210W Highbay with 24000 Lumens, IP65 , power factor of more than 0.95 with housing of High pressure Die cast aluminium. The fixture should be as per approved make list.				
a)	Supply of above given items	Nos	418	18544	**77,51,225**
b)	installation, testing, commissioning of above given items	Nos	380	1515	**5,75,700**
1.6	Supply, Installation, Testing & commissioning of 130 LED highbay 130W Highbay with 16000 Lumens, IP65 , power factor of more than 0.95 with housing of High pressure Die cast aluminium or approved equiavlent make list. For Stabling Shed				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	**Supply of above given items**	Nos	501	15110	75,62,355
b)	**installation, testing, commissioning of above given items**	Nos	501	1515	7,58,258
1.7	Supply, Installation, Testing & commissioning of 42W WellGlass LED light fixture with lumen output of 2700 lm at 6500 colour temperature, IP 66 and IK 08. Fixture has CRI 70, THD <=10% and pf>.95 with High Pressure die cast body as aproved make list.				
a)	Supply of above given items	Nos	561	3957	**22,20,097**
b)	installation, testing, commissioning of above given items	Nos	510	440	**2,24,252**
1.8	Supply, Installation, Testing & commissioning of 250W LED Flood light fixtures with accessories for yard lighting (Highmast fittings) or approved equivalent make list.				
a)	**Supply of above given items**	Nos	66	40400	**26,66,400**
b)	**installation, testing, commissioning of above given items**	Nos	66	4040	**2,66,640**
1.9	80 W LED Street Light with a lumen output of 7000 lumens. The fixtures is made of die cast aluminium. Fixture has a CRI > 70 and IP 66 protection. The fixture should be as per approved make list.				
a)	**Supply of above given items**	Nos	79	9151	**7,24,777**
b)	**installation, testing, commissioning of above given items**	Nos	79	1017	**80,531**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.10	Supply , Installation, Testing & Commissioning of Daylight Harvesting System without heat transfer through UV resistant prismatic polycarbonate lenses & polycarbonate light diffusers for 68% Light Transmission for Stablling Lines Shade (Area Approx. 9000 Sqm., Height – 10 Mtr (Max.))				
a)	**Supply of above given items**	**Nos.**	**80**	**24786**	**1982880**
b)	**Installation, testing, commissioning of above given items**	Nos.	80	2754	**220320**
2	**Fans**				
	Supply, installation, testing & commissioning of the following fans including fixing arrangement and with all accessories like down rods, 5 step electronic fan regulators, cover plates, cups as required for the following complete with necessary seamless pipe required for hanging of the fans etc.				
2.1	**Ceiling Fan 1200 mm Sweep**	Nos	215	1506	**3,23,065**
	Ceiling Fan 1200 mm sweep with out regulator but with all accessories as per IS: 374, 1979 with all amendments as applicable as required.				
2.2	**Air Circulator Fans 600 mm Sweep**	Nos	107	8635	**9,21,401**
	wall / column mounted industrial type heavy duty fan 600 mm dia sweep complete with all accessories required.				
	TOTAL FOR E.05 (INDOOR LIGHTING AND FANS)				**3,32,23,447**
E.06	**HIGHMAST & STREET LIGHT POLES**				
	Highmast	Nos	4	652222	**26,08,889**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supply, installation, testing and commissioning of 30 m high mast system with its accessories. Mast shaft shall be of Bajaj / Philips / Keselec / Thorn, hot dip galvanised and suitable for wind velocity as per IS 875. It shall also include accessories for high mast including head frame, steel wire rope, trailing cable, double drum winch, Galvanised Lantern carriage arrangement suitable for 12 luminaires & its control gear boxes and lightning arrestor. The mast shall have an External powertool installed inside the base compartment for its operation and including following				
	Foundation bolts manufactured from special steel along with nuts, washers, anchor plates and templates.				
	S.I.T.C. of suitable neon Aviation lights as required.				
	Control panel housing with suitable TPN MCB incomer, one numbers single dial timer contactor circuit for the automatic control of luminaries.				
	Common power tool for the operation of the mast with single phase single speed motor along with reversing gear, stand, control push button and other accessories.				
	Earth Station of Pipe earthing (2Nos) as per IS:3043-1987 & IEEE:80-2000, including duplicate earth connection to the mast with 25x3 mm size GI Strip.				
	Street Light Poles	Nos	79	27430.97	21,67,047
	9.0 meter hot dipped galvanised Octagonal with single & Double overhang arm & with foundation bolts, base plate complete with foundation, entry and exit pipes, control JB with connector generally as shown on drawings and as per specifications.				
	TOTAL FOR E.06 (Highmast & Street light pole)				**47,75,936**
E.07	**PROTECTIVE EARTHING SYSTEM**				
	General				
	Contractor has to check the value of soil resistivity before execution and contractor shall subject to submit detail earth mat calculations for approval to Engineer. After their final approval work shall subject to commenced.				
	Note:- Steel structure/pipe shall be Earth by suitable rating of earth strip/wire.				
1	**EARTHMAT**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Eartmat mat for ASS equipments HT Panel, Transformer neutal & body , LT Panel etc.,				
1.1	**50X6mm copper flat for Earth Mat @ ASS -2 Building**	M	825	2191	18,07,819
	Design,Supply, laying, testing and commissioning of 50X6mm copper flat for earth mat (at 700 mm to 3000 mm deep as per approved drawing & calculations) as per specifications including lap (of not less than 150 mm) & cross weld joints and providing bitumin coat at every joint as required. Earthing risers from earth mat to be brought out as per approved drawings and specifications wherever required.				
1.2	**30 mm dia Copper Rod for Vertical Electrodes**	Nos	17	15482	2,55,445
	Design, Supply, laying, testing and commissioning of 30 mm dia copper rod, laying of vertical earth electrodes 3 m deep from earth mat including weld joints with earth mat as per approved drawings and specifications. The weld joints to be provided with bitumin coats.				
1.3	**Extra for Bituminous Coating and Hessian Tape Wrap**	M	440	41	17,950
	Extra for bituminous coating and hessian tape wrap or polyethylene faced hessian complete for buried earthing strips risers mentioned above in item 1.1 as per specifications and drawings as required.				
2	**MAINTENANCE FREE EARTHING**				
2.1	**Maintetance free earthing-**	Nos	77	6737	5,18,732
	Design, Supply, installation and testing of copper bonded (25mmX 3Mtr)electrode chemical earth pit with hygroscopic condactive compound + soil conditioning gel including chamber with cover				
3	**EARTHING STRIPS & CABLES**				
3.1	**Strips for Interconnecting the Earthing Stations, Panels, DBs etc**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supply, Laying, fixing, testing and commissioning of following strips for interconnecting the earthing stations, panels, DBs, Cable trays, etc. of the following sizes in built up trenches/ surface/ wall/ ground complete with holes & fixing, jointing/terminating accessories as per specifications as required. (Quantity shall be paid as per the actual measurement as executed) however direct measurement shall not exceed the quantity indicated in drawing approved by engineer.				
3.1.1	90 mm x 10 mm GI strip	M	220	519	1,14,250
3.1.2	70 mm x 10 mm GI strip	M	2,750	419	11,52,200
3.1.3	65 mm x 8 mm GI strip	M	1,100	315	3,46,873
3.1.4	50 mm x 10 mm GI strip	M	1,100	300	3,29,893
3.1.5	50 mm x 6 mm GI strip	M	2,200	200	4,39,049
3.1.6	25 mm X 6 mm GI strip	M	2,750	110	3,03,210
3.1.7	50 mm x 6 mm Cu strip	M	1,650	2191	36,15,638
3.1.8	8 SWG Cu WIRE	M	3,300	97	3,19,968
3.1.9	70Sqmm single core Copper cable for clean earthing	M	550	530	2,91,526
	Note-1: In case of non availability of any of the sizes mentioned above, next higher size available in market shall be provided at the same rate.				
	Note-2: No additional payment will be made for providing Main Earth Terminals (made out of GI strips from within the above sizes). The METs will be required to be fixed on walls as required and will be provided with 12/16/20mm holes for connections of individual equipments earthing including the other system wide contractors.				
	TOTAL FOR E.07 (PROTECTIVE EARTHING SYSTEM)				**95,12,553**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
E.08	**LIGHTNING PROTECTION**				
1	**Lightning Conductor Finials**	Nos	11	817	8,987
	Supply and fixing Lightning Conductor Finials made of 25 mm dia 1mtr long copper tube having a single prong at the top with 85 mm dia 6 mm thick copper base plate, fixing accessories and clamping with down conductor as per specifications complete as required.				
2	**Stainless Steel horizontal & Vertical Conductor**				
	Supply, laying and fixing of the stainless stell horizontal & vertical conductor of following sizes on surface/wall/parapet/shaft complete with joints, bimetallic connectors, testing links & other fixing accessories and clamping/ connection with earth terminations as per specifications & drawing as required.				
2.1	25 x 3 mm thick SS Strip	M	55	232	12,735
2.2	32 x 6 mm thick SS Strip	M	110	593	65,202
2.3	25 x 6 mm thick SS Strip	M	6,050	463	28,01,664
3	**Testing Joints**				
	Supply and fixing of the testing joints made of 25 mm x 6 mm thick Stainless stell strip 125 mm long with 4 Nos. SS bolts, nuts, check nuts and spring washers complete as required.	M	44	269	11,837
4	**Maintetance free earthing-**				
	Supply, installation and testing of copper bonded (25mmX 3Mtr) electrode chemical earth pit with hygroscopic condactive compound + soil conditioning gel including chamber with cover	Nos	33	6737	2,22,314
5	**Air Craft Warning Lights**	Nos	6	6291	34,602

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supply, installation, testing & commissioning of air craft warning lights complete with non flickering type lights similar to GEC model ZH 752 or WIPRO model no. WAN 20001 or equivalent including lamps, mounting bracket, earthing, painting complete with accessories to automatically switch off lights. (Point wiring shall be done under subhead conduit wiring).				
	TOTAL FOR E.08 (LIGHTNING PROTECTION)				**31,57,342**
E.09	**External Piping System for HUME, TRENCHING & UNDERGROUND**				
1	**PIPES**				
1.1	**HDPE Pipe**				
	Supply and laying of following HDPE pipe NP4 grade under paved areas/track crossings including necessary excavation, honching and back filling complete as required as per IS:14333:1996 with all amendments applicable.				
1.1.1	200 mm dia HDPE Pipe	M	110	3415	3,75,617
1.1.2	120 mm dia HDPE Pipe	M	1,100	1587	17,45,279
1.1.3	80 mm dia HDPE Pipe	M	660	889	5,86,530
1.2	**Heavy/Medium Grade GI Pipes**				
	Supply and installation of following heavy duty grade GI pipes for cables crossing the rail tracks with all bendings complete as required including necessary excavation, honching and back filling as complete as required as per IS:3589 & IS 1239 with all amendments applicable,				
1.2.1	150 mm dia GI pipe	M	55	2149	1,18,191
1.2.2	100 mm dia GI pipe	M	110	1640	1,80,350
1.2.3	80 mm dia GI pipe	M	110	1242	1,36,566

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.2.3	40 mm dia GI pipe	M	55	545	29,957
1.3	**RCC Hume Pipes**				
	Supply and installation of following RCC Hume pipes NP4 grade, for cables crossing the roads with all fitting accessories complete as required including necessary excavation, honching and back filling as compete as required as per IS:458: 2003 with all amendments applicable.				
1.3.1	450mm dia RCC Pipe	M	55	2727	1,49,968
1.3.2	250mm dia RCC Pipe	M	110	1389	1,52,818
1.3.3	150mm dia RCC Pipe	M	550	852	4,68,763
	TOTAL FOR E.09 External Piping System for HUME, TRENCHING & UNDERGROUND				**39,44,040**
E.10	**COMPACT SANDWICH TYPE BUS DUCT**				
1	**3200 amps Compact Sandwich Bus Duct**	M	33	48455	15,99,031
	Supply installation, testing & commissioning of the following totally enclosed, dust and vermin proof Low impedance compact sandwich bus duct:				
	Ingress protection IP 55				
	Indoor mounts				
	14 SWG sheet steel clad				
	Electrolytic Grade Cupper(Cu.) bus bar				
	Operation at 415 Volt 3 phase 50 Hz system				
	Insulation voltage 1000 volts				
	Fault withstand 50 kA symmetrical for 1 second				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	The bus duct shall be complete with all required accessories like clamps, end covers, thrust pads, flexible connections end termination flange joint etc. as required and including wall mounting brackets and including the cost of expansion joints complete as per specifications, as required and as below and suitable for operation at 415 volt 3 phase 50 Hz system.				
	3200 amps 3P +100%N+50% Integral Earth including bends.				
	TOTAL FOR E.10 (COMPACT SANDWICH TYPE BUS DUCT)				**15,99,031**
E.11	**UNINTERRUPTED POWER SUPPLY SYSTEM**				
	Supply, Installation, Testing and Commissioning of **following rating online, UPS** system suitable for providing power supply to emergency lighting and Computerised Control panel load of approved make, suitable for incoming 415 volts, 3 phase +10 % - 20%, 50 Hz, supply and three phase output voltage, variation ± 1%, including transformer, rectifier/dual converter, static switch, inverter, filter, Bypass & static transfer switch for automatic switch over without giving any break of power, maintenance bypass switch, Micro processor/ software controlled annunciation,protection(including against input phase reversal), and menu run diagnostic module,associated cabling and connections/ terminations, erection including associated foundation/ masonorey or RCC work for mounting on base channels etc. complete as per specifications and as required.	Set	1	1640580	16,40,580
	The UPS shall be a true parallel redundant with bypass with Individual Battery Bank on each UPS for 30 Minuits (2X100% Redundancy on Battery Setup)				
11.1	2 X 40KVA UPS (PR System)				
11.2	Supply, Installation, Testing and Commissioning of 2V SMF VRLA lead acid sealed maintenance free battery (Design Life - 10years) suitable for 30Minuits backup to the UPS set. Battery shall comply with relevant regulations & Battery racks shall be made of acid resistant material. (40KVA UPS)				
	TOTAL FOR E.11 (UNINTERRUPTED POWER SUPPLY SYSTEM)				**16,40,580**
E.12	**DG SET WITH PLC BASED AMF PANEL**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supplying, installation, testing & commissioning of Radiator Cooled type Diesel Generating Set comprising of multicylinder diesel oil engine with radiator, fly wheel, exhaust piping upto silencer and outside the remote location, residential type silencer, electric starting equipments, batteries, battery charger, directly coupled to an alternator of suitable capacity at 0.8 P.F. 3 phase, 4 wire 50 Hz 415 volts, A.C supply complete with base plate antivibration mountings foundations for installation of D.G. Set,terminating arrangement for outgoing cables, control panel,controlling MCCB etc, complete of exhaust pipe installation with support arrangement as required as per specifications, Drawings and specified ambient conditions				
	DG Sets shall be suitable for Auto Start, Auto Stop and Auto Load Management.				
12.1	**630 KVA D.G. SET (INCLUDING PLC BASED AMF PANEL)**				
	Supply, erection, testing and commissioning of floor mounted totally enclosed sheet steel AMF Panel with PLC suitable for automatic operation of 630 **k**VA DG set and equipped with automatic gas flooding using linear heat sensing tube type fire trace system or equivalent. The panel shall be suitable for 415 V, 3 phase, 4 wire system, **Copper bus bars** designation labels as per requirement, continuous earth bus, cable clamping supports, panel illuminating lamps, cable gland plates for incoming and outgoing feeders as per details below:	Set	1	6537803	**65,37,803**
(a)	**INCOMING** 1 nos. 1000 A, 50 KA, 4-pole ACB with microprocessor based over load and short circuit protection with time delay and earth fault IDMT release - all site settable				
(b)	**OUTGOING**				
(i)	1no. 630 A, 50 KA, 4-pole MCCB with microprocessor based over load and short circuit protection with time delay and earth fault IDMT release - all site settable.				
(ii)	1no. 400 A, 50 KA, 4-pole MCCB with microprocessor based over load and short circuit protection with time delay and earth fault IDMT release - all site settable.				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
(c)	1 No., 230V, AC operated integrated type Digital Multi function meter for measuring Frequency, Amperes ,Voltage, Energy & Power factor of appproved makes conforming to specifications, latest IEC/ EMC and EMI standards, with necessary Circuit MCBs and suitable size CTs for above two incomer metering supporting SCADA / BMS connectivity				
(d)	One set of "Battery charger" consisting of :				
(i)	Transformer/Rectifier				
(ii)	DC. Ammeter				
(iii)	DC. Voltmeter				
(iv)	Charging rate selector switch (OFF/Trickle/Boost.)				
(e)	One Mains supply Voltage monitor				
(f)	One set of DC Control relays incorporating engine Start/Stop, three attempts starting facility and failure to start lock out.				
(g)	One set of auxiliary relays for automatic closing and opening of the alternator contactor for automatic operation as required.				
(h)	6 nos. potential free contacts for BMS				
(I)	One selector switch Auto/Manual/ Test				
(j)	One set of the following :				
(i)	One Selector switch for engine control OFF/ON				
(ii)	Four Push buttons, Start, Stop, Reset, Test.				
(iii)	Two Indicating lamps "Load on set" "Load on Mains".				
(iv)	Five Indication on annunciator for shutdown for "Low lube oil pressure", "High water Temperature", "overspeed", "low fuel" & "set fails to starts".				
(k)	One counter to indicate number of times set has operated.				
(l)	One **Hour meter** to indicate the number of hours set has operated				
(m)	The AMF panel shall include necessary internal wiring, control circuit fuses, labeling, name plates cable identity tags on both ends etc. complete as per specification and as required				
(n)	Power Pack for the PLC backup of the DG set with all arrangement, including battary, Control Circuits, Internal wiring, labeling, name plates cable identity tags on both ends etc. complete as per specification and as required				
12.2	**FUEL SYSTEM**				

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a	Supplying, installation, testing and commissioning of heavy duty Hand cranking oil pump with 3 mtr. Long flexible oil hose.	Nos	2	1145	2,290
b	Supplying, installation, testing and commissioning of 990 Day Oil fuel steel tank of under mentioned capacities made out of 5 mm thick M.S. sheet with float valve and low level alarm arrangement including fuel oil piping up to the set valves etc. complete as required.	Nos	1	8357	8,357
c	Supplying, installation, testing and commissioning of Suitable rating Fuel Oil pump including foundations, piping, valves, indications, safety devices etc. complete as required.(Crompton / GE / Kirloskar make)	Nos	2	13788	27,576
d	MS C class 25mm fuel pipe	Lum	1	2683	2,683
	The Contractor scope of inspection and approval for getting the layout drawing, installation, license from Electrical Inspectorate local authority, explosive department,HERC for Campus complete as required for satisfatory function of the installation of above DG Sets				
	The contractor shall submit back-pressure calculations in support of exhaust pipe size for each DG Set.				
	TOTAL FOR E.12 (DG SET)				**65,78,709**
E.13	**OHE ON OFF INDICATOR**				
13.1	Supply of 25KV AC OHE (Presence / Absence Indicator)	Nos.	6	120139	7,20,831
13.2	Erection of 25KV AC OHE (Presence / Absence Indicator)	Nos.	6	9888	59,328
13.3	Supply, testing and commissioning of 1100 volt grade, 1.5 sq mm, 3 core **FRLS** copper cable conductor (armoured)	RM	3600	75	**2,69,912**
13.4	Laying and fixing of conductor cables on existing cable trays/ wall with heavy GI clamps with base and provide the cables tags / cable / route marker at both end of cable. 1100 volt grade 1.5 sqmm, 3 core **FRLS** copper cable.	RM	3600	26	**95,263**

(Attachment No-11 to Addendum No-5)
PART-B DEP-LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
13.5	Supply and fixing of 50 mm X 2 mm GI angle with fasteners	RM	80	130	**10,408**
	TOTAL FOR E.13 (OHE ON OFF INDICATOR)				**11,55,743**
E.14	**Conduiting and GI Sleeves for Telephone, Lan & PA System**				
	NOTE:- Conduiting has bee estimated for Telephone / Data Points Through out the OCC Building. Detailed Requirements shall be interfaced with STPT Contractor				
1	Conduitin & GI Sleeves for Telephone System				
1.1	Providing and Fixing in position the fiollowing 16 guage GI Conduit concealed or exposed as called for including all accessories 1.e. bends, junction boxes, of re3quired design				
a	25mm dia	Mtrs	2,200	149	3,27,375
1.2	Providing and Laying of following medium class GI pipe including all fixing accessories concealed or exposed as called for				
	40mm dia	Mtrs	39	562	21,638
	100mm dia	Mtrs	55	1489	81,907
	TOTAL FOR E.14 (Conduiting and GI Sleeves for Telephone, Lan & PA System)				**4,30,919**

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
F.01	**FIRE DETECTION & ALARM SYSTEM**				
1	Supply, installation, testing and commissioning of plug-in type addressable analogue multi-criteria detectors below false ceiling including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	Nos.	281	1,544	4,33,756
2	Supply, installation, testing and commissioning of plug-in type addressable analogue multi-criteria detectors above false ceiling including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	Nos.	22	1,544	33,960
3	Supply, installation, testing and commissioning of plug-in type rate of rise cum fixed temperature addressable analogue Heat detectors including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	Nos.	9	1,433	12,900
4	Supply, installation, testing and commissioning of '4" Loop (750 Detectors, 400 Devices) (Fire Alarm Capability: 1 Loop x 99//125/150 detectors/ devices) wall recess mounting microprocessor based analogue addressable Fire Control Panel expandable by minimum 2 additional loops (Fire loop shall be closed type) with minimum 80 character LCD display, 4 access levels, 1000 events historical logging, flash E-PROM, 240 volts ac power supply, automatic battery charger, 24V SLA batteries suitable for operating the entire system including the talk back units and the hooters/strobes for a minimum of 8 hours in battery condition. The Panel shall have suitable power amplifiers for hooter/strobes. The Panel is to be Integrated with the BMS System including the cost of supply and installation of any additional modules or interfaces required for the same. The pannel shall be complete as per specifications and as required.	Nos.	1	7,88,822	7,88,822
5	Supply, installation, testing and commissioning of Repeater panel including the cost of mounting accessories complete as per specifications and as required	Nos.	4	27,409	1,09,636
6	Supply installation testing and commissioning of dust and vermin proof addressable analogue Manual Call Boxes to initiate audio visual alarm including the cost of mounting accessories complete as per specifications and as required.	Nos.	41	2,315	94,932
7	Supply installation testing and commissioning of addressable analogue Talk Back jacks with face plates for Fireman's Handsets to initiate audio conversation with Main Fire Alarm Panel including the cost of mounting accessories complete as per specifications and as required.	Nos.	14	4,894	68,515

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
8	Supply, installation, testing and commissioning of Wall/ Ceiling mounting Sounder & strobes for visual indication including the cost of mounting accessories complete as per specifications and as required.	Nos.	41	1,213	49,727
9	Supply, installation, testing and commissioning of Control Modules including the cost of mounting accessories complete as per specifications and as required.	Nos.	41	2,315	94,932
10	Supply, installation, testing and commissioning of Monitor Modules including the cost of mounting accessories complete as per specifications and as required.	Nos.	18	2,315	41,678
11	Supply, installation, testing and commissioning of Fault Isolator Modules including the cost of mounting accessories complete as per specifications and complete as required.	Nos.	14	2,095	29,329
12	Supply installation testing and commissioning of two way Talk Back handsets to initiate audio interface complete as required.	Nos.	8	9,765	78,121
13	Supply, installation, testing and commissioning of wall or ceiling mounted 240 Volt AC illuminated double sided pictorial exit signs provided with appropriate direction arrow painted in green on white with an 11W CFL Lamp including the cost of in-built rechargeable batteries with charger suitable for 90 minute operation and including the cost of accessories for surface/ recessed or ceiling suspended mounting complete as required.	Nos.	20	4,725	94,504
14	Supply, installation, testing and commissioning of Response Indicator Lamp assembly in a dust tight sheet steel enclosure as per detailed specifications including accessories for recess mounting as per approved sample as required.	Nos.	45	191	8,602
15	Supplying, Laying, Termination, Testing and commissioning of size 2C x 1.5 sq mm twisted pair Screened Fire Survival cables complying with BS 7846 catagory CWZ.	Mtrs.	3800	189	7,19,446
16	Supplying, Laying, Termination, Testing and commissioning of size 2C x 2.5 sq mm twisted pair Screened Fire Survival cables complying with BS 7846 catagory CWZ.	Mtrs.	10	316	3,155
17	Supplying, installing, testing and commissioning of following sizes 16 gage GI conduits recessed/surface as required including clamps, hardwares etc required for conduiting arrangement complete as per specifications. (Quoted price shall include GI flexible conduits to connect from ceiling to false ceiling)				
a)	20 mm dia	Mtrs.	150	185	27,723

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	25 mm dia	Mtrs.	3500	197	6,90,251
	TOTAL FOR F.01				**3379989**
F.02	**FIRE FIGHTING SYSTEM**				
1.1	Providing, laying, jointing and testing in trenches the following sizes of G.I. class `C' (heavy class) pipes conforming to IS:3589 & IS:1239 with accessories like fittings including tees, elbows, reducers, flanges, rubber gaskets, GI nuts, bolts and washers and providing protection to embedded G.I. pipes and fittings by applying pypkote primer (@ 100 gm/sqm) thereafter wrapping 4 mm thick pypkote (AW 4 mm) protection coating by thermo fusion process. Overlap shall be maintained at 15 mm. The application process shall be strictly according to manufacturer's specification, inclusing necessary excavation trenches and refilling as required. (For under ground works)				
1.1.1	80 mm dia	Mtrs.	250	1,125	281159
1.1.2	100 mm dia	Mtrs.	250	1,522	380391
1.1.3	150 mm dia	Mtrs.	6500	2,150	13975244
1.1.4	200 mm dia	Mtrs.	24	2,955	70918
1.2	Providing, laying, jointing, testing and commissioning of following sizes of G.I. class `C' (heavy class) pipes conforming to IS:3589 & IS-1239 with all accessories like all fittings (standard G.I. fitting with welded joint shall be used on the pipes) including tees, elbows, reducers, union, flanges, rubber gaskets, GI nuts bolts, washer including supporting/fixing the pipe on floor / wall /ceiling with clamps, hangers (using anchor fastners) or angle iron support work in trenches as per specification. G.I. pipe sleeve of suitable higher size shall be provided wherever the pipes are crossing the walls/floors and sealing the sleeves with glass wool in between & fire sealent compound at either end all as per Project Manager's / Consultants requirements including cutting holes and chases in brick and making good the same to original conditions complete in all respects. (For above ground works)				

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	All hangers, civil support for external pipes, clamps, brackets etc. shall be of galvanized iron unless specified otherwire and then supply of the same shall also be included for rates under this head. Including two coats of synthetic enamel paint of approved shade over a coat of primer. Prior to application of primer the surface should be cleaned for any dirt, rusts, rough substance etc. Including painting of legends both direction arrow as per the approval of the Project Manager.				
	Welding of any kind on galvanized support / hanger shall not be permitted				
1.2.1	25 mm dia	Mtrs.	120	342	41016
1.2.2	32 mm dia	Mtrs.	120	441	52924
1.2.3	40 mm dia	Mtrs.	60	496	29770
1.2.4	50 mm dia	Mtrs.	60	695	41678
1.2.5	65 mm dia	Mtrs.	60	816	48955
1.2.6	80 mm dia	Mtrs.	360	1,025	369145
1.2.7	100 mm dia	Mtrs.	360	1,411	508070
1.2.8	150 mm dia	Mtrs.	350	2,205	771808
1.2.9	200 mm dia (wall thickness 6 mm.)	Mtrs.	24	2,701	64832
1.2.10	250 mm dia (wall thickness 6 mm.)	Mtrs.	24	3,363	80709

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.3	Providing & fixing Stainless steel fire Hydrant single landing valve with 80 mm NB flanged inlet, SS-304 spindle controlled 63 mm dia female instantaneous outlet type. SS coupling blank cap, chain, twist relese type lug & all accessories conforming to IS standards, including flanged tapping from wet rise complete as required.	Nos	100	6,291	629109
1.3.1	Providing & fixing controlled RRL fire hose pipe (as per IS:636) of 63 mm dia and 15 meter length rated for brust pressure of 35.7 Kg/sqcm. Hose shall be complete with ISI marked S.S male & female coupling (IS:903) bound & riveted to hose pipe with copper rivets & 1.5 mm copper wire.	Each	200	4,747	949387
1.4	Providing and Fixing stainless steel 63 mm dia instantaneous pattern branch short pipe, 20 mm dia nozzle conforming to IS 903, suitable for inter connection to hose pipe coupling complete as required.	Each	100	2,178	217835
1.5	Constructing masonry chamber 90x90x120 cms inside with 75 class designation brick work in cement mortar 1:5 (1 cement : 5 fine sand) for valve with 560 mm dia. SFRC Manhole cover with frame (Heavy duty) and R.C.C. top slab 1:2:4 mix (1cement:2 coarse sand : 4 graded stone aggregate 20 mm nominal size) necessary excavation foundation concrete 1:5:10 mix (1 cement : 5 fine sand and 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1cement :3 coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard design with FPS bricks.	Nos.	10	13,613	136132
1.6	Providing & fixing Gun Metal fire brigade connection unit consisting of 4 No. 63 mm dia instantaneous type male couplings with built-in check valves, 1 No., 150 mm dia flanged outlet complete with bolts, nuts and rubber insertions as required and as per IS standards	Each	6	16,870	101217
1.7	Providing & fixing Gun Metal fire brigade suction hose coupling (draw-out connection) with nut for female coupling as per IS standards complete with 100 mm dia GI suction pipe and 100 mm dia foot valve (to be connected to static tank). Provision of GI drop pipe and foot valve shall be made in all the fire water static storage tanks (2 No) (GI pipe to be paid separately through appropriate item while cost of foot valve to be included).	Each	1	6,260	6260
1.8	Providing & fixing Stainless steel cabinet (to enclose FB connection,draw off connection & for external hydrants) fabricated from 16 g sheet with full front glass door and locking arrangement duly painted with one coat of primer and two or more coats of synthetic enamel paint of approved make and shade and suitably mounted on a raised masonry platform as required (Approx 0.75m x 0.6m x 0.25m)	Each	6	10,262	61572
1.9	Providing and fixing single acting air release valve with screwed inlet 20 mm dia.	Each	22	1,985	43662

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.10	The rate shall include supply and fixing 50 mm dia Gun metal ball valve CI hand wheel suitable for pressure 15 Kg/sqcm. and confirming to relevant IS of the following size including providing necessary union/flange and making proper connection for air testing and drainage system.	Nos	14	3,118	43655
1.11	Providing and fixing pre fabricated 4 mm thick glass door (with SS frame) of size 2.1 m x 0.9 m with center opening for fire hose cabinet suitabely marked on the outside with the letters "FIRE HOSE" with locking arrangement including 1 No Hydrant landing valves, 1no fire hose reel, 2 Nos.15 m long 63 mm dia hose pipe,1 no branch pipe, 1No. fire man's axe and 2 Nos fire extiguishers.	Each	12	25,049	300585
1.12	Supplying and fixing of hose cabinet fabricated from of size 900 mm x 600 mm x 450 mm made of 3 mm aluminium sheet with 6 mm thick glazed glass doors i/c necessary locking arrangement suitable to accommodate external hydrant with butter fly valve, 2 Nos.15 mtr. Long Hose pipe, 1 No. branch pipe, mounted on wall OR raised brick platform 600mm in height built in brick masonary in cement mortat 1:5, 12mm thick plaster on all sides and finished with existing/ proposed external finish & duly painted with Post office red externally and white internally with synthetic enamel paint completein all respect, for external hydrants, as required.	Each	100	7,222	722170
1.13	Providing and fixing dial type pressure gauge (SS casing) with isolation cock and pipe.				
1.13.1	Dial diameter 100 mm caliberation 0-15 kg	Each	40	3,761	150422
1.14	Providing & fixing butterfly valve tested to a pressure not less than 15 Kg/Sq.cm. Including rubber gasket, flanges, nuts, bolts, washers & painting complete as required.				
1.14.1	65 mm dia	Each	10	3,197	31975
1.14.2	80 mm dia	Each	10	3,528	35283
1.14.3	100 mm dia	Each	10	4,521	45206
1.14.4	150 mm dia	Each	40	6,505	260210
1.14.5	200 mm dia	Each	8	16,208	129664

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.15	Providing & fixing dual plate CI wafer type check valve tested to a pressure of 15 Kg/sqcm. Including rubber gasket, flanges, union, nuts, bolts, washers & painting complete as required.				
1.15.1	65 mm dia	Each	18	5,970	107468
1.15.2	100 mm dia	Each	18	8,686	156354
1.15.3	150 mm dia	Each	24	14,685	352439
1.16	Providing and fixing Orifice plate made out of stainless steel plate (thickness as per specification) for 80/100/150 mm dia. pipe to reduce pressure upto 3.5 Kg/sqcm complete in all respects.	Each	112	1,544	172885
1.17	Providing and fixing standard firemans axe with heavy rubber handle.	Each	13	662	8600
1.18	Providing and laying non-pressure NP2 class (light duty) R.C.C pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc.complete.				
1.18.1	250 mm dia. R.C.C pipe	Mtr.	100	975	97526
1.19	Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) all-round R.C.C pipes including bed concrete as per standard design.				
1.19.1	250 mm dia. R.C.C pipe	Mtr.	100	3,467	346720
1.2	Providing & fixing brass quartzoid sprinklers (UL approved) of 15 mm dia size, suitable for sustaining the pressure on the seat & water hammer effect. The type & temperature rating shall be as follows :				
1.20.1	Supply, installation, testing and commissioning of 150 mm dia control valve inclusive of 1 no 150 mm dia butterfly valve, trainer, alarm valve with water motor gong, pressure gauges, test line with ball valve with necessary GI (H) Piping with threaded fittings of required pipe sizes complet. the item also includes providing and fixing 100 mm dia pressure gauges on sprinkler headers including ball valves, test control box brass strainer retard chamber	Each	1	55,129	55129
1.20.2	Providing, fixing, testing and comissioning of UL listed Pendent/Upright type sprinkler head rated at 68 degree centigrade.	Each	832	331	275205

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.21	Providing and fixing inspector's test assembly complete with test value, sight glass sectional drain valve union with corrosion resistant orifice all complete	Each	10	9,530	95302
1.22	Supply, installation, testing and commissioning of electrically driven multistage, single outlet high pressure centrifugal type fire hydrant /sprinkler pump, suitable for automatic operation consisting of the following:	Each	2	4,07,956	815912
	Horizontal multistage, single outlet, split casing centrifugal pump, suitable for operation on 415 volts ± 6%, 3 phase, 50 HZ AC supply. The installation shall be complete with flexible coupling and coupling guard as required. Fire pump shall have CI casing, CS diffusers, bronze impeller (hard finished and dynamically balanced) and SS (304) shaft with mechanical seal, capable for delivering 2850 LPM at outlet head of 90 mtrs. to ensure a minimum pressure of 3.5 Kg/Sqcm at the farthest or topmost hydrant / sprinkler. The installation shall be complete with necessary pressure gauge on delivery side.				
	Squirrel cage induction motor, TEFC type suitable for operation on 415 volts, 3 phase 50 HZ A.C supply, for the above pump with synchronous speed of 1500 RPM, conforming to IP 55 protection & class F insulation. The motor shall conform to IS 325-1978 (up to date).				
	Common base plate for (a) and (b) from M.S. Channel for required size.				
1.23	Supply, installation, testing and commissioning of Jockey pump (pressurisation pump) comprising of the following:	Each	1	93,720	93720
	Vertical centrifugal pump, suitable for operation on 415 volts ± 6%, 3 phase, 50 HZ A.C supply. The installation shall be complete with Flexible coupling and coupling guard, complete as required.				
	The pump casing shall be SS, shaft shall be SS & impeller/ shaft sleeve/casing wearing ring shall be bronze. The pump shall be provided with mechanical seal The system shall be complete with necessary pressure gauge with gun metal shut off cock on delivery side.				
	Squirrel cage induction motor TEFC type for operation on 415 V, 3 phase 50 Hz AC supply for the above pump with a synchronous speed of 2900 RPM as required.				
	Common base plate for (a) and (b) from M.S. channel as required size.				
	For pump defined above & of duty as follows :				
	Flow : 180 LPM				
	Head : 90 MTRS				

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.24	Providing, fixing, testing and commissioning of precharged air vessel (size 450 mm dia & 2000 mm height) for pressurization of hydrant / sprinkler system complete with adequate pressure switches (as per design/requirement) with valves to operate as per operating sequences including 25 mm dia drain valve, air release valve with stop cock on the top, 100 mm dia inlet with isolating valve duly painted from inside and outside complete as required.	Each	1	31,061	31061
1.25	Providing and fixing **200 mm** MS body Pot Strainer with stainless steel perforated sheet basket tested to a pressure of 15kg/sqcm, including rubber gasket, flanges, nuts, bolts and washers, complete as required.	Each	2	25,690	51380
1.25.1	Providing and fixing 80 **mm** MS body Pot Strainer with stainless steel perforated sheet basket tested to a pressure of 15kg/sqcm, including rubber gasket, flanges, nuts, bolts and washers, complete as required.	Each	1	7,167	7167
1.26	Providing and fixing carbon-di-oxide type fire extinguishers consisting of welded M.S. cylinderical body, squeeze lever discharge valve fitted with pressure indicating gauge internal discharge tube 30 cms long high pressure discharge hose, discharge nozzle, suspension bracket conforming to IS:15683 finished externally with red enamel paint and fixed to wall with brackets complete with internal charge.				
1.26.1	Capacity 4.5 Kg.	Each	110	6,787	746540
1.27	Providing and fixing mechanical foam type fire extingushers consisting of welded M.S. trolley mounted cylindrical body, squeeze lever discharge valve fitted with pressure discharge hose, discharge nozzle, trolley etc., ISI marked as per IS:13386 finished externally with red enamel paint.				
1.27.1	Capacity 50 lit (D.G.Room)	Each	1	12,693	12693
1.28	Providing and fixing carbon-di-oxide fire extingushers trolley mounted with all accessories internal discharge tube,high pressure discharge hose,discharge nozzle, ISI marked as per IS:2878 finished externally with red enamel paint.				
1.28.1	Capacity 22.5 kg.	Each	4	20,812	83249

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.29	Providing and fixing ABC Powder type fire extinguishers consisting of welded M.S. cylinderical body, squeeze lever discharge valve fitted with pressure indicating gauge internal discharge tube 30 cms long high pressure discharge hose, discharge nozzle, suspension bracket conforming to IS:15683 finished externally with red enamel paint and fixed to wall with brackets complete with internal charge.				
1.29.1	Capacity 6.0/5.0 Kg.	Each	40	2,949	117946
1.3	Providing and fixing fire extinguisher water type of capacity 9 litre with internal plastic lining and IS marked as per IS 940 with gun metal cap, CO2 cartridge and initial refill.	Each	12	2,728	32733
1.31	The rate shall include providing two coats of synthetic enamel paint of approved shade over two coats of primer on pipes, fittings and supports, including painting of legends both direction arrow as per the approval of the Engineer.				
1.31.1	25 mm dia	Mtrs	120	20	2382
1.31.2	32 mm dia	Mtrs	120	22	2646
1.31.3	40 mm dia	Mtrs	60	28	1654
1.31.4	50 mm dia	Mtrs	60	33	1985
1.31.5	65 mm dia	Mtrs	60	39	2315
1.31.6	80 mm dia	Mtrs	360	44	15877
1.31.7	100 mm dia	Mtrs	360	50	17862
1.31.8	150 mm dia	Mtrs	350	55	19295

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.31.9	200 mm dia	Mtrs	24	66	1588
1.31.10	250 mm dia	Mtrs	24	77	1852
1.32	The rate shall include supply and fixing double flanged flexicon rubber expansion joint with unit control of standard length. Tested to a pressure of 15 Kg/sqcm including rubber gaskets, flanges, nuts, bolts and washers complete as required and as per specifications.				
1.32.1	80 mm dia	Nos.	2	9,151	18303
1.32.2	200 mm dia	Nos.	4	20,729	82914
2	Providing and fixing set of 4 fire buckets capacity 9 ltrs fabricated from 24 gauge MS sheet brackets filled with jamuna sand, two coats of anti corrosive paint inside and outside and two coats of white enamel inside and two coats of postal red enamel outside with " FIRE" marked on each bucket, including M.S. fabricated 4 bucket standard size with 4 hooks. For Hanging buckets including painting with two coats of anti corrosive primer and two coats of postal red enamel on all surfaces of approved quality and make complete in all respects.	No.	8	1,991	15925
	TOTAL FOR F.02				**24425587**
F.03	**CLEAN AGENT BASED PANEL FLOODING SYSTEM -FIRE TRACE TUBE SYSTEM**				
	Supply, fixing, testing and commissioning of Clean Agent tube based detection and Fire Suppression System for Electrical Panels, consisting of the following components: (UL/FM/VDS Approved)				
1.1	Direct Low Pressure Clean Agent system 10 LBS capacity, complete with Clean agent) (NOVEC 1230 or equivalent), D.O.T/ TC approved Cylinder, nickel plated brass valve with slip on union connector, isolation valve, plug pressure switch port and 195 psi Pressure gauge fittings, operating pressure 195 psi (13.45 Bar) at 70 Deg F, supplied complete with Bolt Pattern Bracket and: INCLUDING	NO.	11	87,435	961783

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Fill Port				
	Outlet Port				
	End of Line Adaptor,				
	End of line Adopter				
	Pressure switch				
1.2	Flexible 4/6mm Polymer Detection Tube 195 Deg C rated complete with all necessary fittings & supports.o make each entire system functional - 2 Nos.	Mtrs.	440	1,047	460880
1.3	System Indication & Control Unit (SICU) integrated panel for indicating the Health and operational status of the system, complete with ports to interface pressure switch, Audio visual Alarm unit, and output to FACP and BMS/ SCADA System including all necessary accessories.	NO.	11	15,436	169798
2.1	Direct Low Pressure Clean Agent system 5 LBS capacity, complete with Clean agent (NOVEC 1230 or equivalent), D.O.T/TC approved Cylinder, nickel plated brass valve with slip on union connector, isolation valve, plug pressure switch port and 195 psi Pressure gauge fittings, operating pressure 195 psi (13.45 Bar) at 70 Deg F, supplied complete with Bolt Pattern Bracket and: INCLUDING	NO.	10	80,819	808194
	Fill Port				
	Outlet Port				
	End of Line Adaptor,				
	End of line Adopter				
	Pressure switch				
2.2	Flexible 4/6mm UL 521, UL listed Polymer Detection Tube 195 Deg C rated complete with all necessary fittings & supports.o make each entire system functional - 2 Nos.	Mtrs.	400	1,047	418982
2.3	System Indication & Control Unit (SICU) integrated panel for indicating the Health and operational status of the system, complete with ports to interface pressure switch, Audio visual Alarm unit, and output to FACP and BMS/ SCADA System including all necessary accessories.	NO.	10	15,436	154362
	Note: The items indicated above are notable items. The vendor to include all allied and implid items in required quantity at no extra cost.				
	TOTAL FOR F.03				**2973998.025**
F.04	**CLEAN AGENT FIRE SUPPRESSION SYSTEM - TOTAL FLOODING**				

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	SIGNALLING EQUIPMENT ROOM (SER), TELECOM EQUIPMENT ROOM (TER) & UPS (S&T)				
1	80 Ltr Cylinder/Valve Assembly & Pressure Gauge (CCOE approved) including piping in compliance to the requirements specified in clause no.4.2.1 of NFPA-2001	Nos.	5	1,23,697	618484
2	Clean Agent (FM200/Novec 1230/Equivalent) filled in above cylinder (Kgs)	Kgs	325	3,258	1058803
3	Master cylinder kit comprising Solenoid actuator, Manual actuator, adapters, discharge hose, warning sign etc.	Nos.	3	67,193	201580
4	Slave cylinder kit comprising Pneumatic actuator, Actuation hose, Discharge hose, connectors etc.	Nos.	3	48,359	145076
5	Manifold check valve	Nos.	5	26,725	133623
6	Discharge pressure switch	Nos.	3	23,543	70629
7	Discharge nozzles	Nos.	10	6,872	68720
8	Cylinder bracket	Nos.	5	1,273	6363
9	Manifold for connecting cylinders	Lot	3	17,816	53449
10	Gas release Panel including smoke detector ,MCP , Abort switch & Strobe cum sounder	Nos.	3	2,41,477	724431

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	TOTAL FOR F.04				**3081159**
F.05	**FIRE PROTECTIVE APPARATUS**				
1	Set of protective clothing containing 2 Nos. Each following items ;	Nos.	1	1,10,258	110258
	Coat				
	Trouser				
	Gloves				
	Anti-Flash Hood				
	Helmets				
	Boots				
	FRP/stainless steel case for storage of Fire Suits				
2	Self- contained open circuit type compressed air Breathing apparatus set confirming to EN-137: 2006, standard complete with one spare cylinders including	Nos.	2	1,21,284	242568
	Air cylinder with valve				
	Back plate with body harness				
	Face mask				
	Pressure reducer, Pressure gauge & warning whistle				
	Lung demand valve				
	Wall mount cabinet for Breathing Apparatus				
	Hoses				
	Carrying case				
	Spare air cylinder				
3	Water-jel fire blanket consisting scientifically formulated cooling gel and a carrier in size 96" * 72" n canister.	Nos.	1	7,151	7151
4	Water-jel fire blanket consisting scientifically formulated cooling gel and a carrier in size 72" * 60" n canister.	Nos.	1	5,721	5721
5	Snap light emergency evacuation system complete with two high intensity yellow klcolour cyalume lightsticsk (light proof, water proof, wind proof, non explosive, and non toxic) with temper proof pin on a all mounted unit.	Nos.	2	14,302	28603

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
6	Emergency Combination EYE / FACE Wash push level and padel operated and Drench Shower - Pull Rod Operated.	Nos.	3	4,545	13635
	TOTAL FOR F.05				**407936**
F.06	**TRANSFORMERS PROTECTION SYSTEM :**				
1	Design, Supply, Installation, Testing & Commissioning of fire protection system for transformers comprising of the following:				
1.1	45 Kg capacity CO2, IHP Valve Assembly with automatic valve, push in connector for tube, 45 Kg CO2 gas & mounting bracket.	Nos.	2	89,082	178164
1.2	End of Line adapter	Nos.	2	3,818	7636
1.3	Pressure Switch	Nos.	2	8,272	16544
1.4	Linear pneumatic heat Detection Tube with all necessary fittings & supports.	RM	40	1,527	61085
1.5	Master Control Unit for controlling each system, complete with pressure switches, buzzers and electronic hooters, including all necessary accessories + electrical wiring to make each entire system functional.	Nos.	2	15,271	30542
1.6	Auto weight measuring unit for cylinders with automatic audio/visual alarm.	Nos.	2	13,999	27997
1.7	Discharge Hose With Two nozzle Kit	Set	2	26,769	53538
	TOTAL FOR F.06				**375506**
F.07	**VESDA SYSTEM FOR SER , TER & UPS ROOM:**				

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1	Laser-Based Absolute Smoke Detection system with single inlet aspiration detector for Up to 250 m2 (2500 sq. ft.) coverage; Wide sensitivity range - 0.025%–20% obs/m; 3 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter; 3 Nos of inbuilt potential free relay outputs;supports linear pipe length of 25m or branched pipe up to 30m; supports 10 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; . Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. VESDA Laser Focus Detector with display - VLF 250 or equivalent (SER & TER)	Nos.	2	2,52,301	504601
2	Laser-Based Absolute Smoke Detection system with single inlet aspiration detector for Up to 500 m2 (5000 sq. ft.) coverage; Wide sensitivity range - 0.025%–20% obs/m; 3 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter; 3 Nos of inbuilt potential free relay outputs;supports linear pipe length of 50m or branched pipe up to 60m; supports 20 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; . Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. VESDA Laser Focus Detector with display & network card - VLF 500 or equivqlent (UPS ROOM)	Nos.	1	3,35,303	335303
3	Short wave length laser-Based Absolute Smoke Detection system with single pipe inlet, 1000 m2 coverage; Wide sensitivity range - 0.005%–20% obs/m ; 4 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter with memory; 7Nos of inbuilt potential free relay outputs;supports linear pipe length of 100m linear or branched pipe up to 130m per pipe; supports 30 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; TCP/IP, WiFi & VESDANet connectivity for central monitoring & monitoring of Andriod/iOS tablets/smartphones, facility to include analytics for notification of smoke from Diesel and PVC wire burning, notification for dust Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. VESDA E VEP A00-1P or equivalent	Nos.	2	4,16,015	832031

(Attachment No-11 to Addendum No-5)
PART-B - DEPOT FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
4	Short wave length laser-Based Absolute Smoke Detection system with 4 pipe inlets, 2000 m2 coverage; Wide sensitivity range - 0.005%–20% obs/m; 4 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter with memory; 7Nos of inbuilt potential free relay outputs;supports linear pipe length of 70m per pipe (total 280m) or branched pipe up to 130m per pipe; supports 40 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; TCP/IP, WiFi & VESDANet connectivity for central monitoring & monitoring of Andriod/iOS tablets/smartphones, facility to include analytics for notification of smoke from Diesel and PVC wire burning, notification for dust Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. VESDA E VEP A00-P or equivalent	Nos.	1	5,10,822	510822
5	Capilllary sampling point set for sampling from below false ceiling (room) E700-TA+CSC+CT+SP+SPLR or equivalent	Nos.	35	3,161	110640
6	Power Supply units for VLF detectors - Power supply unit operate on 230 volts AC mains input & provide 24 to 30 volt DC output for powering up the detector, support battery backup in case of AC mains failure & have built in charging circuit for batterys. VESDA Model - VPS 220E or equivalent	Nos.	3	15,577	46730
7	Power Supply units for VEU detectors - Power supply unit operate on 230 volts AC mains input & provide 24 to 30 volt DC output for powering up the detector, support battery backup in case of AC mains failure & have built in charging circuit for batterys. Power supplies to be mounted on top of the VEU detectors as StaX units VESDA Model - VPS 250 STX or equivalent	Nos.	3	15,577	46730
8	Sampling Pipe - Smooth bore UPVC or CPVC or ABS Pipe 25 mm Outer Dia & 19 to 21mm Inner Dia with all required bends joints & accesorys (approx qty of pipe)	RM	600	211	126751
	TOTAL FOR F.07				**2513608**
	TOTAL				**37157784**

(Attachment No-11 to Addendum No-5)
PART-B - EOT - BOQ - Depot

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
B4-2	**Sub Section - 1 - GENERAL**				
1.1	The BOQ specified below include the latest relevent standards, specifications, drawing details and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval before use as the Employer's representative may opt.				
1.2	The description as mentioned in BOQ, specifications, special conditions, GCC drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.				
1.3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.				
1.4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.				
1.5	Contractor's shall quote resonably rates against each item of BOQ (both in word and figure)				
B4-2	**Sub Section - 2-EOT CRANE**				
2.1	Design, manufacture, supply, installation, testing and commissioning of Electric Overhead Travelling Cranes with Gantry rail and Downshop leads to be installed in the Workshop bay, Inspection bay and other maintenance buildings. The location of cranes in the various buildings is shown in drawings complete as per below.				

(Attachment No-11 to Addendum No-5)
PART-B - EOT - BOQ - Depot

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	**Heavy Lifting bay :15/5 Ton** The rate include Design, manufacture, supply, installation, testing and commissioning transportation of 15T/5T EOT Crane for span 30m and bay length 301 m with Main hoist motor along with accessories, Auxiliary hoist motor along with accessories, and long/cross travel motors along with accessories. Cranes will also be controlled from pendent switch and radio remote control. All the wire ropes along with hook, rope drum and necessary safety devices etc. Necessary arrangement of 3-phase power supply for working the crane throughout the long travel length along with current collection system. The EOT crane shall be complete in all respects and as per technical specifications. 1)The price shall also include one set of spares and tools mentioned in the specification. 2) (In single bay with individual operation control / pendent)	Nos	2	72,34,005	**1,44,68,010**
b)	**Inspection Bay: 2 Ton** The rate include Design, manufacture, supply, installation, testing and commissioning of 2T EOT Crane for span 9m, bay length 295 m with Main hoist motor along with accessories, and long/cross travel motors along with accessories. Crane will be provided on inspection bay with special girder system in the bay. Cranes will also be controlled from pendent switch and radio remote control. All the wire ropes along with hook, rope drum and necessary safety devices etc. Necessary arrangement of 3-phase power supply for working the crane throughout the long travel length along with current collection system. The EOT crane shall be complete in all respects and as per technical specifications. (In single bay with individual operation control / pendent)	nos	2	23,70,078	**47,40,157**

(Attachment No-11 to Addendum No-5)
PART-B - EOT - BOQ - Depot

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
c)	**Bogie workshop Area: 2 Ton** The rate include Design, manufacture, supply, installation, testing and commissioning of 2T EOT Crane for span 14.50m, bay length 96m with Main hoist motor along with accessories, and long/cross travel motors along with accessories. Crane will be provided on inspection bay with special girder system in the bay. Cranes will also be controlled from pendent switch and radio remote control. All the wire ropes along with hook, rope drum and necessary safety devices etc. Necessary arrangement of 3-phase power supply for working the crane throughout the long travel length along with current collection system. The EOT crane shall be complete in all respects and as per technical specifications. (In single bay with individual operation control / pendent)	nos	1	23,26,687	**23,26,687**
d)	**Under Floor Wheel Lathe :5 Ton** The rate include Design, manufacture, supply, installation, testing and commissioning of 5T EOT Crane for span 7 m, bay length 40 m with Main hoist motor along with accessories, and long/cross travel motors along with accessories. Cranes will also be controlled from pendent switch and radio remote control. All the wire ropes along with hook, rope drum and necessary safety devices etc. Necessary arrangement of 3-phase power supply for working the crane throughout the long travel length along with current collection system. The EOT crane shall be complete in all respects and as per technical specifications. 1)The price shall also include one set of spares and tools mentioned in the specification. 2) (In single bay with individual operation control / pendent)	nos	1	41,77,059	**41,77,059**
	TOTAL				**2,57,11,913**

(Attachment No-11 to Addendum No-5)
PART-B - CAS - BOQ - Depot Air Cxompressor and its Piping Network

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
B4	**AIR COMPRESSOR & EOT CRANE**				
	Sub Section - 1 - GENERAL				
1.1	The BOQ specified below include the latest relevent standards, specifications, drawing details and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval before use as the Employer's representative may opt.				
1.2	The description as mentioned in BOQ, specifications, special conditions, GCC drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.				
1.3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.				
1.4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.				
1.5	Contractor's shall quote resonably rates against each item of BOQ (both in word and figure)				
2	**Sub Section - 2 -Maintenance Inspsection Workshop and Central Store**				
2.1	Designing, Supply, installation ,testing and commissioning of air compressor capacity 170 CFM at 10 bar with 30 KW Electrical motor 3 Phase 440 Volts complete with all accessories along with Electrical Control panel, necessary wiring , earthing,reservoir tank of 1500 litres capacity with apropriate inlet and outlet flanges designed for full rated capacity of 2 compressors etc. complete in all respects and as per technical specifications. **BMS Compatibility -** All the compressors / system shall be design such that it should be compatible with BMS for compressor operation monitoring and it should be with open software protocol for easy compatibility with other software. **The price shall also include one set of spares and tools mentioned in the specification.**	**Nos**	**2**	14,44,348	28,88,696

(Attachment No-11 to Addendum No-5)
PART-B - CAS - BOQ - Depot Air Cxompressor and its Piping Network

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.2	Providing MS pipes conforming to IS 1239 (Class C) complete with all fittings such as elbows, sockets, tees, unions, reducers, flanges,clamps and plugs etc with threading, jointing and making connections including cutting hole in wall/floor/slab and making good the same with cement concrete 1:2:4 complete in all respect as per specifications including painting pipe and fittings with two or more coat of synthetic enamel paint of approved quality as per pipe colour over a coat of red oxide primer outside with 1 coat of primer and 2 coats of enamel paint,complete.				
a)	100 mm dia nominal bore	RM	200	2,748	5,49,528
b)	65 mm dia nominal bore	RM	1500	1,643	24,64,274
c)	25 mm dia nominal bore	RM	600	621	3,72,453
d)	20 mm dia nominal bore	RM	150	451	67,643
e)	15 mm dia nominal bore	RM	100	343	34,290
2.3	Providing M.S. structural work, fabricated from standard sections eg. M.S. rods, angles channels including cutting to size, drilling holes, fixing fastener /insert plates in RCC structural members as directed by the Engineer-in-Charge including cutting and making good the walls and floors (for supports,clamps,M.S. ladders,gratings etc.)	Kg	1600	159	2,54,035
2.4	Providing gunmetal ball valve with SS ball & teflon seats and seals inside spindle type tested to 500 psi, complete.				
a)	25 mm dia nominal bore	Nos	100	6,858	6,85,807

(Attachment No-11 to Addendum No-5)
PART-B - CAS - BOQ - Depot Air Cxompressor and its Piping Network

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	20 mm dia nominal bore	Nos	8	4,934	39,472
c)	15 mm dia nominal bore	Nos	50	4,298	2,14,893
2.5	Wafer Type, Cast Steel, Non Return Valves, Suitable for ASA 150 flanges,.				
a)	Size 100 mm nominal bore	Nos	4	54,275	2,17,099
b)	Size 65 mm nominal bore	Nos	7	36,954	2,58,679
2.6	Providing cast iron body PN 16, IS: 210 FG 220 and double flange simple operation type butterfly valve conforming to IS: 13095 with SS304 disc and shaft nitnile rubber replaceable seat of the following size complete with bolts, nuts, washers and rubber isertions as per specification.				
a)	100 mm dia noiminal bore	Nos	5	15,460	77,302
b)	65 mm dia nominal bore	Nos	5	11,201	56,006
2.7	Pressure Gauges, 150 mm Dial, complete with mounting nipple and isolation valve. Range 0 - 15 Kg/Cm Sq.	Nos	30	17,315	5,19,449
2.8	Auto Drain Assembly, with Solenoid Valve and Timer. Timer should be adjustable between 5 Mins to 120 Mins. Size 15 mm NB.	Nos	30	43,142	12,94,256
2.9	Providing Filter regulator 1/2" at every droplet after the ball valve suitable for 10 bar pressure.	Nos	130	19,802	25,74,312
Total -1					**1,25,68,194**

(Attachment No-11 to Addendum No-5)
PART-B - CAS - BOQ - Depot Air Cxompressor and its Piping Network

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Sub Section - 3 - Compressor for UFWL/ Heavy Washing Shed				
3.1	Designing, Supplying, Installing, testing and commissioning of air compressor capacity 55 CFM at 10 baar with 11 KW Electrical motor 3 Phase 440 Volts complete with all accessories along with Electrical control panel, necessary wiring, earthing ,reservoir tank of 800 litres capacity with apropriate inlet and outlet flanges designed for full rated capacity of 2 compressors etc. complete in all respects and as per technical specifications. **BMS Compatibility** All the compressors / system shall be design such that it should be compatible with BMS for compressor operation monitoring and it should be with open software protocol for easy compatibility with other software. **The price shall also include one set of spares and tools mentioned in the specification.**	Nos	2	6,19,029	12,38,058
3.2	Providing and fixing MS pipes conforming to IS 1239 (Class C) complete with all fittings such as elbows, sockets, fees, unions, reducers, flanges,clamps and plugs etc with threading, jointing and making connections including cutting hole in wall/floor/slab and making good the same with cement concrete 1:2:4 complete in all respect as per specifications including painting pipe and fittings with two or more coat of synthetic enamel paint of approved quality as per pipe colour over a coat of red oxide primer outside with 1 coat of primer and 2 coats of enamel paint, complete.				
a)	65 mm dia nominal bore	RM	100	1,643	1,64,285

(Attachment No-11 to Addendum No-5)
PART-B - CAS - BOQ - Depot Air Cxompressor and its Piping Network

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	25 mm dia nominal bore	RM	100	621	62,075
c)	15 mm dia nominal bore	RM	50	343	17,145
3.3	Providing and fixing M.S. structural work, fabricate from standard sections eg. M.S. rods, angles channels including cutting to size, drilling holes, fixing fastenera/insert plates in RCC structural members as directed by the Engineer-in-Charge including cutting and making good the walls and floors (for supports, clamps, M.S. ladders, gratings etc.)	Kg	600	159	95,263
3.4	Providing and fixing gunmetal ball value with SS ball & teflon seats and seals inside spindle type tested to 500 psi, complete.				
a)	65 mm dia nominal bore	Nos	5	6,858	34,290
b)	25 mm dia nominal bore	Nos	25	4,934	1,23,352
c)	15 mm dia nominal bore	Nos	15	4,298	64,468
3.5	Wafer Type, Cast Steel, Non Return Valves, Suitable for ASA 150 flanges,.				
a)	Size 65 mm nominal bore	Nos	3	36,954	1,10,863
3.6	Pressure Gauges, 150 mm Dial, complete with mounting nipple and isolation valve. Range 0 - 15 Kg/Cm Sq.	Nos	8	17,315	1,38,520
3.7	Auto Drain Assembly, with Solenoid Valve and Timer. Timer should be adjustable between 5 Mins to 120 Mins. Size 15 mm NB.	Nos	8	43,142	3,45,135
3.8	Providing and fixing Filter regulator 1/2" at every droplet after the ball valve suitable for 10 bar pressure.	Nos	50	19,802	9,90,120
Total -2					**33,83,574**
GRAND TOTAL = (TOTAL -1 + TOTAL-2)					**1,59,51,768**

(Attachment No-11 to Addendum No-5)
PART-B - DEP - VAC System

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
H.01	**AIRCONDITIONING SYSTEM WITH VRV/VRF**				
1	**Air Cooled VRV System**				
	Design, Supplying, installing, testing and commissioning of Air Cooled Variable Refrigerant Volume/ Veriable Refregent Flow System suitable for R410A and 415V, 50 Hz, AC supply. The unit shall consist of indoor units and external condensing units and other accessories complete in all respects. The unit shall be fully charged with gas and oil.				
2	**Outdoor Unit**				
	Design, Supplying, installing, testing and commissioning of Modular Type Outdoor Condensing Units equipped with highly efficient Inverter scroll compressors to work on 415 V, 50 Hz AC suply with digital/ inverter technology, special acryl precoated heat exchanger, low noise condenser fan with motor, auto check function for errors in display panel, auto address setting, as per specifications. The units shall be complete with necessary mounting frames.				
	The units shall be complete with necessary mounting frames				
a	12HP	Nos.	5	3,39,733	16,98,667
b	16HP	Nos.	10	4,42,844	44,28,438
3	**Indoor Units**				
3.1	Design, Supplying, installing, testing and commissioning of Wall Mounted Type Indoor Units each complete with coil, filter, cordless remote etc. Air conditioners with evaporating unit comprising of cooling coil, blower with motor and 220 volt, 1 phase, 50 Hz, AC supply all and as per specifications. The rate will also include initial run of drain piping upto drain header.				
a	1 TR	Nos.	11	35,535	3,90,887
b	1.28 TR	Nos.	1	35,535	35,535

(Attachment No-11 to Addendum No-5)
PART-B - DEP - VAC System

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
c	1.5 TR	Nos.	1	36,435	36,435
d	2 TR	Nos.	16	38,794	6,20,710
e	3.3 TR	Nos.	30	78,608	23,58,250
3.2	Design, Supplying, installing, testing and commissioning of celing mounted FCU type / cassette type metallic body indoor units each complete with cooling coil, prefilter, blower with motor, cordless remote,etc,including necessary steel supporting structure for ceiling mounting .The unit casing shall be stell construction and 220 volt, 1phase, 50Hz, AC supply all as per specification.The rate will also include initial run of drain piping upto drain header.				
a	1.5 TR	Nos.	4	33,355	1,33,421
b	2 TR	Nos.	4	35,596	1,42,383
c	2.5 TR	Nos.	4	47,420	1,89,680
3.3	Design, Supplying,, installation, testing and commissioning of Centralized Remote controller with scheduler for operation of indoor units.	Nos	10	38,666	3,86,659
3.4	**Scheduled Timer**				
	Design, Supplying,, installation, testing and commissioning of Scheduled Timer.	Nos	10	8,001	80,012
4	**Refrigerant Piping for VRV/VRF system**				

(Attachment No-11 to Addendum No-5)
PART-B - DEP - VAC System

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Design, Supplying, installing, testing and commissioning of interconnecting refrigerant pipe work with elastomeric nitrile rubber/closed cell expanded polythene tubular insulation between each set of indoor & outdoor units as per specifications, all piping should be laid on Galvanised/Powder Coated tray supported by Galvanised M S Hangers & Clamps. The rate also includes cost of Y-joints, distributer and headers in the refrigeration piping system wherever required. The rate also includes items required to complete the piping work and nothing extra should be payable.				
4.1	41.3 mm O.D. (Outer dia) (insulation: 19 mm)	RM	40	2,172	86,884
4.2	34.9 mm O.D. (Outer dia) (insulation: 19 mm)	RM	40	2,119	84,767
4.3	28.6 mm O.D. (Outer dia) (insulation: 19 mm)	RM	180	2,067	3,72,122
4.4	25.4 mm O.D.(Outer dia) (insulation: 19 mm)	RM	140	1,633	2,28,610
4.5	22.2 mm O.D. (Outer dia) (insulation: 13 mm)	RM	140	1,399	1,95,885
4.6	19.1 mm O.D. (Outer dia) (insulation: 13 mm)	RM	140	1,183	1,65,630
4.7	15.9 mm O.D. (Outer dia) (insulation: 13 mm)	RM	140	938	1,31,362
4.8	12.7 mm O.D. (Outer dia) (insulation: 13 mm)	RM	130	809	1,05,209
4.9	9.5 mm O.D. (Outer dia) (insulation: 13 mm)	RM	130	636	82,705
4.1	6.4 mm O.D. (Outer dia) (insulation: 13 mm)	RM	150	540	81,040
5	**Control Cum Transmission Wiring**				

(Attachment No-11 to Addendum No-5)
PART-B - DEP - VAC System

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Design, Supplying, installing, testing and commissioning of control cum transmission wiring of 2 core x 1.5 sqmm copper FRLSH, XLPE insulated cable in suitable GI conduits accessories between indoor and outdoor units. Necessary securing of conduit shall be made by contractor. After completion of work wall and floor shall be repaired and brought to its original finish. The rate will also include cost of laying of GI conduit between indoor and outdoor units.	RM	1500	481	7,21,090
6	**AIR COOLED SPLIT TYPE AIR-CONDITIONERS**				
6.1	**Air Cooled Split type wall mounted Air conditioners**				
	Design, Supplying, installing, testing and commissioning of Inverter Based Energy Efficient Air Cooled Split type wall mounted Air conditioners with evaporating unit comprising of cooling coil, blower with motor and condensing unit comprising hermetically sealed rotary compressor, condenser coil, and propeller fan. Unit shall be complete with controls, interconnecting copper refrigerant piping with insulation, drain pipes and electrical cabling etc. between evaporative and condensing unit, refrigerant gas and oil and complete as per specifications. The unit shall be suitable for operating on 240 volt, 1 phase, 50 Hz AC supply with five star energy rating. The units shall be suitable for chorded remote operation. The refrigerant piping & cabling shall run in PVC sleeve Steel supporting structure for outdoor units suitable for wall mounting / floor mounting. Nothing extra shall be paid on any account i.e. refrigerant pipes, drain pipes etc.				
a)	Capacity 1.5 TR	Nos	8	74,251	5,94,010
b)	Capacity 2.0 TR	Nos	8	93,036	7,44,288
6.2	**Condensate Drain Piping:**				
	Providing, fixing and testing GI Class B drain piping for condensate from unit to nearest suitable drain system as per site conditions as per instructed at site engineer complete with all required fittings and providing clean out plug at suitable location for the pipe when required complete with 6mm thick elastomeric nitrile rubber insulation over GI pipe:				

(Attachment No-11 to Addendum No-5)
PART-B - DEP - VAC System

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	32mm Dia.	RM	90	550	49,517
	25mm Dia.	RM	185	549	1,01,581
	TOTAL OF HEAD-H01				**1,42,45,775**
H.02	**VENTILATION SYSTEM**				
1	Design, Supplying,, installation, testing and commissioning of following equipment .				
1.1	**Propeller Type Fans**				
	Design, Supply. Installation, testing and commissioning of Propeller type fan wall or panel mounting to convey air directly to out side complete with motor suitable for 240/440 volts, 1/3 phase, 50 Hz AC supply, mounting frames and louvers and complete as per specifications.				
	Capacity 800 CMH	Nos.	2	10,996	21,991
	Capacity 1200 CMH	Nos.	2	10,996	21,991
	Capacity 2000 CMH	Nos.	6	10,996	65,974
	Capacity 2200 CMH	Nos.	1	14,248	14,248
	Capacity 2500 CMH	Nos.	24	14,248	3,41,960
	Capacity 2800 CMH	Nos.	4	16,387	65,548
	Capacity 3200 CMH	Nos.	3	17,925	53,776
1.2	**Tube Axial Type Fans for toilet exhaust(Through Ducting)**				
	Design, Supply. Installation, testing and commissioning of Vane Axial flow fans including motors, anti vibration mounts, flexible sleeves. Fan motors and all accessories shall be complete as per Specifications.(Bidders are required to optimize the total pressure as per final detailed design to achieve the performance without any additional cost to MMRC)				

(Attachment No-11 to Addendum No-5)
PART-B - DEP - VAC System

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Capacity 2000 CMH	Nos.	2	37,557	75,114
	Capacity 3600 CMH	Nos.	2	41,682	83,364
	TOTAL OF HEAD-H02				**7,43,968**
3	**AIR DISTRIBUTION SYSTEM**				
	G.I. Sheet Metal Ducts				
3.1	Design, Supplying, installing, testing and commissioning of factory fabricated G.I. Sheet metal ducts (275 GSM) with flanges complete with supports, vanes, links, levers and quadrants etc. as per specifications and drawings. The rates shall include all materials of the duct and labour for suspension and supporting arrangement for plenums, ducts, complete with fire retardant flexible connection as required and as per specifications.				
3.2	0.63mm (24 Gauge)	Sqm	120	938	1,12,596
3.3	0.80 mm (22 Gauge)	Sqm	95	1,110	1,05,479
3.4	1.00 mm (20 Gauge)	Sqm	20	1,539	30,784
3.5	1.25 mm (18 Gauge)	Sqm	20	1,899	37,973
H03	**Grilles and Dampers**				
1	**G.I Dampers**				
	Design, Supplying, installing, testing and commissioning of G.I construction Duct Dampers for Controlling the Airflow in Ducts as per specification..	Sqm	2	7,992	15,983

(Attachment No-11 to Addendum No-5)
PART-B - DEP - VAC System

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2	**Grilles without Dampers**				
	Design, Supplying, installing, testing and commissioning of powder coated extruded aluminum sections grills as per specification.	Sqm	2	8,778	17,555
3	**Grilles with Dampers**				
	Design, Supplying, installing, testing and commissioning of powder coated extruded aluminium section grills with dampers for supply air terminal for air-conditioning as per specification..	Sqm	10	13,325	1,33,247
4	**Linear Grills**				
	Design, Supplying, installing, testing and commissioning of powder coated extruded aluminium section Linear grills supply / Return air as per specification..	Sqm	10	12,791	1,27,911
5	**Exhaust/Fresh Air Louvers**				
	Design, Supplying, installing, testing and commissioning of exhaust air/fresh air louvers of powder coated extruded aluminium construction with bird screen, minimum 80 mm deep, as per specification.	Sqm	45	11,509	5,17,894
	TOTAL FOR H.03				**10,99,422**
	TOTAL OF ALL				**1,60,89,165**

(Attachment No-11 to Addendum No-5)
PART-B - BMS BOQ - Depot

S.N.	Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
A	**BUILDING MANAGEMENT SYSTEM (BMS)**				
1	**Workstation in Depot Control Center (Maintenance Workshop & Central Store)**				
1.1	BMS Workstation shall comprise of the following minimum hardware: Intel Dual Core 3.2 GHz processor, 4 GB of RAM, Dual Screen 22" LED Color Display, 108 Keys - Keyboard, Optical Scrolling Mouse and Pad, 500 GB HDD 2 SATA Hard Disk Drive DVRCombo Drive, Built in dual gigabit port RAID controller, Graphics Card – Nvidia Quadro K6000 graphics or equivalent for High Quality BMS Graphics, Removable storage device (DVD - Read/Write), Minimum 8 X Speed. 2 Nos. USB 2.0 port, 1 Centronic parallel port Minimum 4 USB port, 2parallel Port, 2 Serial Port, Dual LAN Card, License copy of MS office & antivirus software and with all the required software SQL server Fully Redundant Power Supply & Fan Unit 100/1000Mbps network card as per Tender Specifications/relevant standards/as per direction of engineer-in-charge. 132 Column 240 CPS Printer 500 VA UPS with half an hour battery backup	No	1	1,69,690	1,69,690
2	**BMS Equipment & Local/Distributed IO's**				

(Attachment No-11 to Addendum No-5)
PART-B - BMS BOQ - Depot

S.N.	Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.1	**PROGRAMMABLE & APPLICATION SPECIFIC CONTROLLER (PLC) - UL LISTED** SITC of Programmable and Application specific 32 bit, Supplyig, Installing, Testing & Commisioning of Programmable Logic Controllers with following specifications 1) Two identically- configured PLC processors are connected in a “Hot Standby” arrangement as “Master” and “Standby” so that when a component of the Master PLC fails, the standby PLC will take over automatically without interrupting the plant operation. 2) 32 bit CPU module with Ethernet Port for Programming / SCADA applications 3) Program Execution watching 4) Built-in hardware real-time clock 5) Semi conductor memory 6) Input supply 240V 7) Power consumption not more than 5kVA 8) CPU Processor module with Ethernet Port for Programming / SCADA applications The PLCs will be able to continuously operate under the following environment conditions a) Operating temperature: 0 to 40 deg. C b) Relative humidity: upto 95% All the PLCs and allied equipments shall be supplied, installed and commisioned with metal enclosure complying to the Electro - Magnetic Compatibility as per the Technical Specification-with metal enclosure complying to the Electro - Magnetic Compatibility as per the Technical Specification-BMS Systems. The CPU shall have the following key features - a) Industrial type and 2 identical CPU's b) RS 485 port c) Separate Hard disk (Internal Memory) for individual CPU's All PLC Controller input modules served equipment from outside are protected against voltage transients. All input/output modules are galvanically separated from CPU & internal bus. It is	LOT	1	97,24,115	97,24,115

(Attachment No-11 to Addendum No-5)
PART-B - BMS BOQ - Depot

S.N.	Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.2	The same shall be considered as a cumulative no of IOs as per the RIOs detailed below PLC for Station - Supply, Testing and Commissioning of Redundant Remote Input Output modules including IO racks compatible for communication protocols like (Modbus, Profibus, Ethernet, TCP-IP etc.,) with PLC's or Operating System. It shall be of communicating all station I/O's with the LSC. It should be supplied with wheather proof tight enclosure and shall comply to intrinsically safe if used in Hazardous area. Shall be of IP 55 and RIO cubicle shall be mounted on the base frame made of galvanised sheet channel with a minimum height of 100mm. The RIO's will be able to continuously operate under the following environment conditions. a) Operating Temperature: 0 to 40 deg. C b) Relative Humidity: upto 95% All the RIOs, allied equipments including interconnections shall be supplied, installed, tested and commisioned with metal enclosure complying to the Electro - Magnetic Compatibility as per the Technical Specification - BMS Systems, Analogue Input, Analogue Output, Digital Input, Digital Output, Soft IO, etc. shall accomodate complete integration upto 1000 points Touch Screen LCD type Local control Panel directly mounted on the PLC Housing itself, with screen				
3	**BMS SERVER SOFTWARE LICENSE & CD.**				
3.1	SITC of the unlimited multi user with simultaneous minimum 4 user web based Server Software for Building Management System with dynamic graphics. The software shall have unlimited number of user license with minimum up 5 simultaneous users. The Web-Based Server software shall permit use of Standard Web-Browsers such as Microsoft Internet Explorer, Netscape Navigator, etc and unlimited users.	Set	1	4,22,154	4,22,154
3.2	BMS Client License & CD.Software shall be cable of interfacing with BMS Server Software and complete with Extensive System Graphic User Interface designed to suit the project as approved by Client / Consultants.				

(Attachment No-11 to Addendum No-5)
PART-B - BMS BOQ - Depot

S.N.	Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
4	**WEB SERVER ENGINES (NETWORK / SUPERVISORY CONTROLLERS)**				
4.1	SITC of Microprocessor based 32 Bit ,UL Listed Embedded Web Server Engine-cum-Network & Supervisory controller on BACnet/IP units for connecting all field DDC controllers and 3rd party System Integration Units to it and for transferring data from field devices to BMS Web-Server Software . The Network Controller shall support BACnet standard MS/TP Protocol and shall be BACnet testing lab certified (BTL) and carry the BTL label .The Network supervisory Controller shall have imbedded graphic capability for generating web based user graphics & support minimum of Five Concurrent User .The Web user shall have the capability to access all system data through one Network Controller. In case of PC/Software Failure, User can access the system using web server using IP Port.The Web server shall allow multiple simultaneous user access(minimum 4)		1	1,29,915	1,29,915
5	**SYSTEM INTEGRATION UNITS FOR 3RD PARTY SYSTEM SOFTWARE INTEGRATION - UL listed Controllers**				
5.1	SITC of System Integration unit consisting of microprocessor based controller units as required to communicate between the Network Controller & the individual 3rd party microprocessor system controllers like Chillers, DGs, VFDs, VAV terminal units, UPS, Multifunction Digital Electronic Meters, Fire Detection Systems etc. as per distribution given below :	Set	1	3,89,742	3,89,742
6	**PORTABLE MAINTENANCE TERMINAL (LAPTOP).**				

(Attachment No-11 to Addendum No-5)
PART-B - BMS BOQ - Depot

S.N.	Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Supply, Installation, Testing and Commissioning of notebook PC. With minimum 14inch LED display screen, with 1920 x 1080 pixels, the notebook PC shall have Intel i7 or latest , 3.2GHz CPU complete with accessories as given below 500GB hard disk drive External Hard Disk Drive 8 GB RAM Removable Storage Device (CD / DVD) read and write 1 No RS-232 serial port, 3 no's USB Port. 101 Keys - Keyboard All other miscellaneous components to meet highest specifications.	No	1	94,078	94,078
7	**LASER PRINTER**				
7.1	A hard-copy multi-color graphics Laser Printer shall be provided for recording graphic displays and associated dynamic data. Printer shall meet minimum requirements as follows: Print speed – Black: up to 22 ppm; color: up to 4 ppm First page out – 18 seconds black, 29 seconds color Resolution- 600 by 600 dpi Hi-Speed USB 2.0, IEEE 1284-B compliant parallel port Languages – PCL 6 and Postscript level 3 emulation with automatic language switching Font capabilities – 80 TrueType TM internal scalable PCL 6 fonts; 80 TrueType internal scalable HP postscript fonts	No	1	48,383	48,383
8	**SENSORS AND FIELD DEVICES**				
8.1	Supplying, Installing, Testing and Commissioning of the following sensors / transducers / transmitters				
a	Temperature Sensor (To sense the temaparature of Air- inside room)	Nos	6	23,492	1,40,954
	a) Type - Standard platinum 100 ohms element.				

(Attachment No-11 to Addendum No-5)
PART-B - BMS BOQ - Depot

S.N.	Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	b) Accuracy - (+/- 0.2 degree C at Range of 0 to 50 degree C)				
b	Temperature Sensor (To sense the temaparature of Water)	Nos	14	6,647	93,065
	a) Type - Standard platinum 100 ohms element.				
	b) Accuracy - (+/- 0.2 degree C at Range of 0 to 50 degree C)				
8.2	Humidity sensor	Nos	15	1,00,500	15,07,502
8.3	Differential Pressure Switch				
a	Differential Pressure Switch (To sense the filter pressure drop, Flow status of fan - Air type)	Nos	20	3,478	69,551
	a) Type - bourdon tube, bellows or diaphragm				
	b) Rating - 220 volts, 10 amp AC or 24 volts DC.				
b	Differential Pressure Switch (Water type)	Nos	6	14,514	87,086
	a) Type - bourdon tube, bellows or diaphragm				
	b) Rating - 220 volts, 10 amp AC or 24 volts DC.				
c	Differential Pressure Sensor (To sense the pressure difference across AHUs duct - Air type)	Nos	6	10,168	61,008
7.4	Level Sensor	Nos	3	10,526	31,578
7.5	Level Switch (To monitor the water level inside Sump/Tank/chabers)	Nos	6	9,524	57,145
7.6	UL Listed Current Relay with built in LEDs for On / Off commands Status	Nos	10	1,734	17,344

(Attachment No-11 to Addendum No-5)
PART-B - BMS BOQ - Depot

S.N.	Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
8	**WIRING AND CONDUITING**				
	1100v grade armoured XLPE FR ZH Copper (CU) Conductor STP Cable screend control cables on existing trays/walls/columns/indoor/trenches including the cost of support with suitable clamps, hooks, bolts etc and including the cost of proper dressing of cables.				
8.1	2C X 1.5 Sq.mm	Mtr	2700	128	3,45,329
8.2	4C X 1.5 Sq.mm.	Mtr	11920	195	23,26,274
8.3	12C X 1.5 Sq. mm	Mtr	2700	516	13,93,224
	1100v grade SS armoured Fire Survival Cable tested to IEC-331 for circuit integrity under fire at 750 deg C for three hours, ZH Copper (CU) Conductor STP Cable screend control cables on existing trays/walls/columns/indoor/trenches including the cost of support with suitable clamps, hooks, bolts etc and including the cost of proper dressing of cables.				
8.4	2C X 1.5 Sq.mm	Mtr	2500	146	3,63,853
8.5	4C X 1.5 Sq.mm.	Mtr	3800	226	8,58,912

(Attachment No-11 to Addendum No-5)
PART-B - BMS BOQ - Depot

S.N.	Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
8.6	12C X 1.5 Sq. mm	Mtr	2500	573	14,33,358
8.7	Supply and laying of 4 pair cat-5 cable as required in heavy guage GI Conduit	Mtrs	1000	49	48,514
8.8	Flexible PVC Flexible conduit for termination in the PLC Panels	Mtrs	6700	41	2,73,330
	TOTAL				**2,00,86,104**

(Attachment No-11 to Addendum No-5)
PART-B BOQ - Depot Plumbing Pumps

Sr .No	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4		
1	**Submersible sump pumps (Pump room, Workshop & UFWL)**				
1.1	Supply, Installation, Testing and Commissioning of following submersible sump pumps for dewatering with 40 mm thick solid handling capacity suitable for operation on 415+1-10%V pH 50 cycle A/C power supply & lifting arrangement.				
	Type of pump : submersible pump				
	Capacity : 180 lpm				
	Head : 8-10 m				
	Motor RPM : 2900				
	Each set consists of 2 pumps (1 Working + 1 Stand by). At any given time, only one pump need operate. Both the pumps must operate alternatively in service.	SET	4	63,270	2,53,081
1.2	Supply,Installation ,testing and commissioning of level controller switch for automatic operation of sump pumps complete with sensors,switches,relays all wiring from the sensors to the control unit to motor control centre of the various pumps and to the various alarm and indicating devices.	SET	4	14,632	58,526
2	**Transfer pumps**				
2.1	Supply,installation ,testing & commissioning of vertical inline multistage pumping set with stainless steel-316 body,stainless steel- 316 impeller, stainless steel 304 casing, shall of stainless steel-316 and C.I base & head with mechanical seal, Connected to a TEFC induction motor suitable for 415+1-10% volts , 3 phase 50 cycles A.C supply with 150mm dia pressure guage with gunmetal isolation cock,vibration eliminating under foundations, 80x40 mm I section base plate boted to cement concrete foundations complete .				
	Type of pump : (Underground water tank to Centralised overhead tank, UG water tank to OCC)				
	Pump capacity - 300 lpm				
	Head - 50 m				
	RPM - 2900				
	Each set consists of 2 pumps (1 Working + 1 Stand by). At any given time, only one pump need operate. Both the pumps must operate alternatively in service.	SET	2	2,01,943	4,03,886

2.2	Supply,Installation ,testing and commissioning of level controller switch for automatic operation of transfer pumps complete with sensors,switches,relays all wiring from the sensors to the control unit to motor control centre of the various pumps and to the various alarm and indicating devices.	SET	2	14,632	29,263
	TOTAL OF PUMPS				**7,44,757**

(Attachment No-11 to Addendum No-5) Depot Sum - Cost Estimate For Aarey Station and Depot with OCC Building		
PART-C (OCC Building)		
C.01- ELECTRICAL LT SYSTEM		
C.01.1	MV Switchgear	1,65,91,478
C.01.2	Distribution Boards	14,52,936
C.01.3	Distribution Cable	3,16,69,914
C.01.4	Conduit Wiring	95,27,198
C.01.5	Indoor Lighting and Fans	99,63,850
C.01.6	Highmast & Street light pole	46,25,446
C.01.7	Protective Earthing System	88,42,661
C.01.8	Lightning Protection	4,04,565
C.01.9	External Piping System for HUME, TRENCHING & UNDERGROUND	27,22,344
C.01.10	Compact Sandwich BusDuct	15,99,031
C.01.11	Uninterupted Power Supply system	16,40,580
C.01.12	DG Set	1,04,17,373
C.01.13	Conduiting and GI Sleeves for Telephone, Lan & PA System	3,59,243
C.01		**9,98,16,622**
C.02- FIRE DETECTION AND FIRE SUPPRESSION SYSTEM (OCC)		
C.02.1	Fire Detection and Alarm System	35,12,885
C.02.2	Fire Fighting System	1,01,44,783
C.02.3	Clean Agent Based Panel Flooding System for Electrical Panels	20,11,368
C.02.4	**CLEAN AGENT FIRE SUPPRESSION SYSTEM - TOTAL FLOODING**	1,41,02,195
C.02.5	Transformers Protection System:	3,75,506
C.02.6	VESDA System for UPS ROOM,CENTRAL EQUIPMENT ROOM & OCC THEATER:	15,59,434
C.02.7	VESDA SYSTEM FOR SER & UPS ROOM:	25,13,608
C.02 (FIRE DETECTION AND FIRE SUPPRESSION SYSTEM)		**3,42,19,778**

(Attachment No-11 to Addendum No-5) Depot Sum - Cost Estimate For Aarey Station and Depot with OCC Building		
C.03 - VAC SYSTEM WITH AIR COOLED CHILLER (OCC)		
C.03.1	WATER COOLED CHILLERS, PUMPS, AHU's & FCU's AND PRECISION A/C	3,90,41,801
C.03.2	CHILLED & CONDENSER WATER/ PIPING/ VALVES	1,04,23,725
C.03.3	VENTILATION SYSTEM	45,57,805
C.03.4	AIR DISTRIBUTION SYSTEM	94,19,447
C.03.5	CHEMICAL DOSING	
	C.03	**6,34,42,779**
C.04 - EOT Crane & Air Compressor		
C.04.1	EOT CRANE	87,71,823
C.04.2	AIR COMPRESSOR WITH ACCESSORIES & COMPRESSED AIR PIPING	15,84,993
	C.04	**1,03,56,816**
C.05 - WATER TREATMENT PLANT FOR VAC		
C.05.1	Water Treatment Plant for VAC system	**13,30,561**
C.06 - SPARES (CABLES & LIGHT FIXTURE)		
C.05.1	Distribution cables	18,72,052
C.05.2	Light Fixtures	20,69,448
	C.06	**39,41,501**

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1	**GENERAL**				
1.1	The BOQ specified below include the latest relevent standards (unless otherwise specified), specifications, drawing details and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval before use as the Employer.				
1.2	The description as mentioned in this BOQ including details as metntioned in GCC, SCC, Employers Requirement General specifications & Technical specificatios , Drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.				
1.3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.				
1.4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.				
1.5	Bus Bar Sizing calculations shall be submitted for approval of Employer or his representative.				
1.6	Contractor's shall quote reasonable rates against each item of BOQ.				
1.7	Steel structure/pipe shall be earthed.				
E.01	**M V SWITCHGEAR**				
1	**General**				
	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty floor / wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with neoprene gaskets, fabricated from CRCA sheet steel of thickness not less than 2mm in general and load bearing members with 2.5mm and shall be folded and braced as necessary to provide a rigid support for all components with powder coated finish (minimum thickness 50 micron) suitable for 415 volts 3 phase 4 wire 50 Hz system to withstand symmetrical fault level of 50kA for ASS - I & ASS - II at 415 V, including interconnections, bonding to earth etc. and flush doors conforming to relevant IEC/IS (viz. IEC 61439, IS 8623 etc.) standard including the earth leakage protection complete as per specification & drawings as required and as given below. All internal wiring in the panels shall be carried out using FRLS wires.				
a)	The Switchboards shall be provided with detachable gland plates for entry of cables from the top/bottom as required.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
b)	All live accessible parts shall be shrouded and all equipment shall be finger touch proof. The busbars shall be insulated with heat shrinkable sleaves. SMC/DMC (Double Moulding Compound) shrouds and busbar supports suitably spaced shall be used. Hinged doors with padlocking facility shall be provided on all outgoing feeders with switch handles lockable in OFF position.				
c)	The panel shall have Copper busbars (phases, neutral & earth) with bar type feeder connections, spacers etc.and phases & neutral busbar shall be of 100% capacity and Earthing Busbar shall be 50% of Phase.				
d)	All accessories & supporting structures such as channels, ISMC base frame, mounting brackets, lifting lugs, panel heaters, ventilation arrangement etc as required.				
e)	Each incomer and outgoing feeder shall be provided with multiple LED/neon type status indication lamps suitable for 230 V AC as approved.				
f)	Overall Space provision shall be @ 25% for future expansion				
g)	The makes of components and accessories shall, to the extent practically feasible, be same for panels and boards for uniformity, standardisation and replaceability and shall be applicable to all panels/ boards under the scope of work				
h)	Switchboard including interconnections, labeling, earthing,associated foundation / masonary work & erection etc. complete as required.				
i)	All MCCBs shall be current limiting type microprocessor based, rated for requisite specified Service short circuit breaking capacity (Ics suitable for isolation conforming to latest IEC60947-2 duly marked on MCCB, at operating voltage (Ue) of 415 V, insulation voltage (Ui) 750 V and with trip free mechanism, handle indicating ON/OFF/tripped position. The breaking capacity as mentioned shall be Ics values.				
j)	MCCBs shall be compact (As the Engineer may decide), suitably designed to provide protection of motors, cables, busbars to suit rated current, unbalanced power distribution as required and with front adjustable overload and short circuit releases and minimum electrical endurance of the order of 7000-8000 operation cycles (higher shall be preferred) for capacity of 100-250 amps..				
k)	All the MCCBs shall be provided with potential free contacts for connectivity to PLC for ON/OFF status and control, as required.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
l)	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 9/10 kA at 415 V AC, current limiting type, lower power loss approx 40 -70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for motor application duty, with minimum Electrical endurance of the order of 20000 operation cycles.				
m)	Panel/board design shall be compact and components / accessories of compact sizes are used to economise the room space available. Employer reserve the right to seek compact items in place of larger ones				
n)	All incomer ACB's shall be provided with minimum 2 NO + 2 NC auxiliary contacts and all MCCBs shall be provided with 2 NO+ 2NC auxiliary contacts, and there should be provision to add min. 6 Auxiliary contacts.				
o)	All 4-pole ACBs shall have fully rated neutral pole. All 4-pole ACBs & MCCBs shall be provided earth fault protection.				
p)	The panel shall be fitted with fire trace tube system. Scheme of fire trace tube system shall be got approved by Engineer before proceeding with manufacturing and assembly.				
q)	All internal wiring to be FRLS				
r)	Various panels/boards as given below:				
1	**MAIN DISTRIBUTION BOARD (MDB) @ ASS-1**	No	1	43,75,013	43,75,013
A.	**INCOMER - TRANSFORMER - 1**				
	3200 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 50kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 0.5 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
ii.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB's,				
iv	1- set Red/Green ON/OFF indicating lamps				
v	1- set of three phase (red, yellow, blue) indicating lamps				
vi	Amber healthy trip indicating lamps				
vii	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden & Class 5P10 for protection.				
viii	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x	Terminals to receive copper sandwich bus duct				
xi	TNC Switch				
xii	Auto/local/remote selector switch key operated				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 3200 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA for 1 sec. at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	1 No. 1250 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps.				
ii	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
iii	TNC Switch.				
iv	Auto/local/remote selector switch key operated.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
b)	2Nos. 800 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps				
ii	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
iii	TNC Switch.				
iv	Auto/local/remote selector switch key operated.				
c)	1 nos. 400Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	1 no. 250Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
e)	2 nos. 160Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
f)	3 nos. 100Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
g)	1 no. 63Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**BUS COUPLER**				
a)	3200 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage with adjustable setting with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps				
ii	1- set of three phase (red, yellow, blue) indicating lamps				
iii	Amber healthy trip indicating lamps				
iv	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
v.	TNC Switch.				
vi.	Auto/local/remote selector switch key operated.				
E.	**INTERLOCKING**				
	Two incomers & one Bus Coupler shall be interlocked electrically & mechanically so that only two out of three shall be switched on at a time.				
F.	**INCOMER - TRANSFORMER - 2**				
	3200 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (50 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting and with the following accessories :				
i.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
ii.	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv	1- set Red/Green ON/OFF indicating lamps				
v	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy trip indicating lamps.				
vii	3 nos. cast resin current transformers of 3200/5 ratio with 15 VA Burden and Class 5P10 for protection.				
viii	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x.	Terminals to receive copper sandwich bus duct				
xi.	TNC Switch				
xii	Auto/local/remote selector switch key operated				
G	**BUSBAR**				
	Electrolytic high conductivity Copper three phase and neutral busbars rated at 3200 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA at 415 V. The neutral busbar is to be of same size as phases.				
H	**OUTGOING**				
a)	1 No. 1250 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps				
ii	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	TNC Switch				
iv	Auto/local/remote selector switch key operated				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
b)	2 Nos. 800 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps				
ii	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	TNC Switch				
iv	Auto/local/remote selector switch key operated				
c)	3 nos. 400 Amp, 415V, Ics= 50 kA , TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
d)	2 nos. 250 Amp,, 415V, Ics= 50 kA , TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
e)	4 nos. 63 Amp,, 415V, Ics= 50 kA , TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
I	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps, Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/ BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
2	**EMERGENCY POWER PANEL(EPP) @ ASS-1**	No	1	32,22,289	32,22,289

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
A	**INCOMER - 1**				
	1250 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 50 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi.	Amber healthy/ trip indicating lamps				
vii.	3 nos. cast resin current transformers of 1600/5 ratio with 15 VA Burden and Class 5P10 for protection.				
viii.	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x.	Terminals to receive aluminium XLPE armoured cables				
xi.	TNC Switch.				
xii	Auto/Local/Remote Selector Switch Key operated				
B.	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 1250 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to withstand symmetrical fault level of 50kA at 415 V. The neutral busbar is to be of same size as phases.				
C.	**OUTGOING**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
a)	2 nos. 400Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	1 no. 250Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 250/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	2 nos. 160 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	3 nos. 63 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
e)	2 nos. 40 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D.	**BUSCOUPLER**				
a)	1250 amps 50kA, Four pole electrically operated (motorised) fully draw out type air circuit breaker with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage with adjustable setting and with the following accessories :				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
i.	1- set Red/Green ON/OFF indicating lamps.				
ii.	1- set of three phase (red, yellow, blue) indicating lamps.				
iii.	Amber healthy/ trip indicating lamps.				
iv.	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
v.	TNC Switch.				
vi.	Auto/Local/Remote Selector Switch Key operated.				
E.	**INTERLOCKING**				
a)	Three incomers & one Bus Coupler shall be interlocked electrically & mechanically so that only two out of three shall be switched on at a time and only one out of three in DG case.				
F.	**INCOMER - 2**				
	1250 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 50 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi.	Amber healthy/ trip indicating lamps.				
vii.	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 5P10 for protection				
viii.	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x.	Terminals to receive aluminium XLPE armoured cables.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
xi.	TNC Switch.				
xii	Auto/Local/Remote Selector Switch Key operated				
G.	**INCOMER - 3 for DG Supply**				
	1250 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (minimum 50 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi.	Amber healthy /trip indicating lamps.				
vii.	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden and Class 5P10 for protection				
viii.	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x.	Terminals to receive aluminium XLPE armoured cables.				
xi.	TNC Switch.				
xii	Auto/Local/Remote Selector Switch Key operated				
H.	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 1250 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to withstand symmetrical fault level of 50kA at 415 V. The neutral busbar is to be of same size as phases.				
I.	**OUTGOING**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
a)	1 No. 800 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i	1- set Red/Green ON/OFF indicating lamps				
ii	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch				
iii	TNC Switch				
iv	Auto/local/remote selector switch key operated				
b)	2 nos. 400 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	1no. 160 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
d)	1no. 100 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
e)	1 nos. 63 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
f)	2 nos. 40 Amps, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
J	**METERING**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
3	**SDB - POWER (OCC & INFRA BUILDING)**	No	1	6,15,234	6,15,234
A	**INCOMER**				
	1 no. 400 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 400/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 400 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
a)	3 nos. 80 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 80/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
b)	1 no. 63 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
c)	7 nos. 40 Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
d)	4 nos. 32 Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
4	**SDB - LIGHTING (OCC & INFRA BUILDING)**	No	1	7,48,516	7,48,516
A	**INCOMER**				
	1 no. 100 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 100/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 100 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	20 nos. 25 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
5	**VAC PANEL-2 (OCC BUILDING)**	No	1	3,81,582	3,81,582
A	**INCOMER -1**				
	1 no. 160 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
i.	3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 160/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy /trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 160 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	14 nos.32 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
6	**VAC PANEL -1 (24x7) -(OCC BUILDINNG)**	SET	1	4,06,355	4,06,355

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
A	**INCOMER -1 - FROM MDB**				
	1 no. 400 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 400/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy /trip indicating lamps.				
B	**INTERLOCKING**				
	As per SLD - Two incomers shall be interlocked electrically & mechanically so that only ONE out of TWO shall be switched on at a time.				
B	**INCOMER -2 - FROM EMDB**				
	1 no. 400 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 400/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy /trip indicating lamps.				
C	**BUSBAR**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 400 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
D	**OUTGOING**				
a)	8 nos.63 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
b)	6 nos. 40 Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
7	**CHILLER PANEL - (OCC BUILDING) - (Panel Protection IP 65)**	SET	1	24,60,378	24,60,378
A	**INCOMER -1 (FROM MAIN LT PANEL)**				
	800 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (35 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
ii.	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi.	Amber healthy /trip indicating lamps.				
vii.	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 5P10 for protection				
viii.	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x.	Terminals to receive aluminium XLPE armoured cables.				
xi.	TNC Switch.				
xii	Auto/Local/Remote Selector Switch Key operated				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 800 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	1 nos.630 Amp, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 630/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
b)	3 nos.100 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
c)	1 no.63Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
d)	1 no.32Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 32/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
D	**BUSCOUPLER**				
	1 Nos. 800 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 35kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
i.	1- set Red/Green ON/OFF indicating lamps				
ii.	3 nos. cast resin current transformers of 800/5A with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
iii.	TNC Switch				
iv.	Auto/Local/Remote Selector Switch Key operated				
v.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
vi.	1- set of three phase (red, yellow, blue) indicating lamps.				
vii.	Amber healthy/ trip indicating lamps.				
E	**INCOMER -2 (FROM MAIN EMERGENCY PANEL)**				
	800 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker (35 kA) with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting. and with the following accessories :				
i.	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
vi.	Amber healthy /trip indicating lamps.				
vii.	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden and Class 5P10 for protection				
viii.	230 V AC shunt trip coil				
ix.	230 V, AC Motor wound spring closing mechanism				
x.	Terminals to receive aluminium XLPE armoured cables.				
xi.	TNC Switch.				
xii	Auto/Local/Remote Selector Switch Key operated				
F	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 800 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
G	**OUTGOING**				
a)	2 nos.630 Amp, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 630/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
b)	2 nos.100 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
c)	1 no.63Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
H	**METERING**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
8	**ESDB - LIGHTING (OCC & INFRA BUILDING)**	No	1	3,59,841	3,59,841
A	**INCOMER**				
	1 no. 63 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
i.	3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 63/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 63 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	2 nos. 40 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
b)	11 nos. 25 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 25/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
9	**UPS PANEL (OCC & INFRA BUILDING)**	No	1	2,94,911	2,94,911
					LAR 231561
A	**INCOMER**				(-) 8X 22556, 63 Amp
	1 no. 160 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				(+) 10 X21636 25 Amp
i.	3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				
ii.	3 nos. cast resin current transformers of 160/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
iii.	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
iv.	1- set Red/Green ON/OFF indicating lamps.				
v.	1- set of three phase (red, yellow, blue) indicating lamps.				
vi	Amber healthy/ trip indicating lamps.				
B	**BUSBAR**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
a)	Electrolytic high conductivity Copper three phase and neutral busbars rated at 160 A having a maximum current density as per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	2 nos. 63Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
b)	12 nos. 25 Amp, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 100/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
10	**WATER PUM P PANEL - WPP**	No	1	4,44,164	4,44,164
A	**INCOMER**				
	100 Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each complete with:-				
	3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with MFM with Voltage, Current Energy, Power Factor, KVAr, with communication port RS485 etc.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
	1- set Red/Green ON/OFF indicating lamps.				
	1- set of three phase (red, yellow, blue) indicating lamps.				
	Amber healthy/ trip indicating lamps.				
	Auto / Manual selector switch				
	3 nos. cast resin current transformers of 100/5 ratio with 15 VA Burden and Class 5P10 for protection				
B	**BUSBAR**				
	Electrolytic high conductivity Copper three phase and neutral busbars rated at 100 A having a maximum current density per specification with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a	10nos - 25A 4P MCCB 25 KA with 0-5 kW fully automatic DOLstarter with over load protection, current sensing type single phase preventer complete with all accessories and internal wiring required for below points				
	1- set Trip, ON & Run indicating lamps.				
	Start, Stop push button				
	Auto / Manual selector switch				
	3 nos. cast resin current transformers of 25/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b	6nos - 16A 4P MCCB 25 KA with 0-5 kW fully automatic DOLstarter with over load protection, current sensing type single phase preventer complete with all accessories and internal wiring required for below points				
	1- set Trip, ON & Run indicating lamps.				
	Start, Stop push button				
	Auto / Manual selector switch				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	3 nos. cast resin current transformers of 16/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps, Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
	The switchboard shall be complete with all inter connections, risers, internal wiring, labels etc complete as required.				
11.0	**FEEDER PILLAR - EXTERNAL LIGHTING**				
11.1	**FEEDER PILLAR - EXTERNAL LIGHTING - HIGH MAST (OUTDOOR TYPE IP-65 AS PER SPECIFICATIONS)**	SET	2	1,92,853	3,85,706
A	**INCOMER**				
	1 no.63 A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases				
i	3 nos. cast resin current transformers of 63/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
ii	1 Nos. 0-24 Hrs double dial timer				
iii	3 Nos. Auto / manual selector switch				
iv	6 Nos. 16 A TPN contactor with necessary NO& NC auxilliary contacts of 2 Sets.				
v	1 Job control flexible cabling from contactor to Timer				
B	**BUSBAR**				
	63 amps TPN Copper bus bars with heat shrinkable insulation sleeve.				
C	**OUTGOING**				
	16 amps TP+N MCBs 6 Nos				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
11.2	**FEEDER PILLAR - EXTERNAL LIGHTING - STREET LIGHT (OUTDOOR TYPE IP-65 AS PER SPECIFICATIONS)**	SET	2	1,92,853	3,85,706
A	**INCOMER**				
	1 no.40 A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases				
i	3 nos. cast resin current transformers of 40/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
ii	1 Nos. 0-24 Hrs double dial timer				
iii	3 Nos. Auto / manual selector switch				
iv	6 Nos. 10A TPN contactor with necessary NO& NC auxilliary contacts of Sets.				
v	1 Job control flexible cabling from contactor to Timer				
B	**BUSBAR**				
	40 amps TPN Copper bus bars with heat shrinkable insulation sleeve.				
C	**OUTGOING**				
	10 amps TP+N MCBs 6 Nos				
D	**METERING**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/ criterion, with necessary Circuit MCB and supporting SCADA/BMS connectivity.				
12.0	**APFC PANEL**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
12.1	**350 KVAR APFC PANEL @ ASS-1**	SET	2	11,30,727	22,61,454
A	**INCOMER**				
	1 No. 800 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
	1- set Red/Green/Amber -ON/OFF/Alarm indicating lamps				
	1- set of three phase (red, yellow, blue) indicating lamps				
	1 Set of (0-500 volts) digital voltmeter with selector switch with MCB's, and one set of Digital Ammeter with 3 nos. 800/5 Amps, 15 VA, CT				
	TNC Switch.				
	Auto/local/remote selector switch key operated.				
	1 set of suitable rating of Current Transformer for incomer in main panel for APFCR relay				
	1- set of three phase (red, yellow, blue) indicating lamps.				
	1 Set - Automatic microprocessor based digital type power factor compensating relay (including power factor meter) in 10 steps for automatic cut off or add on capacitor units to keep the power factor at 0.95 with variation of loads. All associated auxiliary contactors/relays to be provided. Visual alarms, to display shortfall of P.T., automatic lockout of faulty Step, over temperature protrections. Auto manual selection and indications.				
B	**BUSBAR**				
	Electrolytic high conductivity Copper three phase and neutral busbars rated at 800 A having a maximum current density of 1.4 A per sq mm with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA at 415 V.The neutral busbar is to be of same size as phases.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
C	**OUTGOING**				
	Outgoing feeders consisting of following accessories.				
	1 nos. 250 amps , 35 kA TP MCCB with backup fuses of suitable capacity				
	4 nos. 160 amps , 35 kATP MCCB with backup fuses of suitable capacity				
	2 nos. 80 amps , 35 kATP MCCB with backup fuses of suitable capacity				
	1 nos. 250 amps 415 volts 50Hz heavy duty contactors				
	4 nos.160 amps 415 volts 50Hz heavy duty contactors				
	2 nos. 80 amps 415 volts 50Hz heavy duty contactors				
	11 nos “ON” /”OFF” push buttons and indicating lamps				
	1 nos. 250 amps rating TP terminal blocks				
	4 nos. 160 amps rating TP terminal blocks				
	2 nos. 80 amps rating TP terminal blocks				
	1 nos. 100 KVAR capacitor units in bank form				
	4 nos. 50 KVAR capacitor units in bank form				
	2 nos. 25 KVAR capacitor units in bank form				
	The switchboard shall be complete with all interbconnections, risers, internal wiring, labels etc complete as required.				
13	**Other Accessories**				
13.1	**Safety equipments in Aux. Substation / MDB room**	Set	1	2,50,329	2,50,329
	Supply and fixing of the following safety equipments in Aux. Sub. Station /MDB room as per detailed descriptions given below and as per relevant IE rules & code of standard practice:-				
a)	1000 mm wide Insulating mat,confirming to IS 15652-2006 suitable to withstand LT & HT Panel Requirements in front of all panels in ASS building.				
b)	Laminated standard shock treatment charts in English & Hindi in ASS, DG room and Pump room.				
c)	Danger plate as per approved Style & sample written in English & Hindi for MV installations as required as per IE rules, IES and IS 2551 (latest) - 10 nos.				
d)	10 nos. First Aid Box Complete as approved by St. John ambulance or Indian Red Cross				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
e)	Fire Buckets (Quantity will be in fire fighting BOQ)				
f)	Two Tool kit comprising 1 set of flat spanner (Taparia / Jalan), 1 set of box spanner, 1 no. Hacksaw frame with 10 No. blades, 1 no. large, medium, small screw drivers, 1 no. insulated plier, 1 no nose plier, 1 no. hand crimping tool upto 16 sqmm, 1 no. digital multimeter, 1 no. test lamp and 1 no. tester. Screw driver set for all types of screw heads also to be provided.				
	TOTAL FOR E.01 (M V SWITCHGEAR)				**1,65,91,478**
E02	**DISTRIBUTION BOARDS**				
	General				
	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty dead front wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with foamed-in neoprene gasketted hinged doors, fabricated from 2 mm thick CRCA with powder coated finish suitable for 415 V, 3-phase, 4 wire, 50 Hz system including suitably rated insulated copper busbars, interconnections, neutral bus bar assembly, phase segregating barriers, LED indicating lamps for incoming feeders,15% spare space for future expansion, knockouts and gland plates for entry of cables and conduits, all internal wiring using high temperature range as per IS 694 FRPVC wires, independant terminals for each phase, earthing terminals and including the cost of providing Master key lock on the door and pad locking facility on door as well as at incomer, bonding to earth etc. complete as per specification, drawings as required and as under:				
a)	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 9/10 kA at 415 V AC, current limiting type lower powerloss approx 40 -70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for motor application duty, with minimum Electrical endurance of the order of 20000 operation cycles.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
b)	Residual current circuit breaker (RCCB) conforming to IS 12640 shall be provided with 30 mA sensitivity and electrically connected rated current capacity MCB for short circuit and over load protection as required				
c)	The LDBs may be required to accommodate Dimming Control equipment mountable on DIN rail. Contractor should refer to relevant specifications and drawings in this regard and submit his scheme for approval by Engineer in Charge.				
d)	All the contactors shall be provided with potential free contacts for remote monitoring and control.				
e)	Various distribution boards as given below:				
1	**Lighting distribution boards (LDB) Type-1**	No.	11	15,969	1,75,656
	1 no. 25 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-25 amp DP 30 mA RCBO incoming and 4nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
2	**Lighting distribution boards (LDB) Type-2**	No.	12	19,082	2,28,989
	1no. 25 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-25 amp DP 30 mA RCBO incoming and 8 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
3	**Lighting distribution boards (LDB) Type-3**	No.	13	20,639	2,68,310
	1 no. 25 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-25 amp DP 30 mA RCBO incoming and 12 nos 6 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
4	**Power distribution boards (PDB) Type-4**	No.	4	15,969	63,875
	1 no. 32 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-32 amp DP 30 mA RCBO incoming and 4 nos 16 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
5	**Power distribution boards (PDB) Type-5**	No.	4	23,004	92,017
	1no. 40 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-40 amp DP 30 mA RCBO incoming and 8 nos 16 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
6	**Power distribution boards (PDB) Type-6**	No.	2	23,004	46,009
	1 no. 63 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 63amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-63 amp DP 30 mA RCBO incoming and 8 nos 16 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
7	**Power distribution boards (PDB) Type-7**	No.	2	78,974	1,57,948
	1 no. 80Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 80amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-80 amp DP 30 mA RCBO incoming and 12 nos 16 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
8	**Power distribution boards (PDB) Type-8**	No.	2	19,891	39,781

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	1 no. 40 Amps, 4P, 10 kA, MCB with thermal magnetic protective releases incoming with 4 pole 40 amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 3 single phase banks each comprising of 1-40 amp DP 30 mA RCBO incoming and 12 nos 16 amps, SP, 10 kA, MCB with thermal magnetic protective releases out goings				
9	**VTPN Power distribution boards (LPDB) Type-9**	No.	2	1,90,176	3,80,352
	1 no. 200Amps, 4P, 25 kA, MCCB with thermal magnetic protective releases incoming with 4 pole 200amp HDHC tinned copper bus bar with coloured heat shrinkable PVC sleeves and 8 nos 32A TP MCB with thermal magnetic protective releases out goings with neutral link				
	TOTAL FOR E.02 (DISTRIBUTION BOARDS)				**14,52,936**
E.03	**DISTRIBUTION CABLES**				
	General				
	The Cable and Cable Containment System specified herein, must confirm to technical Specifications, in addition to the description given in respective items of BOQ , whether explicity specified or not. In case of contradiction between specifications and description in BOQ, the most stringent of the condition will apply				
	"All the items / parts mentioned in relevent clauses of the technical specifications and not specifically mentioned in BOQ shall be deemed to be included in the quoted rates, unless specifically excluded."				
	The cable runs shall be measured upto the outer end of the boxes without any allowances for over lap in joints. The rate shall include all the above mentioned material, labour, etc. for laying as required.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	It may be noted that the Contractor will be required to carry out cable sizing based on actual cable lengths, as per working Drawings developed by him and after incorporating any changes in load requirements from the tendering stage. Optimization must be carried out during cable sizing to reduce the cable requirement and size . Further, Contractor must obtain Engineer's approval on the Cable Sizing Calculation.				
1	**FRLS Cable**				
	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured, FRLS, XLPE, aluminium (AL) / Copper (CU) conductor cables on existing trays / walls/columns/ indoor including the cost of supply and fixing, crimping lugs, double compression and weather proof brass glands, Earthing lugs and shrouds, supports with suitable clamps, saddles, hooks, bolts etc. & in ground/ trenches including the cost of proper dressing of cables, markers providing identification tags, sand filling etc. (cost of excavation, sand & bricks, included here) earthing of glands armouring etc. complete as per specifications as required and as below.				
	Note 1: All cables 25 sqmm and above are AL conductors unless specified otherwise.				
1.1	4 core 400 sq mm AL conductor cable	M	2,200	1,409	31,00,023
1.2	4 core 300 sq mm AL conductor cable	M	1,169	1,130	13,20,860
1.3	4 core 240-sqmm AL conductor cable	M	2,131	929	19,80,949
1.4	4 core 185-sqmm AL conductor cable	M	138	744	1,02,334
1.5	4 core 150-sqmm AL conductor cable	M	138	615	84,596
1.6	4 core 120-sqmm AL conductor cable	M	413	531	2,19,221
1.7	4 core 95 sq mm AL. Conductor cable	M	138	475	65,342
1.8	4 core 70-sqmm AL conductor cable	M	138	350	48,059

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1.9	4 core 50 sq mm AL. Conductor cable	M	138	278	38,205
1.10	4 core 35 sq mm AL Conductor cable	M	536	246	1,31,851
1.11	4 core 25 sq mm AL Conductor cable	M	138	207	28,502
1.12	4 core 16 sq mm CU Conductor cable	M	894	528	4,72,023
1.13	4 core 10 sq mm CU Conductor cable	M	1,265	372	4,70,037
1.14	4 core 6 sq mm CU conductor cable	M	2,915	267	7,77,795
1.15	4 core 4 sq mm CU conductor cable	M	1,788	204	3,64,611
1.16	3 core 4 sq mm CU conductor cable	M	1,375	169	2,31,956
1.17	3 core 6 sq mm CU conductor cable	M	275	219	60,339
1.18	3 core 2.5 sq mm CU conductor cable	M	413	127	52,304
1.A	**Fire Survival Cables**				
	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured, **FIRE SURVIVAL CABLE, XLPE, Copper (CU)** conductor cables on existing trays / walls/columns/ indoor including the cost of supports with suitable clamps, saddles, hooks, bolts etc. & in ground/ trenches including the cost of supply and fixing, crimping lugs, double compression weather proof flame proof brass glands, Earthing lugs and shrouds, proper dressing of cables, markers providing identification tags, sand filling etc. (cost of excavation, sand & bricks, included here) earthing of glands armouring etc. complete as per specifications as required and as below.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	FIRE SURVIVAL cables are manufactured and tested in accordence with BS 7846, IS 7098 (Part-1), IEC 69331 and BS 6387 for required temperatures and duration based on the application and site conditions.				
i	4 core 240 sq mm fire survival Cu. conductor cable	M	1,650	4,482	73,95,300
ii	4 core 95 sq mm fire survival Cu. conductor cable	M	825	2,632	21,71,338
iii	4 core 35 sq mm Cu. Conductor cable	M	275	1,082	2,97,452
iv	4 core 10 sq mm Cu Conductor cable	M	275	410	1,12,878
3	**Cable Trays & Raceway's**				
	"Supply, fabrication & installation of perforated hot dipped galvanised double bended cable trays from 2 mm thick GI sheets continuously connected including horizontal and vertical bends, reducers, tees, and other accessories and duly suspended from the ceiling with 12 mm dia vertical GI rods supported by 40mm x 40 mm 5 mm GI angle etc. (or installed on wall supported on suitable brackets as required) complete as per specifications, as required and as below."				
	Note: Trays shall be supported adequately at minimum 1 m distance from the building structure / ceiling by means of galvanized (as specified) MS structural members secured to the structure by dash fasteners or by grouting. This support should be capable of withstanding the weight equivalent of 3m length of the cables that can be laid in the trays. At turns the support has to be double and at both ends of the bend.				
3.1	**Cable Trays - For E&M, Systemwide contractors**				
3.1.1	900 mm wide x 50 mm deep cable tray	M	110	2,028	2,23,042
3.1.2	600 mm wide x 50 mm deep cable tray	M	1,100	1,419	15,60,927
3.1.3	300 mm wide x 50 mm deep cable tray	M	1,650	848	13,99,013

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
3.1.4	150 mm wide x 50mm deep cable tray	M	1,650	572	9,44,197
4	**Raceways in floor**				
	Supply, installation and testing of sheet steel raceways in floor, fabricated from 2.0 mm thick GI with minimum coating thickness 260 gm / sqm on both sides with removable cover plate complete with counter sunk cadmium plated brass screws, bends, tee-junctions, cross junction etc. rendered electrically continuous as approved and of following sizes. Necessary repair of floor shall be done after completion of work.				
4.1	200 mm wide & 50 mm deep Raceway	M	440	912	4,01,208
4.2	150 mm wide & 50 mm deep Raceway	M	440	796	3,50,269
5	**Ladder type cable trays**				
	Supply and fixing pre-galvanized factory fabricated GI ladder type cable trays, with radial bends, supports of the following sizes as per specifications.				
5.1	1000 mm wide Runners 25 x 100 x 25 x 3 mm Rungs 20 x 40 x 20 x 3 mm 250 mm Centre to Centre (C/C) Suspenders 50 x 50 x 5 mm angle 1500 mm Centre to Centre (C/C)	M	110	1,799	1,97,936
5.2	750 mm wide Runners 20 x 75 x 20 x 2.5 mm Rungs 20 x 30 x 20 x 2.5 mm 250 mm Centre to Centre (C/C) Suspenders 50 x 50 x 4 mm angle 1800 mm Centre to Centre (C/C)	M	1,375	1,153	15,85,790
5.3	600 mm wide Runners 20 x 75 x 20 x 2.5 mm Rungs 20 x 30 x 20 x 2.5 mm 250 mm Centre to Centre (C/C) Suspenders 40 x 40 x 4 mm angle 1800 mm Centre to Centre (C/C)	M	2,200	1,057	23,26,230

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
5.4	450 mm wide Runners 20 x 75 x 20 x 2.5 mm Rungs 20 x 30 x 20 x 2.5 mm 250 mm Centre to Centre (C/C) Suspenders 40 x 40 x 4 mm angle 1800 mm Centre to Centre (C/C)	M	1,650	970	16,00,951
5.5	300 mm wide Runners 20 x 75 x 20 x 2.5 mm Rungs 20 x 30 x 20 x 2.5 mm 250 mm Centre to Centre (C/C) Suspenders 40 x 40 x 4 mm angle 1800 mm Centre to Centre (C/C)	M	1,760	883	15,54,378
	TOTAL FOR E.03 (DISTRIBUTION CABLES)				**3,16,69,914**
E04	**CONDUIT WIRING**				
	General				
	Whether explicitly stated in the schedules below or not, the following must be complied with:-				
a	For supply and installation of conduits, flexible conduits and wiring, relevant clauses of Technical Specifications must be followed.				
b	"Wires supplied must conform to relevant clauses of Technical Specifications".				
c	Wiring accessories must conform Technical Specifications.				
d	In case of any contradiction between BOQ and Technical specifications, the most stringest condition of the two will apply.				
e	All final connections specially to vibrating equipments shall be made through steel flexible conduits.				
f	Recovery of conduit & fan boxes laid by Civil contractor will be made as per item no. 3 & 4.				
	"All the items / parts mentioned in relevant clauses of the Technical specifications and not specifically mentioned in BOQ shall be deemed to be included in the quoted rates, unless specifically excluded."				
1	**Light and Fan Wiring**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	Supply, all materials, storing, handling, fixing, laying wiring and testing for light, fan, exhaust fan and 6A Socket points etc starting from the point control box to the point by using 2.5 sq.mm 1100 volts grade FRPVC stranded copper conductor in concealed GI Stove enamelled 16 gauge conduit including 2mm thick GI boxes, fan regulator boxes, together with wiring accessories such as 6A moulded flush mounted modular switches, sockets in boxes of suitable sizes including circuit wiring with 2 x 2.5 sqmm 1100 volts grade FR PVC insulated stranded copper conductor along with one run of 2.5 sq.mm PVC insulated (green colour) stranded earth wire complete with earthing of fixtures, sockets and boxes. PVC bushes for conduits ends, chrome-plated brass screws, identification ferrules at either ends complete in all respects as per standard specifications. (Lights, fans and 6 amps socket outlets may be wired on a common circuit and circuit shall not have more than ten points of light, fans and 6 amps sockets or a load of 800 watts whichever is less).				
1.1	**Primary Light Points**				
1.1.1	**Switch Control**	Nos	569	3,827	21,76,453
	"Point wiring for switch controlled primary light points with 3 x 2.5 sq mm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25mm dia GI recessed and/or surface conduiting system including cost of providing saddles/ hangers etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting and including the cost of Supply and fixing modular grid plate mounted flush mounted 240 volt 6 amp control switch of approved quality & colour housed in zinc chromate passivated GI boxes with moulded cover plate and including cost of circuit wiring (from DB to first switch in the sub circuit) complete as per specifications and as required."				
1.1.2	**MCB Control with 3 x 2.5 sq. mm wire**	Nos	143	5,728	8,19,093

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	Point wiring for DB/MCB controlled primary light points with 3 x 2.5 sq mm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25mm dia GI recessed and/or surface conduiting system including cost of providing saddles/ hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications Including cost of circuit wiring (From DB to first light point) complete as per specifications & as required (cost of MCB not included)				
1.1.3	**MCB Control with 3 x 4 sq.mm wire**	Nos	13	8,317	1,09,784
	"Point wiring for LED high/medium bay light fixtures MCB controlled primary light points with 3 x 4.0 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 32mm dia GI recessed and/or surface conduiting system including cost of providing saddles/ hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications Including cost of circuit wiring (From DB to first light point) complete as per specifications & as required (cost of MCB not included)."				
1.2	**Secondary Light Points**				
1.2.1	**Secondary Light Points with 3 x 2.5 sq. mm wires**	Nos	1,217	1,957	23,80,990
	"Point wiring for Secondary light points with 3 x 2.5 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications and as required."				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1.2.2	**Secondary light points with 3 x 4 sq. mm wires.**	Nos	40	2,808	1,11,208
	Secondary light points for high/medium bay light fixtures with 3 x 4.0 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 32mm dia MS recessed and/or surface conduiting system including cost of providing saddles/hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications and as required.				
1.3	**Point Wiring for Ceiling Fan Points**	Nos	44	2,086	91,788
	"Point wiring for ceiling fan points with 3 x 2.5 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hanger etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting and including the cost of Supply and fixing modular grid plate mounted flush mounted 240 volt 6 amp control switch and 240 volt 300 watt 5 Step electronic speed regulator of approved quality & colour housed in zinc chromate passivated GI boxes with moulded cover plate and with interconnections complete as per specifications and as required."				
1.4	**Point wiring for air circulator fan**	Nos	17	6,224	1,02,697

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	Point wiring for air circulator fan with 3 x 4 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 25 mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hangers etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting and including the cost of Supply and fixing modular grid plate mounted 240 volt 16 Amps, 3 pin combined shuttered socket outlets along with 240 volt 16 Amps, control switch of approved quality and colour housed in zinc chromate passivated GI boxes with moulded cover plate with interconnections complete & supply & fixing of the fan electronic speed regulator as provided with air circulator fan complete as required. (Swiutch & Socket at diffrent location)				
1.5	**Wiring for Socket Outlets**				
1.5.1	**Point wiring for 6 amp socket outlets**	Nos	328	2,239	7,34,058
	Point wiring for 6 amp socket outlets with 3 x 2.5 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (50 strands of 0.25 mm dia) copper conductor wires in IS embossed 25 mm dia GI recessed and/or surface conduiting system including the cost of providing saddles/hangers etc as required and including the cost of cutting/making good chases in brick work and including the cost of Supply and fixing modular grid plate mounted 240 volt 6 amp 5 pin combined shuttered socket outlets alongwith 240 volt 6 amp control switch of approved quality and colour housed in zinc chromate passivated GI boxes with moulded cover plate and interconnections and including the cost of loop earthing with 2.5 sqmm FR PVC insulated 1100 volt grade stranded copper conductor wires complete as per specifications and as required.				
1.5.2	**Point wiring for 16 Amps, socket outlets (1 outlet wired on 1 circuit)**	Nos	286	7,129	20,38,981

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	"Point wiring for 16 Amps, socket outlets (1 outlet wired on 1 circuit) with 3 x 4 sqmm (P+N+E) FRLS PVC insulated 1100 volt grade flexible stranded (56 strands of 0.3 mm dia) copper conductor wires in IS embossed 25 mm dia GI recessed and/or surface conduiting system including cost of providing saddles/hangers etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting and including the cost of Supply and fixing modular grid plate mounted 240 volt 16 Amps, 3 pin combined shuttered socket outlets along with 240 volt 16 Amps, control switch of approved quality and colour housed in zinc chromate passivated GI boxes with moulded cover plate with interconnections complete as per specifications and as required.				
1.5.3	**Point wiring for 3 phase 63 amp socket outlets**	Nos	6	34,784	1,91,314
	"Point wiring for 3 phase 63 amp socket outlets with 6 x 10.0 sqmm (3P+N+2E) FRLS PVC insulated 1100 volt grade flexible stranded (140 strands of 0.3 mm dia) copper conductor wires in IS embossed 50 mm dia GI recessed and/or surface conduiting system including the cost of providing saddles/hangers etc. as required and including the cost of cutting/ making good chases in brick work and including the cost of Supply and fixing industrial type 63 amp 10 kA "C" 4P MCB and 415 volt 63 amp industrial metal clad socket outlet in 16 SWG powder coated GI box with interconnections and including the cost of 415 volts 63 amp 4P plug top complete as per specifications and as required. "				
2	**Modular Grid Plat Mounted Switch/es and Socket/s**				
	Supply & installation of following modular grid plate mounted switch/ (es) and socket/(s) etc. on a suitable size mild steel electrogalvanised switch boxes complete in single or combination on prorate basis complete with the connections, earthing and testing as per specifications and as required: (Note the grid plate and MS BOX shall be selected suitably as per the requirement to fix the switches and sockets.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
2.1	6/10A modular switches.	Nos	11	249	2,741
2.2	6 Amp Universal socket with 6 amp modular switch.	Nos	11	282	3,105
2.3	6/16 Amps, Universal socket with 16 Amps, modular switch.	Nos	11	351	3,857
2.4	**20/25/32 Amps, 1-Phase Industrial Socket Outlet**	Nos	11	1,461	16,070
	20/25/32A 1-Phase industrial socket outlet with 20/25/32A SP MCB in a GI enclosure with IP56 protection rating with all mounting & fixing accessories & terminations with separately lockable facility complete as required.				
2.5	**20/25/32 Amps, 3-Phase Industrial Socket Outlet**	Nos	11	3,904	42,947
	20/25/32 Amps, 3-Phase industrial socket outlet with 20/25/32 Amps, TP MCB in a GI enclosure with IP 56 protection rating with all mounting & fixing accessories, terminations & Cable glands for cable entry with separately lockable facility complete as required.				
3	**GI Conduiting**				
	Supply and installation of GI conduiting complete with GI junction and pull boxes, GI fish wires as specified and as shown below.				
	Note: Conduiting has been assumed for Telephone/Data Points through out the Depot. Requirement shall be confirmed by S & T Contractor.				
3.1	25 mm inner dia 1.6 mm thick	M	4,400	132	5,82,164
3.2	32 mm inner dia 1.6 mm thick	M	110	193	21,225
3.3	50 mm inner dia 2.0 mm thick	M	110	345	37,962

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
4	Providing and fixing circular/ Hexagonal cast iron or M.S. sheet box for ceiling fan clamp, of internal dia 140 mm, 73 mm height, top lid of 1.5 mm thick M.S. sheet with its top surface hacked for proper bonding, top lidshall be screwed into the cast iron/ M.S. sheet box by means of 3.3 mm dia round headed screws, one lock at the corners. Clamp shall be made of 12 mm dia M.S. bar bent to shape as per standard drawing.	each	330	184	60,763
	TOTAL FOR E.04 (CONDUIT WIRING)				**95,27,198**
E05	**INDOOR LIGHTING AND FANS**				
	General				
	"The Lighting System specified herein, must conform to the technical Specifications, in addition to the description given in respective items of BOQ, whether explicitly specified or not. In case of contradiction between specifications and description in BOQ, the most stringent of the condition will prevail."				
	Supply, installation, testing & commissioning of light fittings including all accessories e.g. ballast, HPF condensors, lamps, holders, surface/recess mounting arrangement etc. including necessary supports, accessories and hardware as per specifications & as required at site and as below:-				
A)	**Luminaire minimum specifications and requirements**				
a.	Luminaires should operate at +/- 10% voltage fluctuation for continuous use to comply to IEC.				
b.	All the components including the internal wiring of the luminaries to be used shall be manufactured of material, which are of low smoke and zero halogen type. All luminaires shall be manufactured to relevant sections of IEC60598 or other approved international standards and the type tests for all luminaries shall be provided.				
c.	All internal wiring within the lighting fixtures shall be heat-resisting cables.				
d.	Light fixtures to be controlled by the suitable sensors for desired switching sequence / pattern and to contribute in making of an energy efficient system				
1	**Indoor Light Fixture**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1.1	Supply, installation, testing and commissioning of LED 2X2 recess mounting luminaire with mid flux LED using efficient optics enclosed in a metallic CRCA powder coated housing with high efficiency Lumio diffuser. It has a system lumen efficacy > 80 Lumen/watt with system level luminous flux of 3100 lumens and system wattage of 40W. 50,000 hours burning life for the system at 70% lumen maintenance with a color rendering index > 80 and color temperature 6500K. PF > 0.9 and THD <33%. Luminaire is sealed from bottom and has an inbuilt gear. The luminaire is IP 20 protected. Similar as per approved make list.				
a)	**Supply of above given items**	Nos	558	3,619	20,18,137
b)	**installation, testing, commissioning of above given items**	Nos	558	164	91,622
1.2	Supply, installation, testing and commissioning of 135 mm dia. recessed 18 W LED downlighter with 1200 lumens output at 6500K color temparature and > 70 CRI. The fixture should be DLED comptact LED Engine with a die cast aluminium heat sink, a high efficacy diffuser and a PC reflector with steel clip. The fixture should have an integrated constant color driver. Fixture should be IP 20. or as per approved equivalent make list.				
a)	**Supply of above given items**	Nos	295	1,460	4,30,355
b)	**installation, testing, commissioning of above given items**	Nos	295	132	39,005
1.3	Supply, installation, testing and commissioning of 4' 28 W LED luminaire. Luminaire should be suitable for surface mounting / suspended made of extruded aluminium housing and CRCA front frame. High efficiency covered luminaire with opal diffuser. With minimum lumen output of 3250 lumens and efficacy >60 Lm/W and CCT of 6500K. Electronic driver should have a pf>0.9 and THD < 25%. The product should be suitable for direct installation on RCC with accessories with option of being suspended.				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
a)	**Supply of above given items**	Nos	413	3,403	14,03,561
b)	**installation, testing, commissioning of above given items**	Nos	413	164	67,768
1.4	Supply, installation, testing and commissioning of linear LED batten. The fixture should be a system wattage of 28 W and a high CRI of 85. System efficacy of 85 lumens/W and a system lumen output of 3250 lumens. The fixture should have a metal frame design and is protected to IP20.				
a)	**Supply of above given items**	Nos	704	2,935	20,66,294
b)	**installation, testing, commissioning of above given items**	Nos	704	164	1,15,657
1.5	Supply, Installation, Testing & commissioning of 42W WellGlass LED light fixture with lumen output of 2700 lm at 6500 colour temperature, IP 66 and IK 08. Fixture has CRI 70, THD <=10% and pf>.95 with High Pressure die cast body as aproved make list.				
a)	Supply of above given items	Nos	242	3,957	**9,57,689**
b)	installation, testing, commissioning of above given items	Nos	242	440	**1,06,410**
1.6	Supply, Installation, Testing & commissioning of 210W Highbay with 24000 Lumens, IP65 , power factor of more than 0.95 with housing of High pressure Die cast aluminium. The fixture should be as per approved make list.				
a)	Supply of above given items	Nos	40	18,544	**7,34,327**
b)	installation, testing, commissioning of above given items	Nos	40	1,515	**59,994**

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1.7	Supply, Installation, Testing & commissioning of 10W LED Bulkhead with a lumen package of 600 lumens in cool White color. The fixture should be THD ≤ 20% and PF > 0.9, IP 66 and IK 09. Fixture should be a housing of High Pressure Die Cast aluminium and a front diffuser of poly carbonate. The fixture should be as per approved make list.				
a)	**Supply of above given items**	Nos	26	1,322	34,901
b)	**installation, testing, commissioning of above given items**	Nos	26	99	2,620
1.8	Supply, Installation, Testing & commissioning of 250W LED Flood light fixtures with accessories for yard lighting (Highmast fittings) or approved equivalent make list.				
a)	**Supply of above given items**	Nos	13	40,400	**5,33,280**
b)	**installation, testing, commissioning of above given items**	Nos	13	4,040	**53,328**
1.9	80 W LED Street Light with a lumen output of 7000 lumens. The fixtures is made of die cast aluminium. Fixture has a CRI > 70 and IP 66 protection. The fixture should be as per approved make list.				
a)	**Supply of above given items**	Nos	74	9,151	**6,74,445**
b)	**installation, testing, commissioning of above given items**	Nos	74	1,017	**74,938**
1.10	47W High power LED Decorative Post Top with 1600 lm neutral white output having integral driver with closed diffuser optics protected to IP 65. For decorative lighting with accessories.				
a)	**Supply of above given items**	Nos.	22	11,895	2,61,690

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
b)	**installation, testing, commissioning of above given items**	Nos.	22	1,322	29,077
2	**Fans**				
	Supply, installation, testing & commissioning of the following fans including fixing arrangement and with all accessories like down rods, 5 step electronic fan regulators, cover plates, cups as required for the following complete with necessary seamless pipe required for hanging of the fans etc.				
2.1	**Ceiling Fan 1200 mm Sweep**	Nos	44	1,506	66,270
	Ceiling Fan 1200 mm sweep with out regulator but with all accessories as per IS: 374, 1979 with all amendments as applicable as required.				
2.2	**Air Circulator Fans 600 mm Sweep**	Nos	17	8,635	1,42,485
	wall / column mounted industrial type heavy duty fan 600 mm dia sweep complete with all accessories required.				
	TOTAL FOR E.05 (INDOOR LIGHTING AND FANS)				**99,63,850**
E06	**HIGHMAST & STREET LIGHT POLES**				
	Highmast	Nos	4	6,52,222	26,08,889

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	Supply, installation, testing and commissioning of 30 m high mast system with its accessories. Mast shaft shall be of Bajaj / Philips / Keselec / Thorn, hot dip galvanised and suitable for wind velocity as per IS 875. It shall also include accessories for high mast including head frame, steel wire rope, trailing cable, double drum winch, Galvanised Lantern carriage arrangement suitable for 12 luminaires & its control gear boxes and lightning arrestor. The mast shall have an External powertool installed inside the base compartment for its operation and including following				
	Foundation bolts manufactured from special steel along with nuts, washers, anchor plates and templates.				
	S.I.T.C. of suitable neon Aviation lights as required.				
	Control panel housing with suitable TPN MCB incomer, one numbers single dial timer contactor circuit for the automatic control of luminaries.				
	Common power tool for the operation of the mast with single phase single speed motor along with reversing gear, stand, control push button and other accessories.				
	Earth Station of Pipe earthing (2Nos) as per IS:3043-1987 & IEEE:80-2000, including duplicate earth connection to the mast with 25x3 mm size GI Strip.				
	Street Light Poles	Nos	74	27,362	20,16,558
	9.0 meter hot dipped galvanised Octagonal with single & Double overhang arm & with foundation bolts, base plate complete with foundation, entry and exit pipes, control JB with connector generally as shown on drawings and as per specifications.				
	TOTAL FOR E.06 (Highmast & Street light pole)				**46,25,446**
E.07	**PROTECTIVE EARTHING SYSTEM**				
	General				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	Contractor has to check the value of soil resistivity before execution and contractor shall subject to submit detail earth mat calculations for approval to Engineer. After their final approval work shall subject to commenced.				
	Note:- Steel structure/pipe shall be Earth by suitable rating of earth strip/wire.				
1	**EARTHMAT**				
1.1	**50X6mm copper flat for Earth Mat @ ASS -1 Building**				
	Supply, laying, testing and commissioning of 50X6mm copper flat for earth mat (at 700 mm to 3000 mm deep as per approved drawing & calculations) as per specifications including lap (of not less than 150 mm) & cross weld joints and providing bitumin coat at every joint as required. Earthing risers from earth mat to be brought out as per approved drawings and specifications wherever required.	RMT	385	2,191	8,43,649
1.2	**30 mm dia Copper Rod for Vertical Electrodes**				
	Supply, laying, testing and commissioning of 30 mm dia copper rod, laying of vertical earth electrodes 3 m deep from earth mat including weld joints with earth mat as per approved drawings and specifications. The weld joints to be provided with bitumin coats.	No.	22	15,482	3,40,593
1.3	**Extra for Bituminous Coating and Hessian Tape Wrap**				
	Extra for bituminous coating and hessian tape wrap or polyethylene faced hessian complete for buried earthing strips risers mentioned above in item 1.1 as per specifications and drawings as required.	M	330	41	13,463
2	**MAINTENANCE FREE EARTHING**				
2.1	**Maintetance free earthing-**				
	Supply, installation and testing of copper bonded (25mmX 3Mtr)electrode chemical earth pit with hygroscopic condactive compound + soil conditioning gel including chamber with cover	NOS	7	6,737	44,463
3	**EARTHING STRIPS & CABLES**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
3.1	**Strips for Interconnecting the Earthing Stations, Panels, DBs etc**				
	Supply, Laying, fixing, testing and commissioning of following strips for interconnecting the earthing stations, panels, DBs, Cable trays, etc. of the following sizes in built up trenches /surface/wall/ground complete with holes & fixing, jointing/terminating accessories as per specifications as required. (Quantity shall be paid as per the actual measurement as executed) however direct measurement shall not exceed the quantity indicated in drawing approved by engineer.				
3.1.1	70 mm x 10 mm GI strip	M	1,650	419	6,91,320
3.1.2	65 mm x 8 mm GI strip	M	550	315	1,73,436
3.1.3	50 mm x 10 mm GI strip	M	1,100	300	3,29,893
3.1.4	50 mm x 6 mm GI strip	M	2,200	200	4,39,049
3.1.5	25 mm X 6 mm GI strip	M	2,200	110	2,42,568
3.1.6	50 mm x 6 mm CU strip	M	1,650	2,191	36,15,638
3.1.7	25 mm x 6 mm CU strip	M	1,650	1,096	18,07,819
3.1.8	8 SWG Cu WIRE	M	2,200	97	2,13,312

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
3.1.9	70 Sqmm single core Copper cable for clean earthing	M	165	530	87,458
	Note-1: In case of non availability of any of the sizes mentioned above, next higher size available in market shall be provided at the same rate.				
	Note-2: No additional payment will be made for providing Main Earth Terminals (made out of GI strips from within the above sizes). The METs will be required to be fixed on walls as required and will be provided with 12/16/20mm holes for connections of individual equipments earthing including the other system wide contractors.				
	TOTAL FOR E.07 (PROTECTIVE EARTHING SYSTEM)				**88,42,661**
E.08	**LIGHTNING PROTECTION**				
1	**Lightning Conductor Finials**	Nos	7	817	5,392
	Supply and fixing Lightning Conductor Finials made of 25 mm dia 1mtr long copper tube having a single prong at the top with 85 mm dia 6 mm thick copper base plate, fixing accessories and clamping with down conductor as per specifications complete as required.				
2	**Stainless Steel horizontal & Vertical Conductor**				
	Supply, laying and fixing of the stainless stell horizontal & vertical conductor of following sizes on surface/wall/parapet/shaft complete with joints, bimetallic connectors, testing links & other fixing accessories and clamping/ connection with earth terminations as per specifications & drawing as required.				
2.1	25x6 mm thick SS Strip	M	550	463	2,54,697

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
2.2	25x3 mm thick SS Strip	M	33	232	7,641
3	**Testing Joints**				
	Supply and fixing of the testing joints made of 25 mm x 6 mm thick SS strip 125 mm long with 4 Nos. SS bolts, nuts, check nuts and spring washers complete as required.	M	44	269	11,837
4	**Maintetance free earthing-**				
	Supply, installation and testing of copper bonded (25mmX 3Mtr)electrode chemical earth pit with hygroscopic condactive compound + soil conditioning gel including chamber with cover	Nos	17	6,737	1,11,157
5	**Air Craft Warning Lights**				
	Supply, installation, testing & commissioning of air craft warning lights complete with non flickering type lights similar to GEC model ZH 752 or WIPRO model no. WAN 20001 or equivalent including lamps, mounting bracket, earthing, painting complete with accessories to automatically switch off lights. (Point wiring shall be done under subhead conduit wiring).	Nos	2	6,291	13,841
	TOTAL FOR E.08 (LIGHTNING PROTECTION)				**4,04,565**
E.09	**External Piping System for HUME, TRENCHING & UNDERGROUND**				
4	**PIPES**				
4.1	**HDPE Pipe**				
	Supply and laying of following HDPE pipe NP4 grade under paved areas/track crossings including necessary excavation, honching and back filling complete as required as per IS:14333:1996 with all amendments applicable.				
4.1.1	200 mm dia HDPE Pipe	M	110	3,415	3,75,617
4.1.2	120 mm dia HDPE Pipe	M	330	1,587	5,23,584

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
4.1.3	80 mm dia HDPE Pipe	M	660	889	5,86,530
4.2	**Heavy/Medium Grade GI Pipes**				
	Supply and installation of following heavy duty grade GI pipes for cables crossing the rail tracks with all bendings complete as required including necessary excavation, honching and back filling as complete as required as per IS:3589 & IS 1239 with all amendments applicable,				
4.2.1	150 mm dia GI pipe	M	55	2,149	1,18,191
4.2.2	100 mm dia GI pipe	M	110	1,640	1,80,350
4.2.3	80 mm dia GI pipe	M	110	1,242	1,36,566
4.2.4	40 mm dia GI pipe	M	55	545	29,957
4.3	**RCC Hume Pipes**				
	Supply and installation of following RCC Hume pipes NP4 grade, for cables crossing the roads with all fitting accessories complete as required including necessary excavation, honching and back filling as compete as required as per IS:458: 2003 with all amendments applicable.				
4.3.1	450mm dia RCC Pipe	M	55	2,727	1,49,968
4.3.2	250mm dia RCC Pipe	M	110	1,389	1,52,818
4.3.3	150mm dia RCC Pipe	M	550	852	4,68,763
	TOTAL FOR E.09 (EXTERNAL PIPING SYSYTEM)				**27,22,344**
E.10	**COMPACT SANDWICH TYPE BUS DUCT**				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1	**3200 amps Compact Sandwich Bus Duct**	M	33	48,455	15,99,031
	Supply installation, testing & commissioning of the following totally enclosed, dust and vermin proof Low impedance compact sandwich bus duct:				
	Ingress protection IP 55				
	Indoor mounts				
	14 SWG sheet steel clad				
	Electrolytic Grade Cupper(Cu.) bus bar				
	Operation at 415 Volt 3 phase 50 Hz system				
	Insulation voltage 1000 volts				
	Fault withstand 50 kA symmetrical for 1 second				
	The bus duct shall be complete with all required accessories like clamps, end covers, thrust pads, flexible connections end termination flange joint etc. as required and including wall mounting brackets and including the cost of expansion joints complete as per specifications, as required and as below and suitable for operation at 415 volt 3 phase 50 Hz system.				
	3200 amps 3P +100%N+50% Integral Earth including bends.				
	TOTAL FOR E.010 (COMPACT SANDWICH TYPE BUS DUCT)				**15,99,031**
E.11	**UNINTERRUPTED POWER SUPPLY SYSTEM**				
	Supply, Installation, Testing and Commissioning of **following rating online, UPS** system suitable for providing power supply to emergency lighting and Computerised Control panel load of approved make, suitable for incoming 415 volts, 3 phase +10 % - 20%, 50 Hz, supply and three phase output voltage, variation ± 1%, including transformer, rectifier/dual converter, static switch, inverter, filter, Bypass & static transfer switch for automatic switch over without giving any break of power, maintenance bypass switch, Micro processor/ software controlled annunciation,protection(including against input phase reversal), and menu run diagnostic module,associated cabling and connections/ terminations, erection including associated foundation/ masonorey or RCC work for mounting on base channels etc. complete as per specifications and as required.	Set	1	16,40,580	16,40,580

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
	The UPS shall be a true parallel redundant with bypass with Individual Battery Bank on each UPS for 30 Minuits (2X100% Redundancy on Battery Setup)				
11.1	2 X 40KVA UPS (PR System)	No	1		
11.2	Supply, Installation, Testing and Commissioning of 2V SMF VRLA lead acid sealed maintenance free battery (Design Life - 10years) suitable for 30Minuits backup to the UPS set. Battery shall comply with relevant regulations & Battery racks shall be made of acid resistant material. (40KVA UPS)	Set	1		
	TOTAL FOR E.11 (UNINTERRUPTED POWER SUPPLY SYSTEM)				**16,40,580**
E.12	**DG SET WITH PLC BASED AMF PANEL**				
	Supplying, installation, testing & commissioning of Radiator Cooled type Diesel Generating Set comprising of multicylinder diesel oil engine with radiator, fly wheel, exhaust piping upto silencer and outside the remote location, residential type silencer, electric starting equipments, batteries, battery charger, directly coupled to an alternator of suitable capacity at 0.8 P.F. 3 phase, 4 wire 50 Hz 415 volts, A.C supply complete with base plate antivibration mountings foundations for installation of D.G. Set,terminating arrangement for outgoing cables, control panel,controlling MCCB etc, complete of exhaust pipe installation with support arrangement as required as per specifications, Drawings and specified ambient conditions	Set	1	1,03,77,465	1,03,77,465
	DG Sets shall be suitable for Auto Start, Auto Stop and Auto Load Management.				
	1000 KVA D.G. SET WITH CANOPY (INCLUDING PLC BASED AMF PANEL)				
	Supply, erection, testing and commissioning of floor mounted totally enclosed sheet steel AMF Panel with PLC suitable for automatic operation of 1000 **k**VA DG set and equipped with automatic gas flooding using linear heat sensing tube type fire trace system or equivalent. The panel shall be suitable for 415 V, 3 phase, 4 wire system, **Copper bus bars** designation labels as per requirement, continuous earth bus, cable clamping supports, panel illuminating lamps, cable gland plates for incoming and outgoing feeders as per details below :				
(a)	**Switchgear** 1 nos. 1600 A, 50 kA, 4-pole ACB with microprocessor based over load and short circuit protection with time delay and earth fault IDMT release - all site settable				

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
(b)	1 No., 230V, AC operated integrated type Digital Multi function meter for measuring Frequency, Amperes ,Voltage, Energy & Power factor of appproved makes conforming to specifications, latest IEC/ EMC and EMI standards, with necessary Circuit MCBs and suitable size CTs for above two incomer metering supporting SCADA / BMS connectivity				
(c)	One set of **"Battery charger"** consisting of :				
(i)	Transformer/Rectifier				
(ii)	DC. Ammeter				
(iii)	DC. Voltmeter				
(iv)	Charging rate selector switch (OFF/Trickle/Boost.)				
(d)	One Mains supply Voltage monitor				
(e)	One set of DC Control relays incorporating engine Start/Stop, three attempts starting facility and failure to start lock out.				
(f)	One set of auxiliary relays for automatic closing and opening of the alternator contactor for automatic operation as required.				
(g)	6 nos. potential free contacts for BMS				
(h)	One selector switch Auto/Manual/ Test				
(i)	One set of the following :				
(i)	One Selector switch for engine control OFF/ON				
(ii)	Four Push buttons, Start, Stop, Reset, Test.				
(iii)	Two Indicating lamps "Load on set" "Load on Mains".				
(iv)	Five Indication on annunciator for shutdown for "Low lube oil pressure", "High water Temperature", "overspeed", "low fuel" & "set fails to starts".				
(j)	One counter to indicate number of times set has operated.				
(k)	One **Hour meter** to indicate the number of hours set has operated				
(l)	The AMF panel shall include necessary internal wiring, control circuit fuses, labeling, name plates cable identity tags on both ends etc. complete as per specification and as required				
(m)	Power Pack for the PLC backup of the DG set with all arrangement, including battary, Control Circuits, Internal wiring, labeling, name plates cable identity tags on both ends etc. complete as per specification and as required				
12.2	**FUEL SYSTEM**	Lum	1		

(Attachment No-11 to Addendum No-5)
PART-C - 'SCHEDULE OF QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
a	One Number Semi rotary hand pump for filling fuel in daily fuel tankincluding the cost of suitable fuel piping and connections suitable for decanting from oil drums	Nos	1	1,149	1,149
b	Supplying, installation, testing and commissioning of 990 Day Oil fuel steel tank of under mentioned capacities made out of 5 mm thick M.S. sheet with float valve and low level alarm arrangement including fuel oil piping up to the set valves etc. complete as required.	Nos	1	8,388	8,388
c	Supplying, installation, testing and commissioning of Suitable rating Fuel Oil pump including foundations, piping, valves, indications, safety devices etc. complete as required.	Nos	2	13,839	27,677
d	MS Class-B 25mm fuel pipe	Lum	1	2,693	2,693
	The Contractor scope of inspection and approval for getting the layout drawing, installation, license from Electrical Inspectorate local authority, explosive department,HERC for Campus complete as required for satisfatory function of the installation of above DG Sets				
	The contractor shall submit back-pressure calculations in support of exhaust pipe size for each DG Set.				
	TOTAL FOR E.12 (DG SET)				**1,04,17,373**
E.13	**Conduiting and GI Sleeves for Telephone, Lan & PA System**				
	NOTE:- Conduiting has bee estimated for Telephone / Data Points Through out the OCC Building. Detailed Requirements shall be interfaced with STPT Contractor				
1	Conduitin & GI Sleeves for Telephone System				
1.1	Providing and Fixing in position the fiollowing 16 guage GI Conduit concealed or exposed as called for including all accessories 1.e. bends, junction boxes, of re3quired design				
a	25mm dia	Mtrs	1,925	149	2,86,453
1.2	Providing and Laying of following medium class GI pipe including all fixing accessories concealed or exposed as called for				
	40mm dia	Mtrs	28	562	15,456
	100mm dia	Mtrs	39	1,489	57,335
	TOTAL FOR E.13 (Conduiting and GI Sleeves for Telephone, Lan & PA System)				**3,59,243**

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
F.01	**FIRE DETECTION & ALARM SYSTEM**				
1	Supply, installation, testing and commissioning of plug-in type addressable analogue multi-critical detectors below false ceiling including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	Nos.	365	1,544	5,63,420
2	Supply, installation, testing and commissioning of plug-in type addressable analogue multi-criteria detectors above false ceiling including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	Nos.	49	1,544	75,637
3	Supply, installation, testing and commissioning of plug-in type rate of rise cum fixed temperature addressable analogue Heat detectors including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	Nos.	4	1,433	5,733
4	Supply, installation, testing and commissioning of '4" Loop (750 Detectors, 400 Devices) (Fire Alarm Capability: 1 Loop x 99//125/150 detectors/ devices) wall recess mounting microprocessor based analogue addressable Fire Control Panel expandable by minimum 2 additional loops (Fire loop shall be closed type) with minimum 80 character LCD display, 4 access levels, 1000 events historical logging, flash E-PROM, 240 volts ac power supply, automatic battery charger, 24V SLA batteries suitable for operating the entire system including the talk back units and the hooters/strobes for a minimum of 8 hours in battery condition. The Panel shall have suitable power amplifiers for hooter/strobes. The Panel shall be capable of being Integrated with the BMS System and shall include cost of supply and installation of any additional modules or interfaces required for the same. The pannel shall be complete as per specifications and as required.	Nos.	1	7,88,822	7,88,822
5	Supply, installation, testing and commissioning of Repeater panel including the cost of mounting accessories complete as per specifications and as required	Nos.	4	27,409	1,09,636
6	Supply installation testing and commissioning of dust and vermin proof addressable analogue Manual Call Boxes to initiate audio visual alarm including the cost of mounting accessories complete as per specifications and as required.	Nos.	33	2,315	76,409

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
7	Supply installation testing and commissioning of addressable analogue Talk Back jacks with face plates for Fireman's Handsets to initiate audio conversation with Main Fire Alarm Panel including the cost of mounting accessories complete as per specifications and as required.	Nos.	35	5,042	1,76,479
8	Supply, installation, testing and commissioning of Wall/ Ceiling mounting Sounder & strobes for visual indication including the cost of mounting accessories complete as per specifications and as required.	Nos.	35	1,213	42,449
9	Supply, installation, testing and commissioning of Control Modules including the cost of mounting accessories complete as per specifications and as required.	Nos.	35	2,315	81,040
10	Supply, installation, testing and commissioning of Monitor Modules including the cost of mounting accessories complete as per specifications and as required.	Nos.	18	2,315	41,678
11	Supply, installation, testing and commissioning of Fault Isolator Modules including the cost of mounting accessories complete as per specifications and complete as required.	Nos.	20	2,095	41,898
12	Supply installation testing and commissioning of two way Talk Back handsets to initiate audio interface complete as required.	Nos.	19	9,765	1,85,538
13	Supply, installation, testing and commissioning of wall or ceiling mounted 240 Volt AC illuminated double sided pictorial exit signs provided with appropriate direction arrow painted in green on white with an 11W CFL Lamp including the cost of in-built rechargeable batteries with charger suitable for 90 minute operation and including the cost of accessories for surface/ recessed or ceiling suspended mounting complete as required.	Nos.	20	4,725	94,504
14	Supply, installation, testing and commissioning of Response Indicator Lamp assembly in a dust tight sheet steel enclosure as per detailed specifications including accessories for recess mounting as per approved sample as required.	Nos.	142	191	27,145
15	Supplying, Laying, Termination, Testing and commissioning of size **2C x 1.5** sq mm twisted pair Screened Fire Survival cables complying with BS 7846 catagory CWZ.	Mtrs.	3,200	189	6,05,849
16	Supplying, Laying, Termination, Testing and commissioning of size 2C x 2.5 sq mm twisted pair Screened Fire Survival cables complying with BS 7846 catagory CWZ.	Mtrs.	10	316	3,155

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
17	Supplying, installing, testing and commissioning of following sizes 16 gage GI conduits recessed/surface as required including clamps, hardwares etc required for conduiting arrangement complete as per specifications. (Quoted price shall include GI flexible conduits to connect from ceiling to false ceiling)				
a)	20 mm dia	Mtrs.	10	185	1,848
b)	25 mm dia	Mtrs.	3,000	197	5,91,644
	TOTAL FOR F.01				**35,12,885**
F.02	**FIRE FIGHTING SYSTEM**				
1.1	Providing, laying, jointing and testing in trenches the following sizes of G.I. class `C' (heavy class) pipes conforming to IS:3589 & IS:1239 with accessories like fittings including tees, elbows, reducers, flanges, rubber gaskets, GI nuts, bolts and washers and providing protection to embedded ~~MS~~ G.I. pipes and fittings by applying pypkote primer (@ 100 gm/sqm) thereafter wrapping 4 mm thick pypkote (AW 4 mm) protection coating by thermo fusion process. Overlap shall be maintained at 15 mm. The application process shall be strictly according to manufacturer's specification, inclusing necessary excavation trenches and refilling as required. **(For under ground works)**				
1.1.1	80 mm dia	Mtr.	200	1,125	2,24,927
1.1.2	100 mm dia	Mtr.	550	1,522	8,36,861
1.1.3	150 mm dia	Mtr.	1,800	2,150	38,70,068
1.1.4	200 mm dia	Mtr.	10	2,955	29,549

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.2	Providing, laying, jointing, testing and commissioning of following sizes of pipes conforming to IS:3589 & IS-1239 with all accessories like all fittings (standard G.I. fitting with welded joint shall be used on the pipes) including tees, elbows, reducers, union, flanges, rubber gaskets, GI nuts bolts, washer including supporting/fixing the pipe on floor / wall /ceiling with clamps, hangers (using anchor fastners) or angle iron support work in trenches as per specification. G.I. pipe sleeve of suitable higher size shall be provided wherever the pipes are crossing the walls/floors and sealing the sleeves with glass wool in between & fire sealent compound at either end all as per Project Manager's / Consultants requirements including cutting holes and chases in brick and making good the same to original conditions complete in all respects. **(For above ground works)**				
	All hangers, civil support for external pipes, clamps, brackets etc. shall be of galvanized iron unless specified otherwire and then supply of the same shall also be included for rates under this head. Including two coats of synthetic enamel paint of approved shade over a coat of primer. Prior to application of primer the surface should be cleaned for any dirt, rusts, rough substance etc. Including painting of legends both direction arrow as per the approval of the Project Manager.				
	welding of any kind on galvanized support / hanger shall not be permitted				
1.2.1	25 mm dia	Mtrs.	360	342	1,23,048
1.2.2	32 mm dia	Mtrs.	100	441	44,103
1.2.3	40 mm dia	Mtrs.	330	496	1,63,734
1.2.4	50 mm dia	Mtrs.	130	695	90,302
1.2.5	65 mm dia	Mtrs.	60	816	48,955
1.2.6	80 mm dia	Mtrs.	180	1,025	1,84,572

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.2.7	100 mm dia	Mtrs.	180	1,411	2,54,035
1.2.8	150 mm dia	Mtrs.	400	2,205	8,82,067
1.2.9	200 mm dia (wall thickness 6 mm.)	Mtrs.	10	2,701	27,013
1.2.10	250 mm dia (wall thickness 6 mm.)	Mtrs.	10	3,363	33,629
1.3	Providing & fixing controlled RRL fire hose pipe (as per IS:636) of 63 mm dia and 15 meter length rated for brust pressure of 35.7 Kg/sqcm. Hose shall be complete with ISI marked S.S male & female coupling (IS:903) bound & riveted to hose pipe with copper rivets & 1.5 mm copper wire.	Each	32	4,747	1,51,902
1.4	Providing and Fixing stainless steel 63 mm dia instantaneous pattern branch short pipe, 20 mm dia nozzle conforming to IS 903, suitable for inter connection to hose pipe coupling complete as required.	Each	16	2,178	34,854
1.5	Constructing masonry chamber 90x90x120 cms inside with 75 class designation brick work in cement mortar 1:5 (1 cement : 5 fine sand) for valve with 560 mm dia. SFRC Manhole cover with frame (Heavy duty) and R.C.C. top slab 1:2:4 mix (1cement:2 coarse sand : 4 graded stone aggregate 20 mm nominal size) necessary excavation foundation concrete 1:5:10 mix (1 cement : 5 fine sand and 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1cement :3 coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard design with FPS bricks.	Nos.	5	13,612	68,062
1.6	Providing & fixing Gun Metal fire brigade connection unit consisting of 4 No. 63 mm dia instantaneous type male couplings with built-in check valves, 1 No., 150 mm dia flanged outlet complete with bolts, nuts and rubber insertions as required and as per IS standards	Each	2	16,870	33,739

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.7	Providing & fixing Stainless steel cabinet (to enclose FB connection,draw off connection & for external hydrants) fabricated from 16 g sheet with full front glass door and locking arrangement duly painted with one coat of primer and two or more coats of synthetic enamel paint of approved make and shade and suitably mounted on a raised masonry platform as required (Approx 0.75m x 0.6m x 0.25m)	Each	2	6,259	12,518
1.8	Providing and fixing single acting air release valve with screwed inlet 20 mm dia.	Each	5	1,985	9,923
1.9	The rate shall include supply and fixing **Gun metal ball valve** CI hand wheel suitable for pressure 15 Kg/sqcm. and confirming to relevant IS of the following size including providing necessary union/flange and making proper connection for air testing and drainage system.				
1.9.1	50 mm dia	Nos	12	3,118	37,417
1.10	Providing and fixing pre fabricated 4 mm thick glass door (with SS frame) of size 2.1 m x 0.9 m with center opening for fire hose cabinet suitabely marked on the outside with the letters "FIRE HOSE" including locking arrangement including with 1 No Hydrant landing valves, 1no fire hose reel, 2 Nos.15 m long 63 mm dia hose pipe,1 no branch pipe, 1No. fire man's axe and 2 Nos fire extiguishers.	Each	17	25,049	4,25,829
1.11	Supplying and fixing of hose cabinet fabricated from of size 900 mm x 600 mm x 450 mm made of 3 mm aluminium sheet with 6 mm thick glazed glass doors i/c necessary locking arrangement suitable to accommodate external hydrant valve, with butter fly valve, 2 Nos.15 mtr. Long Hose pipe, 1 No. branch pipe, mounted on wall OR raised brick platform 600mm in height built in brick masonary in cement mortat 1:5, 12mm thick plaster on all sides and finished with existing/ proposed external finish & duly painted with Post office red externally and white internally with synthetic enamel paint completein all respect, for external hydrants, as required.	Each	16	7,222	1,15,547
1.12	Providing and fixing dial type pressure gauge with isolation cock and pipe.		.		
1.12.1	Dial diameter 100 mm caliberation 0-15 kg	Each	30	3,622	1,08,660

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.13	Providing & fixing butterfly valve tested to a pressure not less than 15 Kg/Sq.cm. Including rubber gasket, flanges, nuts, bolts, washers & painting complete as required.				
1.13.1	65 mm dia	Each	4	3,197	12,790
1.13.2	80 mm dia	Each	6	3,528	21,170
1.13.3	100 mm dia	Each	3	4,521	13,562
1.13.4	150 mm dia	Each	15	6,505	97,579
1.13.5	200 mm dia	Each	4	16,208	64,832
1.14	Providing & fixing dual plate CI wafer type check valve tested to a pressure of 15 Kg/sqcm. Including rubber gasket, flanges, union, nuts, bolts, washers & painting complete as required.				
1.14.1	65 mm dia	Each	10	5,970	59,704
1.14.2	100 mm dia	Each	10	8,686	86,863
1.14.3	150 mm dia	Each	10	14,685	1,46,850
1.15	Designing, providing and fixing Orifice plate made out of stainless steel plate (thickness as per specification) for 80/100/150 mm dia. pipe to reduce pressure upto 3.5 Kg/sqcm complete in all respects.	Each	18	1,544	27,785
1.16	Providing and fixing standard firemans axe with heavy rubber handle.	Each	4	662	2,646

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.17	Providing and laying non-pressure NP2 class (light duty) R.C.C pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc.complete.				
1.17.1	250 mm dia. **R.C.C pipe**	Mtr.	50	975	48,763
1.18	Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) all-round R.C.C pipes including bed concrete as per standard design.				
1.18.1	250 mm dia. **R.C.C pipe**	Mtr.	60	3,467	2,08,032
1.19	Providing & fixing brass quartzoid sprinklers (UL approved) of 15 mm dia size, suitable for sustaining the pressure on the seat & water hammer effect. The type & temperature rating shall be as follows :				
1.19.1	Providing, fixing, testing and comissioning of UL listed Pendent/Upright type sprinkler head rated at 68 degree centigrade.	Each	416	331	1,37,602
1.19.2	Supply, installation, testing and commissioning of 150 mm dia control valve inclusive of 1 no 150 mm dia butterfly valve, trainer, alarm valve with water motor gong, pressure gauges, test line with ball valve with necessary GI (H) Piping with threaded fittings of required pipe sizes complet. the item also includes providing and fixing 100 mm dia pressure gauges on sprinkler headers including ball valves, test control box brass strainer retard chamber	Each	1	55,129	55,129
1.19.3	Providing and fixing inspector's test assembly complete with test value, sight glass sectional drain valve union with corrosion resistant orifice all complete	Each	5	9,819	49,095
1.20	Supply, installation, testing and commissioning of electrically driven multistage, single outlet high pressure centrifugal type fire hydrant /sprinkler pump, suitable for automatic operation consisting of the following:				

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Horizontal multistage, single outlet, **split casing** centrifugal pump, suitable for operation on 415 volts ± 6%, 3 phase, 50 HZ AC supply. The installation shall be complete with flexible coupling and coupling guard as required. Fire pump shall have CI casing, CS diffusers, bronze impeller (hard finished and dynamically balanced) and SS (304) shaft with mechanical seal, capable for **delivering 2850 LPM at outlet head of 90 mtrs.** to ensure a minimum pressure of 3.5 Kg/Sqcm at the farthest or topmost hydrant / sprinkler. The installation shall be complete with necessary pressure gauge on delivery side.				
	Squirrel cage induction motor, TEFC type suitable for operation on 415 volts, 3 phase 50 HZ A.C supply, for the above pump with synchronous speed of **1500 RPM,** conforming to IP 55 protection & class F insulation. The motor shall conform to IS 325-1978 (up to date).				
	Common base plate for (a) and (b) from M.S. Channel for required size.	Each	2	4,07,956	8,15,912
1.21	Supply, installation, testing and commissioning of **Jockey pump** (pressurisation pump) comprising of the following:				
	Vertical centrifugal pump, suitable for operation on 415 volts ± 6%, 3 phase, 50 HZ A.C supply. The installation shall be complete with Flexible coupling and coupling guard, complete as required.				
	The pump casing shall be CI, shaft shall be SS & impeller/ shaft sleeve/casing wearing ring shall be bronze. The pump shall be provided with mechanical seal The system shall be complete with necessary pressure gauge with gun metal shut off cock on delivery side.				
	Squirrel cage induction motor TEFC type for operation on 415 V, 3 phase 50 Hz AC supply for the above pump with a synchronous speed of **2900 RPM** as required.				
	Common base plate for (a) and (b) from M.S. channel as required size.				
	For pump defined above & of duty as follows :				
	Flow : **180 LPM**				
	Head : **90 MTRS**	Each	1	93,720	93,720

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.22	Providing and fixing carbon-di-oxide type fire extinguishers consisting of welded M.S. cylinderical body, squeeze lever discharge valve fitted with pressure indicating guage internal discharge tube 30 cms long high pressure discharge hose, discharge nozzle, suspension bracket conforming to IS:15683 finished externally with red enamel paint and fixed to wall with brackets complete with internal charge.				
1.22.1	Capacity **4.5 Kg.**	Each	30	6,787	2,03,602
1.23	Providing and fixing carbon-di-oxide fire extingushers trolley mounted with all accessories internal discharge tube,high pressure discharge hose,discharge nozzle, ISI marked as per IS:2878 finished externally with red enamel paint.				
1.23.1	Capacity **22.5 kg.**	Each	2	20,812	41,625
1.24	Providing and fixing ABC Powder type fire extinguishers consisting of welded M.S. cylinderical body, squeeze lever discharge valve fitted with pressure indicating guage internal discharge tube 30 cms long high pressure discharge hose, discharge nozzle, suspension bracket conforming to IS:15683 finished externally with red enamel paint and fixed to wall with brackets complete with internal charge.				
1.24.1	Capacity **6.0/5.0 Kg.**	Each	20	2,949	58,973
1.25	Providing and fixing fire extinguisher water type of capacity **9 litre** with internal plastic lining and IS marked as per IS 940 with gun metal cap, CO2 cartridge and initial refill.	Each	8	2,728	21,822
1.26	The rate shall include providing two coats of synthetic enamel paint of approved shade over two coats of primer on pipes, fittings and supports, including painting of legends both direction arrow as per the approval of the Engineer.				
1.26.1	25 mm dia	Mtrs	360	20	7,145
1.26.2	32 mm dia	Mtrs	100	22	2,205

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.26.3	40 mm dia	Mtrs	330	28	9,096
1.26.4	50 mm dia	Mtrs	130	33	4,300
1.26.5	65 mm dia	Mtrs	60	39	2,315
1.26.6	80 mm dia	Mtrs	180	44	7,939
1.26.7	100 mm dia	Mtrs	180	50	8,931
1.26.8	150 mm dia	Mtrs	400	55	22,052
1.26.9	200 mm dia	Mtrs	10	66	662
1.26.10	250 mm dia	Mtrs	10	77	772
	TOTAL FOR F.02				**1,01,44,783**
F.03	**CLEAN AGENT BASED PANEL FLOODING SYSTEM -FIRE TRACE TUBE SYSTEM**				
	Supply, fixing, testing and commissioning of UL 521, UL listed Polymer Tube Detection based Clean Agent Fire Suppression System for Electrical Panels, consisting of the following components:				

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.1	Direct Low Pressure Clean Agent system **10 LBS** capacity, complete with Clean agent) (NOVEC 1230 or equivalent), D.O.T/TC approved Cylinder, nickel plated brass valve with slip on union connector, isolation valve, plug pressure switch port and 195 psi Pressure gauge fittings, operating pressure 195 psi (13.45 Bar) at 70 Deg F, supplied complete with Bolt Pattern Bracket and: **INCLUDING**	Nos.	7	87,435	6,12,044
	Fill Port				
	Outlet Port				
	End of Line adaptor,				
	End of line Adopter - 2 Nos.				
	Pressure switch				
1.2	Flexible 4/6mm UL 521, UL listed Polymer Detection Tube 195 Deg C rated complete with all necessary fittings & supports.o make each entire system functional - 2 Nos.	Mtrs.	350	1,047	3,66,609
1.3	System Indication & Control Unit (SICU) integrated panel for indicating the Health and operational status of the system, complete with ports to interface pressure switch, Audio visual Alarm unit, and output to FACP and BMS/ SCADA System including all necessary accessories.	Nos.	7	15,436	1,08,053
1.9	Providing and fixing set of 4 fire buckets capacity 9 ltrs fabricated from 24 gauge MS sheet brackets filled with jamuna sand, two coats of anti corrosive paint inside and outside and two coats of white enamel inside and two coats of postal red enamel outside with " FIRE" marked on each bucket, including M.S. fabricated 4 bucket standard size with 4 hooks. For Hanging buckets including painting with two coats of anti corrosive primer and two coats of postal red enamel on all surfaces of approved quality and make complete in all respects.	Nos.	6	1,991	11,943

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.1	Direct Low Pressure Clean Agent system **5 LBS** capacity, complete with Clean agent **(NOVEC 1230 or equivalent)**, D.O.T/TC approved Cylinder, nickel plated brass valve with slip on union connector, isolation valve, plug pressure switch port and 195 psi Pressure gauge fittings, operating pressure 195 psi (13.45 Bar) at 70 Deg F, supplied complete with Bolt Pattern Bracket and:**INCLUDING**	Nos.	6	80,819	4,84,916
	Fill Port				
	Outlet Port				
	End of Line adaptor,				
	End of line Adopter - 2 nos.				
	Pressure switch				
2.2	Flexible 4/6mm UL 521, UL listed Polymer Detection Tube 195 Deg C rated complete with all necessary fittings & supports.o make each entire system functional - 2 Nos.	Mtrs.	320	1,047	3,35,185
2.3	System Indication & Control Unit (SICU) integrated panel for indicating the Health and operational status of the system, complete with ports to interface pressure switch, Audio visual Alarm unit, and output to FACP and BMS/ SCADA System including all necessary accessories.	Nos.	6	15,436	92,617
	Note: The items indicated above are notable items. The vendor to include all allied and implid items in required quantity at no extra cost.				
	TOTAL FOR F.03				**20,11,368**
F.04	**CLEAN AGENT FIRE SUPPRESSION SYSTEM - TOTAL FLOODING**				
A	**CENTRAL EQUIPMENT ROOM**				
1	120 Ltr Cylinder/Valve Assembly & Pressure Gauge (CCOE approved) including piping in compliance to the requirements specified in clause no.4.2.1 of NFPA-2001	Nos.	8	1,32,987	10,63,894

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2	Clean Agent (FM200/Novec 1230/Equivalent) filled in above cylinder (Kgs)	Kgs	960	3,258	31,27,542
3	Master cylinder kit comprising Solenoid actuator, Manual actuator, adapters, discharge hose, warning sign etc.	Nos.	1	67,193	67,193
4	Slave cylinder kit comprising Pneumatic actuator, Actuation hose, Discharge hose, connectors etc.	Nos.	7	48,359	3,38,512
5	Manifold check valve	Nos.	8	26,725	2,13,797
6	Discharge pressure switch	Nos.	1	23,543	23,543
7	Discharge nozzles	Nos.	22	6,872	1,51,185
8	Cylinder bracket	Nos.	8	1,273	10,181
9	Manifold for connecting 8 cylinders	Lot	1	8,908	8,908

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
10	Gas release Panel including smoke detector ,MCP , Abort switch & Strobe cum sounder	Nos.	1	2,41,477	2,41,477
B	**OCC THEATER**				
1	120 Ltr Cylinder/Valve Assembly & Pressure Gauge (CCOE approved) including piping in compliance to the requirements specified in clause no.4.2.1 of NFPA-2001	Nos.	8	1,32,987	10,63,894
2	Clean Agent (FM200/Novec 1230/Equivalent) filled in above cylinder (Kgs)	Kgs	960	3,258	31,27,542
3	Master cylinder kit comprising Solenoid actuator, Manual actuator, adapters, discharge hose, warning sign etc.	Nos.	1	67,193	67,193
4	Slave cylinder kit comprising Pneumatic actuator, Actuation hose, Discharge hose, connectors etc.	Nos.	7	48,359	3,38,512
5	Manifold check valve	Nos.	8	26,725	2,13,797
6	Manifold to connect 8 cylinders	Lot	1	1,04,990	1,04,990
7	Discharge pressure switch	Nos.	1	23,543	23,543

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
8	Discharge nozzles	Nos.	21	5,854	1,22,933
9	Cylinder bracket	Nos.	8	1,145	9,163
10	Gas release Panel including smoke detector, MCP, Abort switch & Strobe cum sounder	Nos.	1	2,41,477	2,41,477
C	**SIGNALLING EQUIPMENT ROOM (SER) & UPS (S&T)**				
1	120 Ltr Cylinder/Valve Assembly & Pressure Gauge (CCOE approved) including piping in compliance to the requirements specified in clause no.4.2.1 of NFPA-2001	Nos.	3	1,32,987	3,98,960
1.1	80 Ltr Cylinder/Valve Assembly & Pressure Gauge (CCOE approved) including piping in compliance to the requirements specified in clause no.4.2.1 of NFPA-2001	Nos.	3	1,23,697	3,71,090
2	Clean Agent (FM200/Novec 1230/Equivalent) filled in above cylinder (Kgs)	Kgs	500	3,258	16,28,928
3	Master cylinder kit comprising Solenoid actuator, Manual actuator, adapters, discharge hose, warning sign etc.	Nos.	2	67,193	1,34,387
4	Slave cylinder kit comprising Pneumatic actuator, Actuation hose, Discharge hose, connectors etc.	Nos.	4	48,359	1,93,435

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
5	Manifold check valve	Nos.	6	26,725	1,60,348
6	Discharge pressure switch	Nos.	2	23,543	47,086
7	Discharge nozzles	Nos.	12	6,872	82,464
8	Cylinder bracket	Nos.	6	1,273	7,636
9	Manifold for connecting cylinders	Lot	2	17,816	35,633
10	Gas release Panel including smoke detector ,MCP , Abort switch & Strobe cum sounder	Nos.	2	2,41,477	4,82,954
	TOTAL FOR F.04				**1,41,02,195**
F.05	**TRANSFORMERS PROTECTION SYSTEM :**				
1	Design, Supply, Installation, Testing & Commissioning of fire protection system for transformers comprising of the following:				
1.1	45 Kg capacity CO_2, IHP Valve Assembly with automatic valve, push in connector for tube, 45 Kg CO_2 gas & mounting bracket.	Nos.	2	89,082	1,78,164

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.2	End of Line adapter	Nos.	2	3,818	7,636
1.3	Pressure Switch	Nos.	2	8,272	16,544
1.4	Linear pneumatic heat Detection Tube with all necessary fittings & supports.	RM	40	1,527	61,085
1.5	Master Control Unit for controlling each system, complete with pressure switches, buzzers and electronic hooters, including all necessary accessories + electrical wiring to make each entire system functional.	Nos.	2	15,271	30,542
1.6	Auto weight measuring unit for cylinders with automatic audio/visual alarm.	Nos.	2	13,999	27,997
1.7	Discharge Hose With Two nozzle Kit	Set	2	26,769	53,538
	TOTAL FOR F.05				**3,75,506**
F.06	**VESDA SYSTEM FOR UPS ROOM,CENTRAL EQUIPMENT ROOM & OCC THEATER:**				

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1	Short wave length laser-Based Absolute Smoke Detection system with single pipe inlet, 1000 m2 coverage; Wide sensitivity range - 0.005%–20% obs/m ; 4 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter with memory; 7Nos of inbuilt potential free relay outputs;supports linear pipe length of 100m linear or branched pipe up to 130m per pipe; supports 30 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; TCP/IP, WiFi & VESDANet connectivity for central monitoring & monitoring of Andriod/iOS tablets/smartphones, facility to include analytics for notification of smoke from Diesel and PVC wire burning, notification for dust Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. **VESDA E VEP A00-1P or equivalent (SYSTEM UPS ROOM B & CENTRAL EQUIPMENT ROOM)**	Nos.	2	4,16,015	8,32,031
2	Short wave length laser-Based Absolute Smoke Detection system with 4 pipe inlets, 2000 m2 coverage; Wide sensitivity range - 0.005%–20% obs/m; 4 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter with memory; 7Nos of inbuilt potential free relay outputs;supports linear pipe length of 70m per pipe (total 280m) or branched pipe up to 130m per pipe; supports 40 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; TCP/IP, WiFi & VESDANet connectivity for central monitoring & monitoring of Andriod/iOS tablets/smartphones, facility to include analytics for notification of smoke from Diesel and PVC wire burning, notification for dust Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. **VESDA E VEP A00-P (OCC THEATER)**	Nos.	1	5,10,822	5,10,822
3	Capilllary sampling point set for sampling from below false ceiling (room) **E700-TA+CSC+CT+SP+SPLR**	Nos.	27	3,161	85,351

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
4	Power Supply units for VEU detectors - Power supply unit operate on 230 volts AC mains input & provide 24 to 30 volt DC output for powering up the detector, support battery backup in case of AC mains failure & have built in charging circuit for batterys. Power supplies to be mounted on top of the VEU detectors as StaX units	Nos.	3	15,577	46,730
5	Sampling Pipe - Smooth bore UPVC or CPVC or ABS Pipe 25 mm Outer Dia & 19 to 21mm Inner Dia with all required bends joints & accesorys (approx qty of pipe)	Nos.	400	211	84,501
	TOTAL FOR F.06				**15,59,434**
F.07	**VESDA SYSTEM FOR SER & UPS ROOM:**				
1	Laser-Based Absolute Smoke Detection system with single inlet aspiration detector for Up to 250 m2 (2500 sq. ft.) coverage; Wide sensitivity range - 0.025%–20% obs/m; 3 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter; 3 Nos of inbuilt potential free relay outputs;supports linear pipe length of 25m or branched pipe up to 30m; supports 10 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; . Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. **VESDA Laser Focus Detector with display - VLF 250 or equivalent (SER)**	Nos.	2	2,52,301	5,04,601

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2	Laser-Based Absolute Smoke Detection system with single inlet aspiration detector for Up to 500 m2 (5000 sq. ft.) coverage; Wide sensitivity range - 0.025%–20% obs/m; 3 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter; 3 Nos of inbuilt potential free relay outputs;supports linear pipe length of 50m or branched pipe up to 60m; supports 20 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; . Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. **VESDA Laser Focus Detector with display & network card - VLF 500 or equivalent (UPS ROOM)**	Nos.	1	3,35,303	3,35,303
3	Short wave length laser-Based Absolute Smoke Detection system with single pipe inlet, 1000 m2 coverage; Wide sensitivity range - 0.005%–20% obs/m ; 4 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter with memory; 7Nos of inbuilt potential free relay outputs;supports linear pipe length of 100m linear or branched pipe up to 130m per pipe; supports 30 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; TCP/IP, WiFi & VESDANet connectivity for central monitoring & monitoring of Andriod/iOS tablets/smartphones, facility to include analytics for notification of smoke from Diesel and PVC wire burning, notification for dust Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. **VESDA E VEP A00-1P or equivalent**	Nos.	2	4,16,015	8,32,031

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
4	Short wave length laser-Based Absolute Smoke Detection system with 4 pipe inlets, 2000 m2 coverage; Wide sensitivity range - 0.005%–20% obs/m; 4 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter with memory; 7Nos of inbuilt potential free relay outputs;supports linear pipe length of 70m per pipe (total 280m) or branched pipe up to 130m per pipe; supports 40 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; TCP/IP, WiFi & VESDANet connectivity for central monitoring & monitoring of Andriod/iOS tablets/smartphones, facility to include analytics for notification of smoke from Diesel and PVC wire burning, notification for dust Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. **VESDA E VEP A00-P**	Nos.	1	5,10,822	5,10,822
5	Capilllary sampling point set for sampling from below false ceiling (room) **E700-TA+CSC+CT+SP+SPLR**	Nos.	35	3,161	1,10,640
6	Power Supply units for VLF detectors - Power supply unit operate on 230 volts AC mains input & provide 24 to 30 volt DC output for powering up the detector, support battery backup in case of AC mains failure & have built in charging circuit for batterys. **VESDA Model - VPS 220E or Equivalent**	Nos.	3	15,577	46,730
7	Power Supply units for VEU detectors - Power supply unit operate on 230 volts AC mains input & provide 24 to 30 volt DC output for powering up the detector, support battery backup in case of AC mains failure & have built in charging circuit for batterys. Power supplies to be mounted on top of the VEU detectors as StaX units **VESDA Model - VPS 250 STX or equivalent**	Nos.	3	15,577	46,730
8	Sampling Pipe - Smooth bore UPVC or CPVC or ABS Pipe 25 mm Outer Dia & 19 to 21mm Inner Dia with all required bends joints & accesorys (approx qty of pipe)	RM	600	211	1,26,751
	TOTAL FOR F.07				**25,13,608**

(Attachment No-11 to Addendum No-5)
PART-C - OCC - FIRE Detection & Suppression Systems

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	TOTAL				**3,42,19,778**

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
H.01	**WATER COOLED CHILLER, PUMPS, AHUs & FCUs AND PRECISION A/C**				
1A	**Water cooled screw Chillers**	Nos.	2	64,91,801	1,29,83,602
	Design, Supply, installation, testing and commissioning of Water cooled packaged Screw Water chillers at below mentioned operating conditions with R-134a refrigerant, hermetically sealed compressor, driven by suitable kW. Sq.Cage induction motor complete with water cooled shell and tube condenser with Anti Fouling Device on inlet connection, insulated shell and tube chiller, refrigerant piping, Refrigerant and oil (First Charge), Microprocessor based control panel and accessories etc. as per specifications, all mounted on M.s. frame. Motor shall be suitable for 415 volts + 10% , 50 Hz + 3%, three phase AC supply, VFD driven. (Duty and standby arrangement)				
	Capacity = 300 TR on following design conditions				
	Minimum COP at ARI conditions : 6.1				
	Water in condenser : 30.5 °C				
	Water out condenser : 36.5 °C				
	Chilled water 'In' : 15 °C				
	Chilled water 'Out' : 8 °C				
	Chiller FF (MKS) : 0.000088 m² °C/W				
	Condenser FF (MKS): 0.000176 m² °C/W				
	Chiller Plant Manager				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1B	Design, Supply, installation, testing and commissioning of 32 bit, UL Listed BACnet (BTL certified) Supervisory Controller for management level interface in MS Enclosure powder coated SIEMENS grey for Supervisory Controller, IO Cards (with accessories like Transformer, MCB, internal wiring and Relays with bases) (A) The Network supervisory Controller shall have imbedded graphic capability for generating web based user graphics and support Multi user with simultaneous minimum 4 user login facility (B) Unlimited user without additional licence (C) Shall be browsed by Microsoft Internet Exlporer and Netscape Navigator(D) BTL certified (E) Web engine should be 32bit configuration (F) Should have inbuilt display and keys to operate in absence of PC (G) Should have inbuilt IO points (H)Functionally able to act as a DDC controller also apart from Supervisory controller function (I) Web engine should support ASHRAE standard BACnet MS/TP protocol , Proprietry Protocol shall not be accepted((J) Web engine should support integration of third party protocol (eg MODbus-RTU) seemlessly without adding additional hardware (K) Web engine should support DHCP function for IP addressing. DDC / IOM CONTROLLERS for equipment control SITC of Programmable and Application specific 32 bit, UL Listed BACnet (BTL certified) controllers, field mounted configured as per Data Point Summary for respective building services and as per below distributions. The controller shall be housed in vandal proof lockable MS cabinets. The Expansion controller connected with Controller shall also be 32 Bit, UL Listed BACnet(BTL)/Mod Bus controller and communication with Expansion units to Main Controller shall be on BACnet MS/TP. Proprietry Protocol shall not be accepted. Chiller / Pump / Cooling Tower / Isolation valve DDC/IOM Field Devices (In scope of Contractor)	Set	1	26,45,761	26,45,761

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Immersion type temperature sensors with all accessories for measuring temperature of Chilled and Condenser Header Temperature				
	Outside air & temperature sensor				
	Peripheral Systems				
	Interface for software integration on Chiller on N2/BACnet MS/TP protocol				
	2 core, ATC, multistrand, 1.0 sqmm, twisted, shielded, FRLS PVC sheathed cable (BAS Signal)				
	25 mm GI Conduit.				
1C	**Cooling Tower**	Nos.	2	10,79,712	21,59,424
	FRP Vertical induced draft counter flow/ Cross Flow type CTI Certified Cooling Towers, each complete with FRP basin, FRP body, Fan and Twin speed Motor (EFF-1), necessary drive mechanism, sprinkler, fill media, distribution basin pipe connections, Ladder etc. as per specifications including all necessary civil work and a, multiple digital and analog outputs with communication software compatible with BMS as required.(1W+1S)				
	Capacity : 1318KW				
2	**Pumps**				
	Chilled Water Pumps with VFD				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.1	Supply, installation, testing and commissioning of primary variable speed pumping system with Horizontal/Vertical split case double suction centrifugal pump set with bronze impeller, TEFC IP-55 motor (IE-2) with class 'F' insulation and complete with base plate,inertia base with associated civil works, insulation and consisting of adjustable frequency drive (AFD) for each pump & 1 no. Microprocessor based pump controller housed within the enclosure of one of the AFD with pumping software duly down loaded single / multiple differential pressure sensor / transmitter compatible with BMS system, energy optimization sequencing system complete as per specification and datasheet . The system shall be complete in all respects and suitable for following ratings. The AFD's shall be mounted in a factory built panel and in AFD panel no internal wiring shall be permitted at site. Pump performance characteristics shall be as follows : Water flow rate =36 lps Head = 25M w.c. (Contractor shall estimate actual head required) (Duty & standby arrangement)	Nos.	2	7,12,418	14,24,835
2.2	**Condenser water pump** Supply, installing, testing and commissioning of Horizontal split casing condenser water circulating centrifugal pump sets with bronze impeller, for condenser water recirculation complete with TEFC IP-55 motor (EFF-1) with class 'F' insulation and EN-8 shaft (suitable for 415 V + 10%, 50Hz + 3% 3 phase AC) with base plate ,inertia base with associated civil work confirming to technical specification and as per following parameters. complete with motor, base plate etc. as per specifications.	Nos.	2	2,76,961	5,53,922

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Pump performance characteristics shall be as follows : Water flow rate =52.5 lps Head = 15M w.c. (Duty & standby arrangement)				
2.3	**Make up Water Pumps** Design, Supply. Installation, testing and commissioning of horizontal monoblock pumping set with C.I body and bronze impeller, shaft of SS-316 and M.S base & head, mechanical seal, connected to a TEFC induction motor suitable for 400/440 volts, 3 phase 50 cycle A.C supply with 150mm dia pressure guage with gun metal isolation cock, Vibration eliminating pads under foundations, 80x40 mm M.S section base plate bolted to cement concrete foundations complete. Pump performance characteristics shall be as follows : Water flow rate = 5.0 lps (80 US gpm) Head = 45M w.c. Pump head specified on the Drawings and / or Equipment Schedules are for guidance and information only and are calculated based on assumed equipment pressure drops. The exact pump head based on the pipe run and the offered equipment shall be carefully checked and re-calculated for each pump before ordering the equipment. Calculation shall be submitted for approval. No modification to the piping system shall be allowed without prior approval. Any additional cost for the modification of the system (pumps, motors, switchgears, cables, panel boards, switchboards, etc.) from that indicated in BOQ, necessary to meet the specified duties, special conditions and the offered equipment shall be provided at no extra cost to the Employer.	Nos.	1	1,20,763	1,20,763
	Air Handling Units (Double Skin)				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3	Supply, installing, testing and commissioning of Air Handling Unit double skin type (Euro Vent Certified for mechanical & unit Performance), complete with plug fan, fan section, cooling coils, coil section,V filter section with 50mm thick panel type filters, fan motor(IE-2), isolator for motor, with UVC emitter fitted etc. AHU shall be with cooling coil minimum 4/6 Row Deep and fin spacing shall be Max 10 FPI. The complete compartmentation shall be provided in fan and coil section. VFD operated. Fan section shall be provided with twin fans (1 Fan working, 1 Standby) Cap. 26000 CFM, 65 TR ,50 mm w.c.with suitable VFD-For second floor OCC theatre, incidence management room, operation manager room, NMS room, security room.	No.	1	23,91,026	23,91,026
4	**Fan Coil Units(Double Skin)** Supply, installation, testing and commissioning of Fan Coil units complete with fan section, cooling coil (AHRI certified), filter section with standard filters, fan motor, return air plenum etc. as per specifications and data sheet, including drip tray for whole unit and valve assembly.				
a)	Capacity 0.5TR	Nos.	14	40,521	5,67,297
b)	Capacity 1.0TR	Nos.	1	40,521	40,521
c)	Capacity 1.5 TR	Nos.	16	73,502	11,76,024
d)	Capacity 2.0 TR	Nos.	14	76,728	10,74,187

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
e)	Capacity 2.5 TR	Nos.	45	85,419	38,43,870
f)	Capacity 3.0TR	Nos.	26	90,712	23,58,505
g)	Capacity 3.5TR	Nos.	13	90,712	11,79,253
h)	Capacity 4.0TR	Nos.	2	1,02,803	2,05,605
5	Supply, installing, testing and commissioning of Pressure independent control valve factory fitted with (GM) Ball valves and Y strainer at return and (GM) Ball valve at supply for FCU, complete and complying with Technical Specification				
a)	25 mm		80	20,333	16,26,619
b)	20 mm		46	19,371	8,91,079
	Precision AC Units				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
6	SITC Precision air conditioning units(chilled water type); with totally Double skin sandwitched panels on all four side, Bottom discharge type complete with dynamically balanced centrifugal plug type fan driven by Electronically Commutated (EC) motor, hydrophilic coated cooling coil. The unit shall be equipped with high efficiency filters(EU4), micro processor based programmable logic controller, heater. Each unit shall be provided with RS-485 serial card to communicate with Modbus protocol BMS. Nominal Capacity 15 TR (3 Working + 1 Standby)	Nos.	4	8,82,981	35,31,923
7	**Server room floor grille with damper 600X600mm**	Nos.	50	5,352	2,67,585
	TOTAL OF HEAD-H01				**3,90,41,801**
H.02	**CHILLED & CONDENSER WATER/PIPING/VALVES**				
1	**CHILLED WATER PIPING & VALVES**				
1.1	**Chilled Water Piping** Design, Supply. Installation, testing and commissioning of MS C class Chilled water piping complete with companion flanges, nuts, bolts, gaskets fittings supports etc. as required and as per specifications and drawings including all necessary civil work Duly Insulated (Nitrile Rubber) as per specifications.				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
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Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	250 mm	RM	50	6,619	3,30,940
b)	200 mm	RM	100	5,170	5,17,001
c)	150 mm	RM	100	4,153	4,15,343
d)	125 mm	RM	30	3,805	1,14,150
e)	100 mm	RM	250	2,077	5,19,317
f)	80 mm	RM	175	1,680	2,94,059
g)	65 mm	RM	320	1,465	4,68,907
h	50 mm	RM	300	1,174	3,52,275
i)	40 mm	RM	300	927	2,78,182
j)	32 mm	RM	370	813	3,00,663
k)	25 mm	RM	400	590	2,35,953

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
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Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
l)	20 mm	RM	900	517	4,65,400
1.2	Design, Supply. Installation, testing and commissioning of Manually Operated Butterfly Valve will flanges gasket duly insulated as per technical specifications				
a)	200 mm	Nos.	2	21,490	42,979
b)	150mm	Nos.	8	12,209	97,675
c)	125 mm	Nos.	2	8,854	17,707

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
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Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
d)	100 mm	Nos.	5	7,602	38,008
e)	80 mm	Nos.	2	5,571	11,143
f)	65 mm	Nos.	2	5,043	10,086
g)	50 mm	Nos.	10	4,368	43,684
1.3	Design, Supply. Installation, testing and commissioning of Flexible connection				
a)	150mm	Nos.	8	10,994	87,953
b)	100 mm	Nos.	2	7,466	14,932
1.4	Design, Supply. Installation, testing and commissioning of Balancing Double Regulating Valves duly insulated as per technical specifications				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	150 mm	Nos.	1	29,943	29,943
b)	125 mm	Nos.	1	26,567	26,567
c)	100 mm	Nos.	2	16,040	32,081
d)	80 mm	Nos.	2	13,827	27,655
e)	65 mm	Nos.	2	12,324	24,647
f)	50 mm	Nos.	2	10,000	20,001

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
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Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.5	Design, Supply. Installation, testing and commissioning of Gate/Ball valve with insulation as per technical specifications				
a)	50 mm	Nos.	20	5,633	1,12,662
b)	32mm	Nos.	20	3,951	79,012
c)	25 mm	Nos.	20	1,927	38,546
1.6	Design, Supply. Installation, testing and commissioning of Non-return Valve with insulation as per technical specifications				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	200 mm	Nos.	2	20,501	41,002
b)	150 mm	Nos.	2	13,937	27,875
1.7	Design, Supply. Installation, testing and commissioning of MS Y Type Strainer with insulation as per technical specifications				
a)	150 mm	Nos.	2	14,385	28,770
b)	100 mm	Nos.	1	11,449	11,449
1.8	Design, Supply. Installation, testing and commissioning of Motorised Butterfly Valves complete with actuator (Should be BMS compatible) with insulation as per specification.				
a)	200 mm	Nos.	2	56,543	1,13,086

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	150 mm	Nos.	2	24,210	48,420
1.9	Design, Supply. Installation, testing and commissioning of Pressure Independent Control Valve for AHUs as per specification.				
a)	80 mm	Nos.	1	69,040	69,040
b)	65 mm	Nos.	1	68,758	68,758
2.0	Design, Supply. Installation, testing and commissioning of following:				
a)	Pressure Gauges with nipple, elbow and ball valve including of syphon & lock.	Nos.	12	4,079	48,945
b)	Thermometers	Nos.	8	2,025	16,203
c)	Flow Switches	Nos.	1	7,860	7,860
d)	Automatic Air Vents	Nos.	4	4,460	17,841
e)	Differential Pressure Switch	Nos.	2	3,775	7,550

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
f)	Water level switch for expansion tank	Nos.	1	7,841	7,841
g)	Air & Dirt Separator as per technical specification.	Nos.	1	4,01,940	4,01,940
h)	Vaccum degasser as per technical specification.	Nos.	1	7,06,948	7,06,948
2	**CONDENSER WATER PIPING & VALVES**				
2.1	Condensor Water Piping With MS "C" Class Pipe Complete With All Accessories Such As Bends, Elbow, Flanges, Nut Bolts, Tee With M.S. Angle & Rod Supporting Work etc with of Following Sizes as per approved drawings, Technical specifications and requirements:				
a)	250 mm dia	RM	30	4,839	1,45,181
b)	200 mm dia	RM	180	3,868	6,96,173
c)	150 mm dia	RM	60	2,569	1,54,166
d)	125 mm dia	RM	42	2,148	90,225

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
e)	100 mm dia	RM	42	1,728	72,578
f)	80 mm dia	RM	43	1,302	56,007
g)	50 mm dia	RM	42	812	34,117
h)	32 mm dia	RM	42	353	14,819
2.2	Design, Supply. Installation, testing and commissioning of Manually Operated Butterfly Valve will flanges gasket as per technical specifications				
a)	200 mm	Nos	8	18,528	1,48,224
b)	150 mm	Nos	8	8,977	71,819
c)	100 mm	Nos	4	6,221	24,882
d)	50 mm	Nos	12	4,190	50,277

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.3	Design, Supply. Installation, testing and commissioning of Motorized Operated Butterfly Valve will flanges gasket as per technical specifications				
a)	250 mm	Nos	1	77,147	77,147
b)	200 mm	Nos	4	56,543	2,26,171
2.4	Design, Supply. Installation, testing and commissioning of Non Return Valve will flanges gasket as per technical specifications				
a)	200 mm	Nos	2	18,900	37,799
2.5	Design, Supply. Installation, testing and commissioning of Y strainer will flanges gasket as per technical specifications				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	200 mm	Nos	2	27,835	55,670
2.6	Design, Supply. Installation, testing and commissioning of Balancing Double Regulating Valves as per technical specifications				
a)	200 mm	Nos.	2	53,309	1,06,617
b)	150 mm	Nos.	4	26,711	1,06,846
2.7	Design, Supply. Installation, testing and commissioning of following:				
a)	Pressure Gauges with nipple, elbow and ball valve including of syphon & lock.	Nos.	8	4,079	32,630
b)	Thermometers	Nos.	4	2,025	8,102
c)	Flow Switches	Nos.	2	7,503	15,005
d)	Automatic Air Vents	Nos.	4	4,079	16,315
e)	Differential Pressure Switch	Nos.	2	3,775	7,550

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.7	Design, Supply. Installation, testing and commissioning of following GI medium class drain piping with necessary clamps, support, fittings, with insulation as per technical specification.				
a)	50 mm	RM	75	842	63,178
b)	40 mm	RM	75	635	47,632
c)	32 mm	RM	100	550	55,019
d)	25 mm	RM	100	549	54,909
e)	20 mm	RM	50	438	21,886
f)	15 mm	RM	30	421	12,636
2.8	Design, Supply. Installation, testing and commissioning of Closed type Expansion Tank of size for operating pressure as per technical specifications.				
a)	1000 Ltrs. Capacity	No.	1	2,93,916	2,93,916
2.9	Design, Supply. Installation, testing and commissioning of Flexible Connection at inlet / outlet of condensers pipe sizes as given below.				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
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Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	200 mm	Nos.	8	13,075	1,04,596
b)	150 mm	Nos.	4	9,041	36,165
3	**Chemical Dosing System (Optional)**				
3.1	Design, Supply. Installation, testing and commissioning chemical dosing system consisting of dosing tank pumps, chemical formulation to (a) keep water circulating system clean and free form corrosion and b) to control organic and algae growth in the circulating water (board spectrum biocide) c) for pH value maintenance, piping from dosing pumps to condenser return header and chilled water return header, necessary valves and accessories, pump mounting arrangement on tanks, tank covers, and piping insulation wherever necessary as per technical specifications.the system shall consist of, but not limited to, the following:-	set	1	3,99,460	3,99,460
	The tanks requirements are as follows.				
a)	Dosing tank 100 liters capacity				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
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Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	Electronic Positive Displacement Dosing pump made form polypropylene capable of withstanding a back-pressure of 3.5 Kg/Sq.cm complete with 1 phase motor, low-level switch and anti syphon valve assembly.				
c)	UPVC piping from dosing pumps to header.				
d)	Valve and accessories				
3.2	**TESTING EQUIPMENT AND KITS**				
	a) Corrosion test rack	Lot	1	3,24,113	3,24,113
	b) pH reagents				
	c) T.d.S. meter				
	d) Hardness testing reagent				
	e) Nitrite test kit (5547/5137)				
	f) Chemical for 1 year				
3.3	**Automatic motorised Condenser water bleed off 25 mm valve complete with sensing device**	no	2	45,447	90,894
	TOTAL OF HEAD-H02				**1,04,23,725**
H.03	**VENTILATION SYSTEM**				
	Tube Axial Type Fans for toilet exhaust(Through Ducting)				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1	Design, Supply. Installation, testing and commissioning of Vane Axial flow fans including motors, anti vibration mounts, flexible sleeves. Fan motors and all accessories shall be complete as per Specifications.(Bidders are required to optimize the total pressure as per final detailed design to achieve the performance without any additional cost to MMRC)				
a)	Capacity 7000 CMH at 300 Pa static pressure	Nos.	2	62,492	1,24,984
b)	Capacity 5000 CMH at 300 Pa static pressure	Nos.	2	54,546	1,09,091
2	**Cabinet Type Fans for FCU Fresh air (Fresh air through ducting)** Design, Supply. Installation, testing and commissioning of Cabinet fans including motors, anti vibration mounts, flexible sleeves. Fan motors and all accessories shall be complete as per Specifications.(Bidders are required to optimize total pressure as per final detailed design to achieve the performance without any additional cost to MMRC)				
a)	Capacity 1000 CMH at 500 Pa static pressure	Nos.	1	47,202	47,202
b)	Capacity 3000 CMH at 500 Pa static pressure	Nos.	2	55,492	1,10,984
c)	Capacity 4300 CMH at 500 Pa static pressure	Nos.	2	73,199	1,46,398
d)	Capacity 7500 CMH at 500 Pa static pressure	Nos.	1	93,478	93,478
3	**Tube Axial Type Fans for Staircase & Lift pressurization** Design, Supply. Installation, testing and commissioning of Vane Axial flow fans including motors, anti vibration mounts, flexible sleeves. Fan motors and all accessories shall be complete as per Specifications.(Bidders are required to optimize the total pressure as per final detailed design to achieve the performance without any additional cost to MMRC)				
a)	Capacity 54000 CMH at 300 Pa static pressure-Staircase(4 nos) of OCC buidling	Nos.	4	2,36,542	9,46,169
b)	Capacity 23660 CMH at 300 Pa static Lift pressurization Fan(4 nos) for OCC buidling	Nos.	4	1,42,107	5,68,429

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
4	**Tube Axial Type Fans for ECS Plant Room (Exhaust and fresh air through ducting)** Design, Supply. Installation, testing and commissioning of Vane Axial flow fans including motors, anti vibration mounts, flexible sleeves. Fan motors and all accessories shall be complete as per Specifications.(Bidders are required to optimize the total pressure as per final detailed design to achieve the performance without any additional cost to MMRC)				
a)	Capacity 8000 CMH at 300 Pa static pressure	Nos	4	82,371	3,29,483
5	**Tube Axial Type Fans for ASS-1&ASS-2,Pump Room (Exhaust air through ducting & fresh air through louvers)** Design, Supply. Installation, testing and commissioning of Vane Axial flow fans including motors, anti vibration mounts, flexible sleeves. Fan motors and all accessories shall be complete as per Specifications.(Bidders are required to optimize the total pressure as per final detailed design to achieve the performance without any additional cost to MMRC)				
a)	Capacity 15000 CMH at 300 Pa static pressure	Nos	9	84,968	7,64,713
6	**Propeller Type Fans** Design, Supply. Installation, testing and commissioning of Propeller type fan wall or panel mounting to convey air directly to out side complete with motor suitable for 240/440 volts, 1/3 phase, 50 Hz AC supply, mounting frames and louvers and complete as per specifications.				
a)	Capacity 400 CMH	Nos.	2	10,996	21,991
b)	Capacity 800 CMH	Nos.	5	10,996	54,978

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
c)	Capacity 1200 CMH	Nos.	1	10,996	10,996
d)	Capacity 1400 CMH	Nos.	1	10,996	10,996
e)	Capacity 2000 CMH	Nos.	4	14,248	56,993
f)	Capacity 2200 CMH	Nos.	6	14,248	85,490
g)	Capacity 2500 CMH	Nos.	7	14,248	99,738
h)	Capacity 2800 CMH	Nos.	11	16,387	1,80,258
i)	Capacity 3200 CMH	Nos.	11	17,928	1,97,210
j)	Capacity 5000 CMH	Nos.	9	25,799	2,32,191
k)	Capacity 7000 CMH	Nos.	5	31,792	1,58,960
7	**Kitchen Scrubber**				
	Design, Supply. Installation, testing and commissioning of Scrubber (nozle type double skin air washer)Scrubber shall be factory fabricated and complete with fan casing,humidifier section, SS tank,DIDW(double inlet double width) centrifugal backward curved fan with motor monbloc pumps,brass spray nozzles and water distribution header,pipin with valves and fittings between pumps and scrubber,4 bend PVC/GI eliminator along with electrical panel and starter etc complete as per specification.Capacity 4500 cfm static pressure 50mmwg.	Nos.	1	2,07,073	2,07,073
	TOTAL OF HEAD-H03				**45,57,805**
H.04	**AIR DISTRIBUTION SYSTEM**				

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1	Design, Supply. Installation, testing and commissioning of factory fabricated G.I. Sheet metal ducts (275 GSM) with flanges complete with supports, vanes, dampers, links, levers and quadrants etc. as per specifications and drawings. The rates shall include all materials of the duct and labour for suspension and supporting arrangement for plenums, ducts, complete with fire retardant flexible connection as required and as per specifications.				
a)	0.63 MM (24 Gauge)	sqm	1000	938	9,38,298
b)	0.80 MM (22 Gauge)	sqm	600	1,110	6,66,181
c)	1.00 MM (20 Gauge)	sqm	600	1,539	9,23,524
d)	1.25 MM (18 Gauge)	sqm	400	1,899	7,59,459
2	**Grills and Dampers**				
2.1	**G.I construction Duct Dampers** Design, Supply. Installation, testing and commissioning of G.I construction Duct Dampers for Controlling the Airflow in Ducts as per specification.	Sqm	25	7,992	1,99,788
2.2	**Grilles without Dampers** Design, Supply. Installation, testing and commissioning of powder coated extruded aluminum sections grills as per specification.	Sqm	50	8,778	4,38,883
2.3	**Grilles with Dampers** Design, Supply. Installation, testing and commissioning of powder coated extruded aluminium section grills with dampers for supply air terminal for air-conditioning as per specification.	Sqm	60	13,325	7,99,483

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.4	**Diffusers** Design, Supply. Installation, testing and commissioning of powder coated extruded aluminium square diffusers with antismudge ring and removable core.				
a)	Supply air with dampers	Sqm	20	16,404	3,28,085
b)	Return air without damper	Sqm	20	11,857	2,37,144
2.5	**Linear Grills**				
	Design, Supplying, installing, testing and commissioning of powder coated extruded aluminium section Linear grills supply / Return air as per specification..	Sqm	40	12,791	5,11,643
2.6	**Exhaust/Fresh Air Louvers**				
	Design, Supply. Installation, testing and commissioning of exhaust air/fresh air louvers of powder coated extruded aluminium construction with bird screen, minimum 80 mm deep.	Sqm	60	11,509	6,90,526
2.7	**Motorized Fire Damper**				
	Supplying, installation, testing and commissioning of motorized type fire and smoke dampers with actuators and dampers of 18 gauge GI sheet construction suitable for 120 minute fire rating.	Sqm	15	35,978	5,39,676

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.8	**Fire Damper with Spring and Fusible Link**				
	Supplying, installation, testing and commissioning of Fusible Link type fire and smoke dampers of 18 gauge GI sheet construction suitable for 120 minute fire rating.	Sqm	10	21,288	2,12,876
2.9	**Motor Operted Damper**				
	Supplying, installation, testing and commissioning of motor operated damper for AHU.	Sqm	5	25,870	1,29,350
3	**Duct Insulation**				
	Design, Supply. Installation, testing and commissioning of Nitrile rubber insulation on the surface of the duct per specifications . The rates shall include all materials of the insulation and labour works with adhesive, complete as required and specifications.				
a)	13 mm	Sqm	30	531	15,943
b)	19 mm	Sqm	1000	663	6,62,653
c)	25 mm	Sqm	650	831	5,40,376
4	**Acoustic Lining**				
	Design, Supply. Installation, testing and commissioning of acoustic lining within supply air ducts as per the specifications. All ducts specified in the specification shall be provided with acoustic lining of fibre glass insulation as per the specifications.	Sqm	100	862	86,222

(Attachment No-11 to Addendum No-5)
PART-C - OCC BUILDING VAC System
(AIR CONDITIONING SYSTEMS WITH WATER COOLED CHILLER FOR OCC BUILDING)

Sl.No	Item Description	Unit	Qty	UnitPrice (Rs)	Total Amount (Rs)
1	2	3	4	5	6
5	**Acoustic Lining AHU Room**				
	Design, Supply. Installation, testing and commissioning of Acoustic Lining AHU's Rooms. The walls and ceiling of the AHU rooms shall be provided with 50 mm thick resin bonded fibre glass of density 32 Kg/m3 and finish the above surface with 24 G Al. perforated sheet (20% perforations) fixed with Aluminium/brass screws.	Sqm	300	1,645	4,93,516
6	**Aluminium Cladding**				
	Design, Supply. Installation, testing and commissioning of aluminium cladding for piping as per the specifications.	Sqm	350	702	2,45,821
	TOTAL OF HEAD-H04				**94,19,447**
	TOTAL OF ALL HEADS				**6,34,42,779**

(Attachment No-11 to Addendum No-5)
PART-C - OCC-VAC
Water Treatment Plant for VAC

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.0	**WATER TREATMENT PLANT**				
	Whether explicitly specified or not, the water treatment plant and pumps specified herein must conform to M&W Specificatiomns and motors must conform to M&W Specifications, in addition to the description given in respective items of BOQ, In case of contradiction between M&W Specifications and description in BOQ , the most stringent of the condition will prevail.				
	All the items /parts mentioned in relevant clauses of the M&W specifications and not specifically mentioned in BOQ shall be deemed to be included in the quoted rates, unless specifically excluded.				
	The motor HP to be confirmed by the manfacturer for the duty mentioned for each pump along with performance characteristic curve.				
	Rates quoted shall be inclusive of all structral supports,clamps etc. as per approved design/specifications.				
1.1	**DUAL MEDIA FILTER**				
	Providing and fixing of mild steel (rubber lined) pressure vessel confirming to IS 2285 dual media filter complete in all respects as	NO	1	3,10,033	3,10,032.83
	1) Capacity = 15 Cum/hr				

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	2) Rate of flow = Not more than 12.5 Cum/hr/sqm of surface area				
	3) Wall thickness of shell and of dished ends as per IS:2825				
	4) Initial charge of media.				
	5) Sample valves				
	6) Sockets and valve for dosing chemicals.				
	7) Pressure guage at inlet and outlet with isolating cocks and supports.				
1.2	**SOFTENER UNITS**				
	Providing and fixing of mild steel (rubber lined) pressure vessel confirming to IS 2285 dual media filter complete in all respects as per M&W specifications,having following	NO	1	4,51,797	4,51,797
	1) Capacity = 15 Cum/hr				
	2) Rate of flow = Not more than 12.5 Cum/hr/sqm of surface area				
	3) Wall thickness of shell and of dished ends as per IS:2825				
	4) Initial charge of media.				
	5) Sample valves				
	6) OBR (13 Hrs) 200 cum				
	7) Pressure guage at inlet and outlet with isolating cocks and supports.				
	8) All Face piping and diaphragm valve etc.				
	9) Thickness of rubber lining not less then 3 mm				
	10) All pipes to be as per IS:1239 class "c"				
	11) Ejector for generation				
	12) For resin quantity and design purpose consider hardness of water as 350 ppm quality of outgoing water -commercial Zero hardness				

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.3	**IRON REMOVAL FILTER**				
	Providing and fixing of mild steel (rubber lined) pressure vessel confirming to IS 2285 dual media filter complete in all respects as per M&W specifications,having following	NO	1	4,23,444	4,23,444
	1) Capacity = 15 Cum/hr				
	2) Rate of flow = Not more than 12.5 Cum/hr/sqm of surface area				
	3) Wall thickness of shell and of dished ends as per IS:2825				
	4) Initial charge of media.				
	5) Sample valves				
	6) OBR (13 Hrs) 200 cum				
	7) Pressure guage at inlet and outlet with isolating cocks and supports.				
	8) All Face piping and diaphragm valve etc.				
	9) Thickness of rubber lining not less then 3 mm				
	10) All pipes to be as per IS:1239 class "c"				
	11) Ejector for generation				
	12) For resin quantity and design purpose consider hardness of water as 350 ppm quality of outgoing water -commercial Zero hardness				
1.4	**REGENERATION TANK/ SALT DILUTION TANK**				
	Providing and fixing HDPE tank of capacity 2000 litres to store and measure brine for regeneration of softening plant. Tank shall be complete with all interconnecting MS/HDPE pipes and other assemblies /accessories required for commissioning.				

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	Brine Measuring tank - 2000 litres capacity	NO	1	63,180	63,180
1.5	**CHEMICAL DOSING PUMP**				
	Providing,Fixing,Installation and commissioning of chemical dosing pump capacity 6 lph with 250 ltrs capacity chemical tank.	NO	1	29,403	29,403
1.6	**LEVEL CONTROLLERS/ LEVEL INDICATORS**				
	supply, Installation, Testing and Commissioning of Magnetic float type Level controllers/ Indicators having adequate number of switches (Minimum 5 Nos) for the services mentioned below . Controller Equipment shall be mounted inside the electrical panels				
a)	For domestic water tanks for the following levels.				
i)	High level to trigger alarm				
ii)	High level to switch OFF the Tube well				
iii)	Raw Water tank Tank 1/2 full				
iv)	Low level to trigger alarm	set	1	17,568	17,568
b)	For Fire water Tanks ,One set for each of the tanks for the following levels.				
i)	High level to trigger alarm				
ii)	Full Fire water Tank indication				
iii)	Low level in Fire water tank to trigger alarm	set	1	17,568	17,568
c)	For Treated Water Tank for the following level				
i)	High level to trigger alarm				
ii)	High level to switch OFF the Filter feed pumps				

Sl.No	Item Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
iii)	Treat water Tank 1/2 full				
iv)	Low level to switch ON the Filter feed pumps				
v)	Low level to trigger alarm	set	1	17,568	17,568
	Note:				
	All above level controllers / Indicators to be complete with sensors, switches, relays, all wiring from the sensors to the Control unit ,Control units to motor control centres of the various pumps and to the various alarm and indicating devices.				
	Sensors Terminal units would be in weather proof enclosures(IP-56)				
	TOTAL FOR WATER TREATMENT PLANT				**1330561**

(Attachment No-11 to Addendum No-5)
(OCC & INFRA BUILDING-WORK TRAIN WORKSHOP)

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1	**Sub Section - 1 - GENERAL**				
1.1	The BOQ specified below include the latest relevent standards, specifications, drawing details and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval before use as the Employer's representative may opt.				
1.2	The description as mentioned in BOQ, specifications, special conditions, GCC drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.				
1.3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.				
1.4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.				
1.5	Contractor's shall quote resonably rates against each item of BOQ (both in word and figure)				
2	**Sub Section - 2-EOT CRANE**				
2.1	Design, manufacture, supply, installation, testing and commissioning of Electric Overhead Travelling Cranes with Gantry rail and Downshop leads to be installed in the Workshop bay, Inspection bay and other maintenance buildings. The location of cranes in the various buildings is shown in drawings complete as per below.				

(Attachment No-11 to Addendum No-5)
(OCC & INFRA BUILDING-WORK TRAIN WORKSHOP)

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
d)	**OCC & Infra Building (Work Train Workshop) :10 Ton** The rate include Design, manufacture, supply, installation, testing and commissioning of 10T EOT Crane for span 18.5 m, bay length 100m with Main hoist motor along with accessories, and long/cross travel motors along with accessories. Crane will be provided on inspection bay with special girder system in the bay. Cranes will also be controlled from pendent switch and radio remote control. All the wire ropes along with hook, rope drum and necessary safety devices etc. Necessary arrangement of 3-phase power supply for working the crane throughout the long travel length along with current collection system. The EOT crane shall be complete in all respects and as per technical specifications. 1)The price shall also include one set of spares and tools mentioned in the specification. 2) (In single bay with individual operation control / pendent)	nos	1	87,71,823	**87,71,823**
	TOTAL				**87,71,823**

(Attachment No-11 to Addendum No-5)
(COMPRESSED AIR SYSTEM)
OCC & INFRA BUILDING (WORKTRAIN WORKSHOP)

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
B4	**AIR COMPRESSOR & EOT CRANE**				
	Sub Section - 1 - GENERAL				
1.1	The BOQ specified below include the latest relevent standards, specifications, drawing details and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval before use as the Employer's representative may opt.				
1.2	The description as mentioned in BOQ, specifications, special conditions, GCC drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.				
1.3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.				
1.4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.				
1.5	Contractor's shall quote resonably rates against each item of BOQ (both in word and figure)				
2	**Sub Section - 4 - Compressor for** OCC & Infra Building (Work Train Workshop shed)				

(Attachment No-11 to Addendum No-5)
(COMPRESSED AIR SYSTEM)
OCC & INFRA BUILDING (WORKTRAIN WORKSHOP)

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.1	Designing, Supplying, Installing, testing and commissioning of air compressor capacity 55 CFM at 10 bar with 11 KW Electrical motor 3 Phase 440 Volts complete with all accessories along with Electrical control panel, necessary wiring, earthingreservoir tank of 800 litres capacity with apropriate inlet and outlet flanges designed for full rated capacity of 2 compressors etc. complete in all respects and as per technical specifications. The price shall also include one set of spares and tools mentioned in the specification.	Nos	1	6,19,029	6,19,029
2.2	Providing and fixing MS pipes conforming to IS 1239 (Class C) complete with all fittings such as elbows, sockets, fees, unions, reducers, flanges,clamps and plugs etc with threading, jointing and making connections including cutting hole in wall/floor/slab and making good the same with cement concrete 1:2:4 complete in all respect as per specifications including painting pipe and fittings with two or more coat of synthetic enamel paint of approved quality as per pipe colour over a coat of red oxide primer outside with 1 coat of primer and 2 coats of enamel paint, complete.				
a)	65 mm dia nominal bore	RM	100	1,643	1,64,285

(Attachment No-11 to Addendum No-5)
(COMPRESSED AIR SYSTEM)
OCC & INFRA BUILDING (WORKTRAIN WORKSHOP)

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	25 mm dia nominal bore	RM	200	621	1,24,151
c)	15 mm dia nominal bore	RM	50	343	17,145
2.3	Providing and fixing M.S. structural work, fabricate from standard sections eg. M.S. rods, angles channels including cutting to size, drilling holes, fixing fastenera/insert plates in RCC structural members as directed by the Engineer-in-Charge including cutting and making good the walls and floors (for supports, clamps, M.S. ladders, gratings etc.)	Kg	100	159	15,877
2.4	Providing and fixing gunmetal ball value with SS ball & teflon seats and seals inside spindle type tested to 500 psi, complete.				
a)	65 mm dia nominal bore	Nos	6	7,120	42,719
b)	25 mm dia nominal bore	Nos	5	4,934	24,670

(Attachment No-11 to Addendum No-5)
(COMPRESSED AIR SYSTEM)
OCC & INFRA BUILDING (WORKTRAIN WORKSHOP)

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
c)	15 mm dia nominal bore	Nos	15	4,298	64,468
2.5	Pressure Gauges, 150 mm Dial, complete with mounting nipple and isolation valve. Range 0 - 15 Kg/Cm Sq.	Nos	8	17,315	1,38,520
2.6	Auto Drain Assembly, with Solenoid Valve and Timer. Timer should be adjustable between 5 Mins to 120 Mins. Size 15 mm NB.	Nos	5	43,142	2,15,709
2.7	Providing and fixing Filter regulator 1/2" at every droplet after the ball valve suitable for 10 bar pressure.	Nos	8	19,802	1,58,419
Total -1					**15,84,993**
GRAND TOTAL = (TOTAL -1)					**15,84,993**

(Attachment No-11 to Addendum No-5)
PART-C - SCHEDULE OF SPARE QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
S.01	**DISTRIBUTION CABLES**				
1	**FRLS Cable**				
	Supply of 1100 V grade, armoured, FRLS, XLPE, aluminium (AL) / Copper (CU) conductor cables on existing trays / walls/columns/ indoor including the cost of supply and fixing, crimping lugs, double compression and weather proof brass glands, Earthing lugs and shrouds, supports with suitable clamps, saddles, hooks, bolts etc. & in ground/ trenches including the cost of proper dressing of cables, markers providing identification tags, sand filling etc. (cost of excavation, sand & bricks, included here) earthing of glands armouring etc. complete as per specifications as required and as below.				
	Note 1: All cables 25 sqmm and above are AL conductors unless specified otherwise.				
1.1	4 core 400 sq mm AL conductor cable	M	341	1,057	3,60,378
1.2	4 core 300 sq mm AL conductor cable	M	257	848	2,17,738
1.3	4 core 240-sqmm AL conductor cable	M	157	697	1,09,655
1.4	4 core 185-sqmm AL conductor cable	M	56	558	31,084
1.5	4 core 150-sqmm AL conductor cable	M	75	461	34,737
1.6	4 core 120-sqmm AL conductor cable	M	79	399	31,376

(Attachment No-11 to Addendum No-5)
PART-C - SCHEDULE OF SPARE QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1.7	4 core 95 sq mm AL. Conductor cable	M	80	320	25,588
1.8	4 core 70-sqmm AL conductor cable	M	86	262	22,618
1.9	4 core 50 sq mm AL. Conductor cable	M	101	208	20,989
1.10	4 core 35 sq mm AL Conductor cable	M	101	184	18,573
1.11	4 core 25 sq mm AL Conductor cable	M	130	155	20,201
1.12	4 core 16 sq mm CU Conductor cable	M	395	396	1,56,476
1.13	4 core 10 sq mm CU Conductor cable	M	174	279	48,473
1.14	4 core 6 sq mm CU conductor cable	M	673	200	1,34,720
1.15	4 core 4 sq mm CU conductor cable	M	160	153	24,506
1.16	3 core 4 sq mm CU conductor cable	M	190	198	37,488
1.17	3 core 6 sq mm CU conductor cable	M	64	165	10,522
1.18	3 core 2.5 sq mm CU conductor cable	M	113	95	10,788

(Attachment No-11 to Addendum No-5)
PART-C - SCHEDULE OF SPARE QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1.19	2 core 50 sq mm Cu Conductor	M	15	575	8,693
1.20	2 core, 16 sq mm Cu Conductor	M	91	235	21,313
2	**Fire Survival Cables**				
	Supply, of 1100 V grade, armoured, **FIRE SURVIVAL CABLE, XLPE, Copper (CU)** conductor cables on existing trays / walls/columns/ indoor including the cost of supports with suitable clamps, saddles, hooks, bolts etc. & in ground/ trenches including the cost of supply and fixing, crimping lugs, double compression weather proof flame proof brass glands, Earthing lugs and shrouds, proper dressing of cables, markers providing identification tags, sand filling etc. (cost of excavation, sand & bricks, included here) earthing of glands armouring etc. complete as per specifications as required and as below.				
	FIRE SURVIVAL cables are manufactured and tested in accordence with BS 7846, IS 7098 (Part-1), IEC 69331 and BS 6387 for required temperatures and duration based on the application and site conditions.				
i	4 core 240 sq mm fire survival Cu. conductor cable	M	83	4,482	3,69,765
ii	4 core 95 sq mm fire survival Cu. conductor cable	M	49	2,106	1,02,777
iii	4 core 35 sq mm Cu. Conductor cable	M	43	865	36,884
iv	4 core 10 sq mm Cu Conductor cable	M	46	328	15,126
v	4 core 6 sq mm CU conductor cable	M	7	231	1,588
	TOTAL FOR S.01 (DISTRIBUTION CABLES)				**18,72,052**
S.02	**INDOOR LIGHTING AND FANS**				

(Attachment No-11 to Addendum No-5)
PART-C - SCHEDULE OF SPARE QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1	**Indoor Light Fixture**				
1.1	2 x 2 recess mounting luminaires with mid flux LED using efficient optics enclosed in a mettallic CRCA powder coated housing with high efficiency Lumin diffuser. It has a system lumen efficact > 80 lumens/watt system level luminous flux of 3100 lumens and system wattage of 40 W, 50,000 hours burning life for the system at 70 % lumen maintenance with a color rendering index > 80 and color temparature 6500 K. PF > 0.9 and THD < 33 %. Luminaire is sealed from bottom and has inbuilt gear. The luminaire is IP20 protected. Similar as per approved make list.				
a)	**Supply of above given items**	Nos	74	3,619	**2,67,891**
1.2	135 mm dia. recessed 18 W LED downlighter with 1200 lumens output at 6500K color temparature and > 70 CRI. The fixture should be DLED comptact LED Engine with a die cast aluminium heat sink, a high efficacy diffuser and a PC reflector with steel clip. The fixture should have an integrated constant color driver. Fixture should be IP 20. or as per approved equivalent make list.				
a)	**Supply of above given items**	Nos	31	1,460	**45,364**
1.3	4', 28 W LED luminaire or superior as per approved make list. Luminaire should be suitable for surface mounting/suspended made of extruded aluminium housing and CRCA front frame. High efficiency covered luminiaire with opal diffuser. With minimum lumen output of 3250 lumens and efficacy > 60 Lm/W and CCT of 4000 K. Electronic driver should have a PF> 0.9 and THD < 25 %.				
a)	Supply of above given items	Nos	26	3,403	**89,828**

(Attachment No-11 to Addendum No-5)
PART-C - SCHEDULE OF SPARE QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1.4	4' 28 W LED luminaire similar or superior as per approved make list. Luminaire should be suitable for surface mounting/ suspended made of extruded aluminium housing and CRCA front frame. The product should be suitable for direct installation on RCC with accessories with option of being suspended. (TYPE A - PUBLIC AREA, Platform Area, ASS Room, Mesh Room, Security Room, EL UPS Room, Corridor, Store Area etc.)				
a)	Supply of above given items	No	88	2,000	**1,75,678**
1.5	Linear LED batten. The fixture should be a system wattage of 28 W and a high CRI of 85. System efficacy of 85 lumens/W and a system lumen output of 3250 lumens. The fixture should have a metal frame design and is protected to IP20. The fixture should be as per approved make list.				
a)	Supply of above given items	Nos	61	2,935	**1,79,025**
1.6	210W Highbay with 24000 Lumens, IP65 , power factor of more than 0.95 with housing of High pressure Die cast aluminium. The fixture should be as per approved make list.				
a)	Supply of above given items	Nos	28	18,544	**5,15,048**
1.6	130 LED highbay 130W Highbay with 16000 Lumens, IP65 , power factor of more than 0.95 with housing of High pressure Die cast aluminium or approved equiavlent make list. For Stabling Shed				

(Attachment No-11 to Addendum No-5)
PART-C - SCHEDULE OF SPARE QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
a)	**Supply of above given items**	Nos	25	15,110	**3,78,118**
1.7	42W WellGlass LED light fixture with lumen output of 2700 lm at 6500 colour temperature, IP 66 and IK 08. Fixture has CRI 70, THD <=10% and pf>.95 with High Pressure die cast body as per aproved make list.				
a)	Supply of above given items	Nos	40	3,957	**1,58,889**
1.8	250W LED Flood light fixtures with accessories for yard lighting (Highmast fittings) or approved equivalent make list.				
a)	**Supply of above given items**	Nos	4	40,400	**1,59,984**
1.9	80 W LED Street Light with a lumen output of 7000 lumens. The fixtures is made of die cast aluminium. Fixture has a CRI > 70 and IP 66 protection. The fixture should be as per approved make list.				
a)	**Supply of above given items**	Nos	8	9,151	**69,963**

(Attachment No-11 to Addendum No-5)
PART-C - SCHEDULE OF SPARE QUANTITIES -OCC - LT

S.No.	Description.	Unit.	Qty.	Unit Price (INR)	Total Amount (Rs).
1	2	3	4	5	6
1.10	10W LED Bulkhead with a lumen package of 600 lumens in Cool White color. The fixture has a THD ≤ 20% and PF > 0.9 . Fixture is protected to IP 66 and IK 09 . Fixture has a housing of High pressure die cast aluminum and a front diffuser of Poly carbonate. (Type-D, LIFT AND SHAFT AREA)				
a)	**Supply of above given items**	Nos	2	1,322	**2,181**
1.11	47W High power LED Decorative Post Top with 1600 lm neutral white output having integral driver with closed diffuser optics protected to IP 65. For decorative lighting with accessories.				
a)	**Supply of above given items**	Nos.	1	13,217	**13,217**
1.12	80 W LED High Bay with a system lumen output of >7300 lumens at 5700 color Temperature. The fixture is made of High Pressure Die Cast Aluminium and is protected to IP 65. Fixture has a high efficacy of 91 lm/W, a CRI > 70, PF > 0.9 and a THD < 20%. The fixture has a symmetric wide optics. Similar or equivalent as per approved list.(TYPE-F, TERRACE AREA)				
a)	**Supply of above given items**	No	1	14,263	**14,263**
	TOTAL FOR S.02 (LIGHT FIXTURE)				**20,69,448**

(Attachment No-11 to Addendum No-5) STN- SUM- PART-D (Aarey Station)		
Sub Head No.	**ITEMS**	**Amount (INR)**
S.01 - ELECTRICAL LT SYSTEM FOR AAREY STATION		
E.01	MV Switchgear	1,15,98,811
E.02	Distribution Boards	10,85,455
E.03	MV Cabling	1,29,77,276
E.04	Conduit Wiring	53,30,017
E.05	Indoor Lighting and Fans	46,76,562
E.06	Protective Earthing	26,39,624
E.07	Lightning Protection	10,51,148
E.08	UPS System	32,81,161
E.09	D.G. Sets	35,73,187
	S.01 - ELECTRICAL SYSTEM FOR AAREY STATION	**4,62,13,240**
S.02- FIRE DETECTION AND FIRE FIGHTING SYSTEM		
F.01	Fire Alarm System	24,09,178
F.02	Fire Hydrant System	17,57,970
F.03	Piping For Fire Fighting System	1,18,40,361
F.04	Sprinkler System	4,67,451
F.05	Portable Fire Extinguishers	2,53,287
F.06	Clean agent based panel flooding system for electrical panels.	24,30,976
F.07	Clean agent based Fire Supression System - Total Flooding	21,37,908
F.08	Miscellaneous Fire Services Equipment	2,42,568
F.09	Transformer Protection System	**3,75,506**
F.10	VESDA SYSTEM FOR SER,TER & UPS ROOM:	14,02,685
	S.02 - FIRE DETECTION AND FIRE FIGHTING SYSTEM	**2,33,17,891**

(Attachment No-11 to Addendum No-5) STN- SUM- PART-D (Aarey Station)		
Sub Head No.	**ITEMS**	**Amount (INR)**
S.03-BUILDING MANAGEMENT SYSTEM		
B.01	BUILDING MANAGEMENT SYSTEM	92,65,883
	S.03 - BMS FOR AAREY STATION	**92,65,883**
S.04-PLUMBING PUMP STATION		
S.04	PLUMBING PUMP AAREY STATION	**6,96,808**
S.05-BASEMENT VENTILATION		
S.05	Basement Ventilation for Aarey Station	**42,02,917**
	Grand Total	**8,36,96,739**

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
E.00	**General**				
1	The BOQ specified below include the latest relevent standards (unless otherwise specified), specifications, drawing details and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval by the employer before use.				
2	The description as mentioned in this BOQ including details as mentioned in GCC, SCC, Employer's Requirement', General specifications & Technical specificatios , Drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.				
3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.				
4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.				
5	Bus Bar Sizing calculations shall be submitted for approval of Employer or his representative.				
6	Contractor shall quote reasonable rates against each item of BOQ (both in word and figure)				
7	Steel structure/pipe shall be earthed.				
E.01	**M V SWITCHGEAR**				
1.0	**Switch Boards/panels**				
	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty floor / wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with neoprene gaskets, fabricated from CRCA sheets steel of thickness not less than 2mm in general and load bearing members with 2.5mm and shall be folded and braced as necessary to provide a rigid support for all components with powder coated finish (minimum thickness 50 micron) suitable for 415 volts 3 phase 4 wire 50 Hz system to withstand symmetrical fault level of 50 kA for ASS Aarey Station at 415 V, including interconnections, bonding to earth etc. and flush doors conforming to relevant IEC/IS (viz. IEC 61439, IS 8623 etc.) standard including the earth leakage protection complete as per specification & drawings as required and as given below. All internal wiring in the panels shall be carried out using FRLS wires.				
a)	The Switchboards shall be provided with detachable gland plates for entry of cables from the top/bottom as required.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	All live accessible parts shall be shrouded and all equipment shall be finger touch proof. The busbars shall be insulated with heat shrinkable sleaves. SMC/DMC (Double Moulding Compound) shrouds and busbar supports suitably spaced shall be used. Hinged doors with padlocking facility shall be provided on all outgoing feeders with switch handles lockable in OFF position.				
c)	The panel shall have Copper busbars (phases, neutral & earth) with bar type feeder connections, spacers etc.and phases & neutral busbar shall be of 100% capacity and Earthing Busbar shall be 50% of Phase.				
d)	All accessories & supporting structures such as channels, ISMC base frame, mounting brackets, lifting lugs, panel heaters, ventilation arrangement etc as required.				
e)	Each incomer and outgoing feeder shall be provided with multiple LED type status indication lamps suitable for 230 V AC as approved.				
f)	Overall Space provisionshall be @ 25% for future expansion				
g)	The makes of components and accessories shall, to the extent practically feasible, be same for panels and boards for uniformity, standardisation and replaceability and shall be applicable to all panels/ boards under the scope of work				
h)	Switchboard including interconnections, labeling, earthing,associated foundation / masonary work & erection etc. complete as required.				
i)	All MCCBs shall be current limiting type microprocessor based, rated for requisite specified Service short circuit breaking capacity (Ics suitable for isolation conforming to latest IEC947-2/IS13947-2 duly marked on MCCB, at operating voltage (Ue) of 415 V, insulation voltage (Ui) 750 V and with trip free mechanism, handle indicating ON/OFF/tripped position. The breaking capacity as mentioned shall be Ics values.				
j)	MCCBs shall be compact (As the Engineer may decide), suitably designed to provide protection of motors, cables, busbars to suit rated current, unbalanced power distribution as required and with front adjustable overload and short circuit releases and minimum electrical endurance of the order of 7000-8000 operation cycles (higher shall be preferred) for capacity of 100-250 amps..				
k)	All the MCCBs shall be provided with potential free contacts for connectivity to PLC in ESR/Pump Room for ON/OFF status and control, as required.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
l)	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 9/10 kA at 415 V AC, current limiting type, lower power loss approx 40 -70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for motor application duty, with minimum Electrical endurance of the order of 20000 operation cycles.				
m)	Panel/board design shall be compact and components / accessories of compact sizes are used to economise the room space available. Employer reserve the right to seek compact items in place of larger ones				
n)	All incomer ACB's shall be provided with minimum 2 NO + 2 NC auxiliary contacts and all MCCBs shall be provided with 2 NO+ 2NC auxiliary contacts, and there should be provision to add min. 6 Auxiliary contacts.				
o)	All 4-pole ACBs shall have fully rated neutral pole. All 4-pole ACBs & MCCBs shall be provided earth fault protection.				
p)	The panel shall be fitted with fire trace tube system. Scheme of fire trace tube system shall be got approved by Engineer before proceeding with manufacturing and assembly.				
q)	All internal wiring to be FRLS				
r)	Various panels/boards as given below:				
1.1	**MAIN DISTRIBUTION BOARD (MDB)**	No.	1	22,53,534	**22,53,534**
A	**INCOMER -TRANSFORMER - I**				
	1 no. 1250 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:				
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase (red, yellow, blue) indicating lamps				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
c)	Amber healthy / trip indicating lamps				
d)	3 nos. cast resin current transformers of 1250/5A ratio with 15 VA Burden & Class 5P10 for protection				
e)	Micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting.				
f)	230 V AC shunt trip coil				
g)	230 V, AC Motor wound spring closing mechanism				
h)	Terminals to receive alum. XLPE armoured cables				
i)	RS-485 port for display of ON/OFF status, current and energy parameters etc. of ACB on BMS workstation through MODBUS protocol				
j)	Auto/Local/Remote Selector Switch Key operated				
	Note: Contractor shall provide an earmarked terminal boards for SCADA signals as per specification & requrments.				
B	**BUS-1 OUTGOINGS**				
a)	1 no. 630 A, 415V, I_{cs}= 50 kA, 4P MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
b)	2 no. 400 A, 415V, I_{cs}= 50 kA, 4P MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
c)	1 no. 250 A, 415V, I_{cs}= 50 kA, 4P MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
d)	2 no. 200 A, 415V, Ics= 50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch..				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
e)	1 no. 160 A, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
f)	1 no. 125 A, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 125/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
C	**BUS COUPLER & BUS BAR**				
a)	1 no. 1250 A, 415V, 50kA, 4P, draw out electrically operated ACB, on & off , indications				
b)	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 1250 A as per specification suitable with stand symmetrical fault level of 50 kA. at 415 V with necessary high temp.sleeving.The neutral busbar shall be of 100% capacity.				
c)	The incomers shall be interlocked electrically & mechanically with the Bus Coupler.				
d)	RS-485 port for display of ON/OFF status, of ACB on BMS workstation through MODBUS protocol				
	Note: E&M Contractor shall provide an earmarked terminal boards for SCADA signals as per specification & requirement.				
e)	Micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting.				
D	**TRANSFORMER - II INCOMING**				
	1 no. 1250 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:				
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase (red, yellow, blue) indicating lamps				
c)	Amber healthy / trip indicating lamps				
d)	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden & Class 5P10 for protection				
e)	Micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault, Under voltage, over voltage, residual voltage & reverse power protection with adjustable setting.				
f)	230 V AC shunt trip coil				
g)	230 V, AC Motor wound spring closing mechanism				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
h)	Terminals to receive alum. XLPE armoured cables				
i)	RS-485 port for display of ON/OFF status, current and energy parameters etc. of ACB on BMS workstation through MODBUS protocol				
j)	Auto/Local/Remote Selector Switch Key operated				
	Note: Contractor shall provide an earmarked terminal boards for SCADA signals as per specification & requrments.				
E	**BUS-2 OUTGOINGS**				
a)	1 no. 630 A, 415V, I_{cs}= 50 kA, 4P MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 630/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
b)	2 no. 400 A, 415V, I_{cs}= 50 kA, 4P MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
c)	1 no. 250 A, 415V, I_{cs}= 50 kA, 4P MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 400/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
d)	2 no. 200 A, 415V, Ics= 50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 200/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch..				
e)	1 no. 160 A, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
f)	1 no. 125 A, 415V, Ics=50 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 125/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
D	**METERING**				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	2 sets (4 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Volt meter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders				
b)	2 No., 230V, AC operated integral type Digital Multifunction meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVAH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size summating CTs for above two incomer metering supporting SCADA/BMS connectivity				
H	**INTERLOCKING**				
	Two above two incomers & Bus Coupler shall be interlocked electrically & mechanically so that only two out of three shall be switched on at a time.				
1.2	**EMERGENCY POWER PANEL (EPP)**	**No.**	1	73,805	**73,805**
A	**INCOMER -1 (From MDB Bus-1)**				
a)	630 A, 415V, Ics=35 kA, 4P, Motorised MCCB complete with variable overcurrent and short circuit releases for Normal supply				
b	Contactor-relay based automatic changeover system complete.				
c)	1 set of Red/Green ON/OFF indicating lamps				
d)	1 set of three phase indicating lamps (red, yellow, blue)				
e)	Amber healthy/ trip indicating lamps for above feeders.				
B	**BUSBAR**				
a)	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 630 A **as per specification,** suitable with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of 100% capacity.				
C	**OUTGOING UNITS (From Bus-1)**				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	3 nos.125Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1-set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 125/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	3 nos.63Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	8 nos.40Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**BUSCOUPLER**				
	1 nos. 630 A, 415V, Ics= 35 kA, 4P, Motorised MCCBs complete with variable overcurrent and short circuit releases				
a)	1- set of Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber healthy trip indicating lamps for above feeders				
E	**INCOMER (From MDB Bus-2)**				
a)	630 A, 415V, Ics=35 kA, 4P, Motorised MCCB complete with variable overcurrent and short circuit releases for Normal supply				
b	Contactor-relay based automatic changeover system complete.				
c)	1 set of Red/Green ON/OFF indicating lamps				
d)	1 set of three phase indicating lamps (red, yellow, blue)				
e)	Amber healthy/ trip indicating lamps for above feeders.				
F	**INCOMING FROM DG PANEL**				
	1 nos. 630 A, 415V, Ics= 35 kA, 4P, Motorised MCCBs complete with variable overcurrent and short circuit releases				
a)	1- set of Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber healthy trip indicating lamps for above feeders				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
G	**OUTGOING UNITS (From Bus-2)**				
a)	2 nos.160Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1-set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 160/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	2 nos.125Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1-set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 125/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
c)	5 nos.40Amps, 415V, Ics=35 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
H	**INTERLOCKING**				
a)	All incomers shall be interlocked electrically & mechanically with contactor based automatic changeover system so that only one supply is switched on at a time and fail safe restoration.				
I	**METERING**				
a)	1 No., 230V, AC operated integral type Digital Multifunction meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVRH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				
b)	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Volt meter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders				
1.3	**MAIN LIGHTING PANEL (MLP)**	**No.**	1	3,16,451	**3,16,451**
A	**INCOMER**				
	1 no. 160A, 415V, Ics=35 kA, TPN MCCB with fixed neutral and with variable overcurrent and short circuit releases				
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
c)	Amber healthy trip indicating lamps for above feeders				
B	**BUSBAR**				
a)	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 160 A **as per specification,** suitable with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	13 nos.40Amps, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases & each having 1-set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**Metering**				
a)	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVRH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				
b)	2 sets (4 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Volt meter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders				
1.4	**UPS PANEL**	**No.**	1	2,25,433	**2,25,433**
A	**INCOMER**				
	1 no. 250A, 415V, Ics=35 kA, TPN MCCB with variable overcurrent and short circuit releases				
a	3 nos. cast resin current transformers of 160/5 ratio 15 VA burden with Ammeter and Ammeter Selector Switch				
b	1 Set of (0-500 volts) digital voltmeter with selector switch with 2 amps MCB.				
c	1- set Red/Green ON/OFF indicating lamps.				
d	1- set of three phase (red, yellow, blue) indicating lamps.				
e	Amber healthy/ trip indicating lamps.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
B	**BUSBAR**				
a)	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 250A **as per specification,** suitable with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phase				
C	**OUTGOING**				
a)	22 nos. 25A, 415V, Ics=25 kA,DB MCB ELCB/RCCB having indication lamps to give status.				
b)	03 nos. 63A, 415V, Ics=25 kA, TPN MCCB and with variable overcurrent and short circuit releases each having 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 80/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D	**Metering**				
a)	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVRH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				
1.5	**AC POWER PANEL (ACPP)**	**No.**	1	1,63,759	**1,63,759**
A	**INCOMER**				
	200A, 415V, Ics=35 kA, TPN MCCB with variable overcurrent and short circuit releases.				
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber healthy trip indicating lamps for above feeders				
d)	1 set (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Volt meter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with 200/5A size CTs connections as required for incoming feeders				
B	**BUSBAR**				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 200 A **as per specification,** suitable with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	05 no. 63A, 415V, Ics=10 kA, TP MCB's(Motor Duty) with 1- set Red/Green ON/OFF indicating lamps & 3 nos. cast resin current transformers of 63/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	06 no. 06A, 230V, Ics=10 kA, DP MCB's with 1- set Red/Green ON/OFF indicating lamps.				
D	**Metering**				
	1 No., 230V, AC operated integral type Digital Multifunction meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVAH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				
1.6	**Aircondition Distribution Board as per specification & Drawing as per following details.**	No.	1	25,010	**25,010**
	One A C distribution board (ACDB) unit with respective incoming TPN MCBs, and outgoing SP MCBs each having indications for incoming feeder status as per specifications and as under:				
	INCOMER				
a)	1 no. 63A TPN MCB				
b)	1 set of (ON) indicating lamps for each.				
	OUTGOINGS				
a)	42 Nos of 6 A SP MCB arranged in three rows .				
1.7	**WATER PUMP PANEL**	No.	1	4,83,557	**4,83,557**
	Internal wiring in the Starters shall be done with FRLS insulated cables of adequate size. Internal wiring, contactors, relay contacts, push button contacts should be rated not less than 2.5 sq mm.				
A	**INCOMER**				
	125 A ,415V, Ics=35 KA , TPN MCCB with variable over current and short circuit releases.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber healthy trip indicating lamps for above feeders				
d)	3 nos. cast resin current transformers of 125/5 with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
B	**BUSBAR**				
	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 125 A **as per specification,** suitable with stand symmetrical fault level of 35kA. at 415 V. The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				
a)	3 Nos. 40A, Ics = 25 kA, 415V, TP MCCB(Motor Duty) each with phase indication lamp.				
b)	6 nos. 5-32 A, Ics = 10 kA, 415 V, TP MCB (motor duty) each with phase indication lamp.				
c)	3 Nos. 16A, Ics = 10kA, 230V, DP MCB (motor duty) each with phase indication lamp.				
D	**Metering**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVAH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				
E.	Presettable switching timer set for each pump				
1.8	**FIRE PUMP PANEL (FPP)**	No.	1	7,17,856	**7,17,856**
	Internal wiring in the Starters shall be done with FRLS insulated cables of adequate size. Internal wiring, contactors, relay contacts, push button contacts should be rated not less than 2.5 sq mm.				
A	**INCOMER - I from MDB**				
	1 no. 400 A, 415 V, Ics=35kA ,4P, MCCB with variable over current and short circuit releases having:				
a)	1 set of Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber trip indicating lamps				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
d)	3 nos. cast resin current transformers of 400/5 with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
B	**INCOMER - II from DG set**				
	1 no. 400 A, 415 V, Ics=35kA ,4P,MCCB with variable over current and short circuit releases having:				
a)	1 set of Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber healthy trip indicating lamps				
d)	3 nos. cast resin current transformers of 400/5 with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
C	**BUSBAR**				
a)	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 400 A **as per specification,** suitable with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of capacity as phases				
b)	Two incomers shall be interlocked electrically & mechanically with contactor based automatic changeover system so that only one supply is switched on at a time.				
D	**OUTGOING**				
a)	4 nos. 160 A, Ics=25 kA, 415 V, TP MCCB with fixed neutral and with variable overcurrent and short circuit releases				
a1)	4 nos. 75 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.				
a2)	1 - set Red/Green ON/OFF indicating lamps				
a3)	1 no. for each feeder of AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 with necessary Circuit MCBs and with suitable size CTs, connections as required for incoming feeder and suitable selector for measuring other circuit current				
a4)	1 set of start stop push buttons.				
a5)	Auto / Manual selector switch.				
a6)	Amber healthy trip indicating lamps.				
a7)	Provision of remote start of main fire pump should be kept by pressing of push button switch.This provision shall be extended upto station control room.				
b)	2 no. 40 A, Ics= 25 kA, 415 V, TP MCCB with fixed neutral and with variable overcurrent and short circuit releases				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b1)	2 nos. upto 5 HP DOL starter with bimetallic over current relays single phasing preventer & with potential free contact for remote monitoring.				
b2)	1 – set Red/Green ON/OFF indicating lamps				
b3)	1 no. for each feeder of AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 with necessary Circuit MCBs and with suitable size CTs, connections as required for incoming feeder and suitable selector for measuring other circuit current				
b4)	1 set of start stop push buttons.				
b5)	Auto / Manual selector switch.				
b6)	Amber healthy trip indicating lamps				
C	**Metering**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVAH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				
D	Auxiliary relay shall be provided which shall be activated by pressure switch for remote monitoring.				
1.9	**ESCALATOR POWER PANEL (ESPP)**	No.	1	2,92,639	**2,92,639**
A	**INCOMER**				
1	250 A ,415V, Ics=35 kA, TPN MCCB with variable over current and short circuit releases				
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber healthy trip indicating lamps for above feeders				
d)	3 nos. cast resin current transformers of 250/5 with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
B)	**BUSBAR**				
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 250 A as per specification, suitable with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of capacity as phases				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
C)	**OUTGOING**				
	8 nos. 63A, Ics=25 kA, 415V, TPN MCCB with fixed neutral and with variable overcurrent and short circuit releases suitable for motor application duty suitable for elevator/escalator drive motors accessories, connections as required & 3 nos. cast resin current transformers of 63/5A ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
D)	**Metering**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVAH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				
1.10	**Basement Exhaust Panel (BEP)**	No.	2	2,80,687	**5,61,374**
A	**INCOMER**				
1	125 A ,415V, Ics=35 kA, TPN MCCB with variable over current and short circuit releases.				
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber healthy trip indicating lamps for above feeders				
d)	3 nos. cast resin current transformers of 125/5 with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
B)	**BUSBAR**				
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 125 A **as per specification,** suitable with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of 50% capacity.				
C)	**OUTGOING**				
	10 nos. 63A, Ics=25 kA, 415V, TPN MCCB with fixed neutral and with variable overcurrent and short circuit releases suitable for motor application duty suitable for elevator/escalator drive motors accessories, connections as required and each having indication lamps to give status				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
D)	**Metering**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVAH, frequency, Maximum Demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				
1.11	**PASSANGER AMENITIES PANEL (PAP)**	No.	1	2,80,687	**2,80,687**
A	**INCOMER**				
	1 nos. 125 A ,415V, Ics= 35 kA, TPN MCCB with variable over current and short circuit releases having:				
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase indicating lamps (red, yellow, blue)				
c)	Amber healthy trip indicating lamps for above feeders				
d)	3 nos. cast resin current transformers of 125/5 with 15 VA Burden and Class 1.0 with Ammeter and Ammeter selector Switch.				
B)	**BUSBAR**				
	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 125A **as per specification,** suitable with stand symmetrical fault level of 35 kA at 415 V. The neutral busbar is to be of same capacity as phases.				
C)	**OUTGOING**				
a)	10 nos. 40A Ics=25 kA, 415V, TPN MCCB with fixed neutral and with variable overcurrent and short circuit releases & 3 nos. cast resin current transformers of 40/5 ratio with 15 VA Burden and Class 1.0 with Ammeter and Ammeter Selector Switch.				
b)	Space for providing variable KVAH , Energy Meter etc with TOD facility with required CT's/PT's for each of the outgoing feeder with locking arrangement.				
D)	**Metering**				
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, kWH, kVAH, frequency, Maximum Demand & power factor etc with TOD Facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.12	**APFC PANEL**				
1.12A	**150 KVAR APFC PANEL @ STATION**	No.	2	3,78,409	**7,56,818**
A	**INCOMER**				
	1 No. 400 amps Four pole electrically operated (motorised) fully draw out type air circuit breaker 50 kA with built in micro processor based release unit for short circuit, selective short circuit, instantaneous short circuit, Earth fault with adjustable setting and with the following accessories :				
	1- set Red/Green/Amber -ON/OFF/Alarm indicating lamps				
	1- set of three phase (red, yellow, blue) indicating lamps				
	1 Set of (0-500 volts) digital voltmeter with selector switch with MCB's, and one set of Digital Ammeter with 3 nos. 400/5 Amps, 15 VA, CT				
	TNC Switch.				
	Auto/local/remote selector switch key operated.				
	1 set of suitable rating of Current Transformer for incomer in main panel for APFCR relay				
	1- set of three phase (red, yellow, blue) indicating lamps.				
	1 Set - Automatic microprocessor based digital type power factor compensating relay (including power factor meter) in 10 steps for automatic cut off or add on capacitor units to keep the power factor at 0.95 with variation of loads. All associated auxiliary contactors/relays to be provided. Visual alarms, to display shortfall of P.T., automatic lockout of faulty Step, over temperature protrections. Auto manual selection and indications.				
B	**BUSBAR**				
	Electrolytic high conductivity Copper three phase and neutral busbars rated at 400 A having a maximum current density of 1.4 A per sq mm with heat shrinkable insulation sleeves suitable to with stand symmetrical fault level of 50 kA at 415 V.The neutral busbar is to be of same size as phases.				
C	**OUTGOING**				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Outgoing feeders consisting of following accessories.				
	1 nos. 125 amps, 35kA, TP MCCB with backup fuses of suitable capacity				
	2 nos. 80 amps,35kA, TP MCCB with backup fuses of suitable capacity				
	3 nos.63 amps,35kA,TP MCCB with backup fuses of suitable capacity				
	1 nos. 125 amps 415 volts 50Hz heavy capacitor duty contactors				
	2 nos.80 amps 415 volts 50Hz heavy capacitor duty contactors				
	3 nos. 63 amps 415 volts 50Hz heavy capacitor duty contactors				
	6 nos “ON” /”OFF” push buttons and indicating lamps				
	1 nos. 125 amps rating TP terminal blocks				
	3 nos. 80 amps rating TP terminal blocks				
	3 nos. 63 amps rating TP terminal blocks				
	1 nos. 37.5 KVAR capacitor units in bank form				
	2 nos. 25 KVAR capacitor units in bank form				
	3 nos. 12.5 KVAR capacitor units in bank form				
	The switchboard shall be complete with all interbconnections, risers, internal wiring, labels etc complete as required.				
1.13	**ATS**				
a)	Supply & fixing of 200 Amp on load, four pole Automatic Transfer switch (ATS) as per relavent IEC standards with HRC fuses and indications as required, suitable for 415 V, 3 phase, 4 wire, supply with suitable MS enclosure for signaling & telecom UPS.	No.	1	1,15,113	1,15,113
b)	Supply & fixing of 125 Amp on load, four pole Automatic Transfer switch (ATS) as per relavent IEC standards with HRC fuses and indications as required, suitable for 415 V, 3 phase, 4 wire, supply with suitable MS enclosure for E&M UPS.	No.	1	67,486	67,486
1.14	**Door Limit Switch** Design, manufacture, testing, transporting to site & suitable for outdoor/Indoor installation. These are intended for use of auxiliary switches in doors & shall not be affected by dust or moisture.	**Nos.**	1	2,129	2,129
	Degree of protection shall be IP66 as per IEC60529				
	Insulation Voltage/Thermal current for screw terminal 2 contacts shall be 500V/10A.				
	Contact blocks shall be of NO + NC				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Enclosure shall be of metallic type with head, body and connection modularity				
	Limit Switch head shall be of Plunger type with linear movement				
	Cable entry connector shall be of ½ " NPT				
	limit switches of plunger type that are mechanically activated by making contact with another object. As the object makes contact with the actuator of the switch, it eventually moves the actuator to its "limit" where the contacts change state				
	Supply, installation, testing and commissioning of front operated, front access, cubicle type, indoor duty, floor / wall / recess / surface mounted (as specified below), totally enclosed dust and vermin proof control box with minimum Ingress protection classification of IP 54, fabricated from 2 mm thick CRCA sheets with dip coat priming and epoxy powder coated finish. Control box must include all interconnections, earthing and bonding requirements etc. The control box must conform to Drawings & Standards specified in relevant specifications and must include given below items.				
2	**Other accessories (Quantity per station)**				
2.1	Supply and fixing of the following safety equipments in Aux. Sub.Station/MDB room as per detailed descriptions given below and as per relevant IE rules & code of standard practice	Set	1	63,637	63,637
a)	1000 mm wide Insulating mat,confirming to IS 15652-2006 suitable to withstand LT & HT Panel Requirements in front of all panels in ASS building.				
b)	Laminated standard shock treatment charts in English & Hindi in ASS, ESR, DG room and Pump room in each station.				
c)	Danger plate as per approved Style & sample written in English & Hindi for MV installations as required as per IE rules, IES and IS 2551 (latest) - 8 nos. per station				
d)	2 nos. per station First Aid Box Complete as approved by St. John ambulance or Indian Red Cross.				
e)	4 nos. per station of 3-fire-buckets set each painted red with 'fire' written complete with sand filling, floor/wall mounting brackets/stand complete as per elevant IS and as required.				
f)	One Tool kit per station comprising 1 set of flat spanner (Taparia / Jalan), 1 set of box spanner, 1 no. Hacksaw frame with 10 No. blades, 1 no. large, medium, small screw drivers, 1 no. insulated plier, 1 no nose plier, 1 no. hand crimping tool upto 16 sq.mm, 1 no. digital multimeter, 1 no. test lamp and 1 no. tester. Screw driver set for all types of screw heads also to be provided.				
3	**Adjustment Rate for Addition/Deletion**				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3.1	Adjustment rates for addition/deletion of supply & fixing of following including making of suitable holes/space in the panel/DBs and making good all external finishes, terminations etc. complete as required.				
a)	Multiple LED/neon type indications	No.	1	1,512	1,512
b)	Astronomic digital Timer	No.	1	3,848	3,848
c)	Ammeter/Voltmeter (3.5 digit display)	No.	1	4,084	4,084
d)	TP Contractor - 40/32 Amp.	No.	1	4,488	4,488
e)	Aux. Contact 1 NO + 1NC for MCB	No.	1	1,013	1,013
3.2	Adjustment rates for addition/deletion of compartmentalised switchgear in above panels/board of following rating including the supply, fabrication, extension, modification of the enclosure or in a separate enclosure, earthing ,basbar, other sub-systems, accessories etc complete as required and as per specifications and as specified in of item 1.0 above				
3.2.1	1 no. 1600 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	No.	1	3,90,896	3,90,896
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase (red, yellow, blue) indicating lamps				
c)	Amber healthy trip indicating lamps				
d)	3 nos. cast resin current transformers of 1600/5 ratio with 15 VA Burden & Class 5P10 for protection.				
e)	3 nos. cast resin current transformers of 1600/5 ratio with 15VA burden and Class 1.0 for measurement				
f)	Microprocessor based release having variable range of overcurrent, short circuit,UVR and earth fault protection with time log facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.				
g)	230 V AC shunt trip coil				
h)	230 V, AC Motor wound spring closing mechanism				
i)	Terminals to receive alum. XLPE armoured cables				
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol				
3.2.2	1 no. 1250 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	No.	1	3,58,090	3,58,090
a)	1- set Red/Green ON/OFF indicating lamps				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	1- set of three phase (red, yellow, blue) indicating lamps				
c)	Amber healthy trip indicating lamps				
d)	3 nos. cast resin current transformers of 1250/5 ratio with 15 VA Burden & Class 5P10 for protection.				
e)	3 nos. cast resin current transformers of 1250/5 ratio with 15VA burden and Class 1.0 for measurement				
f)	Microprocessor based release having variable range of overcurrent, short circuit,UVR and earth fault protection with time log facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.				
g)	230 V AC shunt trip coil				
h)	230 V, AC Motor wound spring closing mechanism				
i)	Terminals to receive alum. XLPE armoured cables				
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol				
3.2.3	1 no. 1000 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	No.	1	3,31,136	3,31,136
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase (red, yellow, blue) indicating lamps				
c)	Amber healthy trip indicating lamps				
d)	3 nos. cast resin current transformers of 1000/5 ratio with 15 VA Burden & Class 5P10 for protection				
e)	3 nos. cast resin current transformers of 1000/5 ratio with 15VA burden and Class 1.0 for measurement				
f)	Microprocessor based release having variable range of overcurrent, short circuit,UVR and earth fault protection with time log facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.				
g)	230 V AC shunt trip coil				
h)	230 V, AC Motor wound spring closing mechanism				
i)	Terminals to receive alum. XLPE armoured cables				
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol				
3.2.4	1 no. 800 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	No.	1	3,11,682	3,11,682
a)	1- set Red/Green ON/OFF indicating lamps				
b)	1- set of three phase (red, yellow, blue) indicating lamps				
c)	Amber healthy trip indicating lamps				
d)	3 nos. cast resin current transformers of 800/5 ratio with 15 VA Burden & Class 5P10 for protection.				
e)	3 nos. cast resin current transformers of 800/5 ratio with 15VA burden and Class 1.0 for measurement				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
f)	Microprocessor based release having variable range of overcurrent, short circuit,UVR and earth fault protection with time log facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.				
g)	230 V AC shunt trip coil				
h)	230 V, AC Motor wound spring closing mechanism				
i)	Terminals to receive alum. XLPE armoured cables				
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol				
3.2.5					
a)	630A, 415V, Ics= 35 kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.	1	68,692	68,692
b)	630A, 415V, Ics= 35 kA, TP, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.	1	61,581	61,581
c)	400A, 415V, Ics=35 kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.	1	57,042	57,042
d)	400A, 415V, Ics=35 kA, TP, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.	1	52,195	52,195
e)	250A, 415V, Ics=35 kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.	1	49,167	49,167
f)	250 A ,415V, Ics=35kA, TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	1	44,607	44,607
g)	250/200A, 415V, Ics=35 kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.	1	49,167	49,167
h)	250/200 A ,415V, Ics=35kA, TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	1	44,607	44,607
I)	160 A, 415V, Ics=25 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	1	29,345	29,345
j)	125 A, 415V, Ics=25 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	1	28,980	28,980
k)	100/63 A, 415V, Ics=25 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	1	24,870	24,870

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
l)	Less than 63A to 40A, 415V, Ics=25 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	1	23,095	23,095
m)	Electrical Operating mechanism (Motorised mechanism) for all types of above MCCBs	No.	1	22,291	22,291
n)	5-32A FP MCB 10 kA	No.	1	3,888	3,888
o)	40-63A FP MCB 10 kA	No.	1	4,572	4,572
p)	5-32A TP MCB 10 kA	No.	1	3,611	3,611
q)	40-63A TP MCB 10 kA	No.	1	4,288	4,288
r)	5-32A DP MCB 10 kA	No.	1	1,900	1,900
s)	40-63A DP MCB 10 kA	No.	1	2,308	2,308
t)	5-32A SP MCB 10 kA	No.	1	874	874
u)	40-63A SP MCB 10 kA	No.	1	1,160	1,160
v)	16-32Amp DP RCCB, 30 mA	No.	1	3,369	3,369
w)	40-63Amp DP RCCB, 30 mA	No.	1	4,399	4,399
x)	16-32Amp DP RCCB, 100 mA	No.	1	3,398	3,398
y)	40-63Amp DP RCCB, 100 mA	No.	1	3,989	3,989

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
z)	16-32Amp DP RCCB, 300 mA	No.	1	3,398	3,398
aa)	16-32Amp DP RCBO, 30 mA	No.	1	3,858	3,858
ab)	40-63Amp DP RCBO, 30 mA	No.	1	4,780	4,780
ac)	16-32Amp DP RCBO, 100 mA	No.	1	3,886	3,886
ad)	40-63Amp DP RCBO, 100 mA	No.	1	4,809	4,809
ae)	16-32Amp DP RCBO, 300 mA	No.	1	3,886	3,886
3.3	Supply, installation and testing of 63/40 Amp adjustable, TP MCCB with fixed neutral in sheet steel enclosure with incoming & outgoing cable box and ON indication lamp complete as required.	No.	1	21,513	21,513
3.4	Supply, installation and testing of 4 Way TPN sheet steel enclosure with incoming & outgoing cable, distribution Board complete as required.	No.	1	3,734	3,734
4.5	Supply of 1250A,415V,50KA,4P ACB in 2mm. Sheet Steel Enclosure with incoming & outgoing cable.	No.	1	3,52,926	3,52,926
3.6	Supply of 800A,415V,50KA,4P ACB in 2mm. Sheet Steel Enclosure with incoming & outgoing cable.	No.	1	18,39,096	18,39,096
3.7	Supply of 630A,415V,35KA,TP MCCB in 2mm. Sheet Steel Enclosure with incoming & outgoing cable	No.	1	60,486	60,486
3.8	Supply of 400A,415V,35KA,TP MCCB in 2mm. Sheet Steel Enclosure with incoming & outgoing cable	No.	1	4,65,817	4,65,817
3.9	Supply of 250A,415V,35KA,TP MCCB in 2mm. Sheet Steel Enclosure with incoming & outgoing cable	No.	1	44,167	44,167
3.10	Supply of 250A,415V,35KA,TP MCCB in 2mm. Sheet Steel Enclosure with incoming & outgoing cable	No.	1	44,167	44,167
3.11	Supply of 160A,415V,35KA,TP MCCB in 2mm. Sheet Steel Enclosure with incoming & outgoing cable	No.	1	28,906	28,906
3.12	Over Load Relay				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	4 - 6 A	No.	1	1,624	1,624
b)	6 - 12 A	No.	1	1,655	1,655
c)	9 - 15 A	No.	1	1,655	1,655
d)	30 - 40 A	No.	1	2,452	2,452
e)	40 - 65 A	No.	1	4,150	4,150
f)	63 - 100 A	No.	1	4,075	4,075
3.13	75 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.	1	1,02,668	1,02,668
3.14	50 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.	1	73,109	73,109
3.15	10/7.5 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.	1	54,905	54,905
3.16	Upto 5HP, **DOL starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.	1	67,657	67,657
	TOTAL FOR E.01				**1,15,98,811**
E.02	**DISTRIBUTION BOARDS**				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.0	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty dead front wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with foamed-in neoprene gasketted hinged doors, fabricated from 2 mm thick CRCA with powder coated finish suitable for 415 V, 3-phase, 4 wire, 50 Hz system including suitably rated insulated copper busbars, interconnections, neutral bar assembly, phase segregating barriers, LED indicating lamps for incoming and outgoing feeders,15% spare space for future expansion, knockouts and gland plates for entry of cables and conduits, all internal wiring using high temperature FR wires, independant terminals for each phase, earthing terminals and including the cost of providing Master key lock on the door and pad locking facility on door as well as at incomer, bonding to earth etc. complete as per specification, drawings as required and as under:				
a)	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 10 kA at 415 V AC, current limiting type lower powerloss appx 40 - 70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for motor application duty, with minimum Electrical endurance of the order of 20000 operation cycles.				
b)	RCCB /RCBO conforming to IS 12640 shall be provided with 30mA sensitivity and electrically connected rated current capacity MCB for short circuit and over load protection as required				
c)	All incomer MCBs of boards /panels shall be provided with NO/NC contacts as specified in specifications and drawings				
d)	All the contactors shall be provided with potential free contacts for remote monitoring and control.				
e)	Various distribution boards as given below:				
1.1	**Lighting Distribution Boards (LDB) Type-1 Platform Level and basement parking as per specification and Drawing as per following details.**	No.	5	82,441	4,12,206
	One lighting distribution board (LDB) unit consisting of 2 compartments with respective incoming TPN MCBs, DP MCB RCCBs/ELCBs/RCBO set of contactors and outgoing SP MCBs each having indications for incoming feeder status e.g. LDB-1 is combination of LDB 1/N, LDB 1/U connected to incoming Supplies from Normal & UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:				
A	**Normal**				
	INCOMER				
a)	1 no. 63A TPN MCB				
b)	1 no. 63A TPN Contactor with astronomic digital timer				
c)	1 set of (ON) indicating lamps for each				
	OUTGOINGS with feeder (ON) indication LED lamps				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	21 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP RCBO/MCB ELCB/RCCB.				
b)	3 nos. 32A DP MCB tapped from above contactor (non timer-controlled feeders)				
B	**UPS**				
	INCOMER				
a)	1 no. 25A DP RCBO				
b)	1 no. 25A TPN Contactor with astronomic digital timer(used as a TP contactor)				
c)	1 set of (ON) indicating lamps for each				
	OUTGOINGS with feeder (ON) indication LED lamps				
a)	10 nos. 10A SP MCB				
b)	1 no. 20A SP MCB tapped from above contactor (non timer-controlled feeders)				
1.2	**Lighting Distribution Boards (LDB) Type-1 Concourse Level as per specification and Drawing as per following details.**	No.	4	88,293	3,53,171
	One lighting distribution board (LDB) unit consisting of 2 compartments with respective incoming TPN MCBs, DP MCB RCCBs/ELCBs/RCBO set of contactors and outgoing SP MCBs each having indications for incoming feeder status e.g. LDB-1 is combination of LDB 1/N, LDB 1/U connected to incoming Supplies from Normal & UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:				
A	**Normal**				
	INCOMER				
a)	1 no. 63A TPN MCB				
b)	1 set of (ON) indicating lamps for each				
	OUTGOINGS with feeder (ON) indication LED lamps				
	9 nos.(or as per drawing) Lighting circuit shall be controlled by contactor with one no. astronomic digital timer.				
a)	18 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP RCBO/MCB ELCB/RCCB.				
b)	3 nos. 32A DP MCB tapped from above contactor (non timer-controlled feeders)				
B	**UPS**				
	INCOMER				
a)	1 no. 25A DP RCBO				
b)	1 set of (ON) indicating lamps for each				
	OUTGOINGS with feeder (ON) indication LED lamps				
	9 nos.(or as per drawing) Lighting circuit shall be controlled by contactor with one no. astronomic digital timer.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	9 nos. 10A SP MCB				
b)	1 no. 20A SP MCB tapped from above contactor (non timer-controlled feeders)				
1.3	**Lighting Distribution Boards (LDB) Type-2 Concourse Level as per specification and Drawing as per following details.**	No.	2	61,722	1,23,443
	One lighting distribution board (LDB) unit consist of 2 compartments with respective incoming TPN MCBs, DP MCB RCCBs,RCBO set of contactors and outgoing SP MCBs each having indications for incoming & outgoing feeder status e.g. LDB-2 is combination of LDB 2/N and LDB 2/U connected to incoming Supplies from Normal & UPS respectively as per specifications and as shown on Drawing and as under:				
A	**Normal**				
	INCOMER				
a)	1 no. 40A TPN MCB				
b)	1 set of (ON) indicating lamps for each				
	OUTGOINGS with feeder (ON) indication LED lamps				
	24 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP RCBO/MCB ELCB/RCCB.				
B	**UPS**				
	INCOMER				
a)	1 no. 25A DP RCBO				
b)	1 set of (ON) indicating lamps for each				
	OUTGOINGS with feeder (ON) indication LED lamps				
	6 nos.(or as per drawing) Lighting circuit shall be controlled by contactor with one no. astronomic digital timer.				
a)	16 nos. 10A SP MCB				
1.4	**Lighting Distribution Boards (LDB) Type-3 as per specification and Drawing as per following details.**	No.	1	1,25,369	1,25,369
	One lighting distribution board (LDB) unit consist of 2 compartments with respective incoming TPN MCBs set of contactors and outgoing SP MCBs each having indications for incoming & outgoing feeder status e.g. LDB-3 is combination of LDB 3/N and LDB 3/U connected to incoming Supplies from Normal & UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:				
A	**Normal**				
	INCOMER				
a)	1 no. 40A TPN MCB				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	1 set of (ON) indicating lamps for each				
	OUTGOINGS with feeder (ON) indication LED lamps				
	9 nos.(or as per drawing) Lighting circuit shall be controlled by contactor with one no. astronomic digital timer.				
a)	18 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP RCBO/MCB ELCB/RCCB.				
b)	3 nos. 32A DP RCBO/MCB ELCB/RCCB tapped from above contactor (non timer-controlled feeders)				
B	**UPS**				
	INCOMER				
a)	1 no. 40A TPN MCB				
b)	1 set of (ON) indicating lamps for each				
	OUTGOINGS with feeder (ON) indication LED lamps				
	9 nos.(or as per drawing) Lighting circuit shall be controlled by contactor with one no. astronomic digital timer.				
a)	9 nos. 10A SP MCB arranged in three rows and each row controlled by one no. 32A DP RCBO/MCB ELCB/RCCB.				
b)	3 nos. 32A DP RCBO/MCB ELCB/RCCB tapped from above contactor (non timer-controlled feeders)				
1.5	**Lighting Distribution Boards (LDB) Type-4 as per specification and Drawing as per following details.**	No.	1	36,854	36,854
	INCOMER				
a)	1 no. 40A TPN MCB				
b)	1 set of (ON) indicating lamps.				
	OUTGOINGS with feeder (ON) indication LED lamps				
a)	36 Nos of 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP RCBO/MCB ELCB/RCCB.				
1.6	**Lighting Distribution Boards (LDB) Type-5 as per specification and Drawing as per following details.**	No.	1	34,412	34,412
	INCOMER				
a)	1no. 63A , Ics=35 kA ,TPN, MCCB				
b)	1 set of (ON) indicating lamps.				
	OUTGOINGS with feeder (ON) indication LED lamps				
a)	3 nos. 32A TP MCBs				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
b)	9 Nos. of 20A/32A SP MCB arranged in three rows and each row controlled by one no. 32A DP RCBO/MCB ELCB/RCCB.				
	TOTAL FOR E.02				**10,85,455**
E.03	**MV CABLING & BUS TRUNKING**				
1.0	**FRLS Cable**				
	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured, FRLS, XLPE, aluminium (AL) / Copper (CU) conductor cables on existing trays / walls/columns/ indoor including the cost of supply and fixing, crimping lugs, double compression and weather proof brass glands, Earthing lugs and shrouds, supports with suitable clamps, saddles, hooks, bolts etc. & in ground/ trenches including the cost of proper dressing of cables, markers providing identification tags, sand filling etc. (cost of excavation, sand & bricks, included here) earthing of glands armouring etc. complete as per specifications as required and as below.				
	Note 1: All cables 25 sqmm and above are AL conductors unless specified otherwise.				
a)	4 core 400 sq mm Al Conductor	M	605	1,409	8,52,506
b)	4 core 300 sq mm Al Conductor	M	1,081	1,130	12,22,184
c)	4 core 240 sq mm Al Conductor	M	121	929	1,12,467
d)	4 core 185 sq mm Al Conductor	M	378	744	2,81,417
e)	4 core 150 sq mm Al Conductor	M	1,059	615	6,51,387
f)	4 core 120 sq mm Al Conductor	M	76	531	40,191
g)	4 core 95 sq mm Al Conductor	M	197	475	93,439

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
h)	4 core 70 sq mm Al Conductor	M	151	350	52,865
i)	4 core 50 sq mm Al Conductor	M	756	278	2,10,125
j)	4 core 35 sq mm Al Conductor	M	378	246	92,972
k)	4 core 25 sq mm Al Conductor	M	1,361	207	2,82,168
l)	4 core 16 sq mm Cu Conductor	M	4,840	528	25,56,185
m)	4 core 10 sq mm Cu Conductor	M	454	372	1,68,600
n)	4 core 6 sq mm Cu Conductor	M	454	267	1,21,072
o)	4 core 4 sq mm Cu Conductor	M	454	204	92,555
p)	3 core 16 sq mm Cu Conductor	M	1,044	420	4,38,410
q)	3 core 10 sq mm Cu Conductor	M	454	315	1,43,085
r)	3 core 4 sq mm Cu Conductor	M	2,269	169	3,82,727
s)	3 core 6 sq mm Cu Conductor	M	303	219	66,373
t)	3 core 2.5 sq mm Cu Conductor	M	1,815	127	2,30,137
u)	2 core 50 sq mm Cu Conductor	M	303	765	2,31,471

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
v)	2 core, 16 sq mm Cu Conductor	M	454	313	1,42,084
2.0	**Fire Survival Cables**				
	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured, **FIRE SURVIVAL CABLE, XLPE, Copper (CU)** conductor cables on existing trays / walls/columns/ indoor including the cost of supports with suitable clamps, saddles, hooks, bolts etc. & in ground/ trenches including the cost of supply and fixing, crimping lugs, double compression weather proof flame proof brass glands, Earthing lugs and shrouds, proper dressing of cables, markers providing identification tags, sand filling etc. (cost of excavation, sand & bricks, included here) earthing of glands armouring etc. complete as per specifications as required and as below.				
	FIRE SURVIVAL cables are manufactured and tested in accordence with BS 7846, IS 7098 (Part-1), IEC 69331 and BS 6387 for required temperatures and duration based on the application and site conditions.				
	4 core 95 sq mm fire survival Cu. conductor cable	M	151	2,632	3,98,079
	4 core 35 sq mm Cu. Conductor cable	M	303	1,082	3,27,197
	4 core 10 sq mm Cu Conductor cable	M	303	410	1,24,165
2.0	**Cable Trays**				
2.1	Supply & installation of perforated hot dipped galvanised double bended cable trays from 2 mm thick GI sheets continuously connected including horizontal and vertical bends, reducers, tees, and other accessories and duly suspended from the ceiling with 12 mm dia vertical GI rods supported by 40mm x 40 mm x 5 mm GI angle etc. (or installed on wall supported on suitable brackets as required) complete as per specifications, as required and as below.				
	Note: Trays shall be supported adequately at minimum 1 m distance from the building structure / ceiling by means of galvanized (as specified) MS structural members secured to the structure by dash fasteners or by grouting. This support should be capable of withstanding the weight equivalent of 3m length of the cables that can be laid in the trays. At turns the support has to be double and at both ends of the bend.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	600 mm wide x 50 mm deep	M	66	1,419	93,656
b)	450 mm wide x 50 mm deep	M	248	1,125	2,78,347
c)	300 mm wide x 50 mm deep	M	748	848	6,34,219
d)	150 mm wide x 50mm deep	M	990	572	5,66,518
2.2	Supply, fabrication & installation of hot dipped GI cable ladders continuously connected with suitable size runners horizontal and vertical bends reducers, tees, cross members and suspenders and other accessories and duly suspended from the ceiling with GI suspenders etc. complete as per specifications, as required. **(Note:** where required this item shall also be used making cable cum luminaire fixing tray and for fixing bus trunking to the surface along with associated fixtures, fasteners and other fixing members as approved by employers representative in advance for this purpose.)	Kg	3,520	114	3,99,753
	Note : GI suspenders and necessary anchor fasteners or any other fabricated G.I. item of any size as approved is included in this item and shall not be paid separately				
2.3	Supply, installation and testing of sheet steel raceways in floor, fabricated from 2.0 mm thick GI with minimum coating thickness 260 gm / sq. meter on both sides with removable cover plate complete with counter sunk cadmium plated brass screws, bends, tee-junctions, cross junction etc. rendered electrially continous as approved and of following sizes				
2.3.1	200 mm wide & 50 mm deep	M	99	912	90,272
2.3.2	100 mm wide & 50 mm deep	M	66	796	52,540
3.0	**Bus Trunking**				
3.3	Supply, installation & testing of 25 A, Copper, Lighting Bus Trunking System in easy detachable and conveninet assembly suitable for 415 +-10% Volts, 3 Phase+ Single Phase, 8 Wire, 50 Hz A C System with Cu Bus Conductors of minimum 2.5 sq mm section and stainless steel / hot galvanised steel enclosure, with tap off provision every 0.5 mtr. The Lighting Bus Trunking shall be confirming to latest IEC Standards. It shall be with IP-55 Protection, halogen free and Fault Level Withstand Capacity of 2.5 kA min for 0.1 Sec (Icw) and 9.6 kA (Ipk). The Bus Trunking shall be complete with accessies like supporting clamps for Installation at Site, Fixing Clamps for lumanaries and cable & one run of Cu earthing of 25x3 sqmm. equal to phase etc as required.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a	Straight Feeder with End feed, Cover with flexible Joint 25 A	RM	484	2,675	12,94,636
b	10/16 A Single Phase Tap Off Boxes with fuse and indication.	RM	246	1,029	2,53,474
	TOTAL FOR E.03				**1,29,77,276**
E.04	**CONDUIT WIRING**				
1.1	Supply & laying of conduit and wiring for the following light / Ceiling Fan/ Exhaust Fan / Bracket fan point with 3 x 2.5 sq. mm, 1100 Volt grade PVC insulated FRLS copper condutor wires in heavy gauge GI conduit surface run with GI saddles, or concealed or in GI raceway including chases and complete with GI junction boxes, pull boxes, inspection boxes,bends & other accessories etc. including insulated Protective Earth (PE) Conductor and earthing of switch boxes excluding the cost of switches/sockets and switch boxes.as specified and as under:				
a)	First point controlled by one 6A **switch** / 10A MCB	No.	154	5,381	8,28,613
1.2	Secondary or looping points wiring as specified in 1.1 above using 3x2.5 copper (P+N+PE) wires in 25 dia GI conduit for lights, fans, socket outletsincluding providing terminal block, ceiling rose & other accessories etc as required (exlcuding the cost of switches, sockets & switch boxes) as per specifications and drawings as required	No.	550	1,174	6,45,838
1.3	Supply & laying of wiring for the following light point with 3 core x 2.5 sq. mm, 1100 Volt grade PVC insulated FR copper condutor flexible cabe in existing raceway or existing heavy gauge GI conduit surface run with GI saddles, or concealed or in MS raceway including chases and complete with GI junction boxes, pull boxes, inspection boxes,bends & other accessories etc. including insulated Protective Earth (PE) Conductor and earthing excluding the cost of MCB as specified and as under:	No.			
a)	One point controlled by 10A **MCB**.	No.	125	3,072	3,85,203
1.4	Secondary or looping points wiring as specified in 1.3 above using 3 core x 2.5 sq. mm insulated copper (P+N+PE) flexible cable in existing MS raceway for lights on Platform outlets including providing terminal block, ceiling rose & other accessories etc as required (exlcuding the cost of switches, sockets & switch boxes) as per specifications and drawings as required	No.	392	1,053	4,12,342
1.5	Supply & laying of conduit and wiring for the following 16A socket outlet point with 3 x 6 sq. mm, 1100 Volt grade PVC insulated FR copper condutor wires in heavy gauge GI conduit surface run with GI saddles.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
a)	One no. 16A socket outlet point controlled by one 16A switch.	No.	88	9,344	8,22,307
1.6	Secondary or looping 16A socket outlet points wiring as specified in 1.5 above using 3 x 4 sq. mm copper (P+N+PE) wires in 25 dia GI conduit for socket outletsincluding providing terminal block, ceiling rose & other accessories etc as required (exlcuding the cost of switches, sockets & switch boxes) as per specifications and drawings as required	No.	88	5,650	4,97,168
	NOTE :-				
	With regard to Item Nos. 1.1 to 1.6, for further clarifications, the sample measurement system to be followed is given below :-				
a)	In case of 10 nos. light fixtures looped together and controlled directly from one no. MCB in DB, quantity to be paid shall be 1 No. as per Item No. 1.1 or 1.3 as applicable and quantity to be paid shall be 9 Nos. as per item no. 1.2 or 1.4 as applicable.				
b)	In case of 5 nos. light fixtures looped together and controlled from switch located in a room, quantity to be paid shall be 1 no. as per Item No. 1.1 and quantity to be paid shall be 4 Nos. as per item no. 1.2. Conduit & wire laid from MCB in DB to first light point via switch point shall not be paid separately and is included in the rate in item no. 1.1. Same shall be the case for item nos. 1.5 & 1.6 as applicable.				
2.0	Supply& installation of following modular grid plat mounted switch/es and socket/s etc. on a suitable size mild steel electrogalvanised switch boxes complete in single or combination on prorata basis complete with the connections, earthing and testing as per specifications and as required:(Note the grid plate and MS BOX shall be selected suitably as per the requirement to fix the switches and sockets.				
2.1	1 no. 6A modular switch	Each	330	249	82,231
2.2	1 no. 6A switch & 1 # 6A socket	Each	88	282	24,839
2.3	1 no. 6A socket	Each	55	257	14,130
2.4	6/16 Amp Universal socket with 16 amp modular switch	Each	68	351	23,912
2.5	32A 3 pin industrial socket outlet with 32 A DP RCCB 30mA with MCB shall be of standard powder coated MS steel IP-55 enclosure, separately lockable.	Each	10	7,488	74,127

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.6	Supplying installation testing and commissioning of Industrial Socket with 10/25/32A DP MCB in IP 54 rated surface/recessed box with the total unit having IP 54 ingress protection with incoming & outgoing cable box for AC indoor unit complete as required.	No.	2	2,603	5,206
2.7	Supplying installation testing and commissioning of 63A TP Isolator with powder coated MS box in IP 55 rated surface/recessed box with the total unit having IP 55 ingress protection with incoming & outgoing cable box for AC outdoor unit complete as required.	No.	5	10,876	54,379
2.8	Supplying installation testing and commissioning of 5A DP Isolator with powder coated MS box in IP 55 rated surface/recessed box with the total unit having IP 55 ingress protection with incoming & outgoing cable box for AC indoor unit complete as required.	No.	28	1,939	53,335
3	Supply and installation of GI conduiting complete with GI junction and pull boxes, GI fish wires as specified and as shown below.				
3.1	25 mm dia 1.6mm thick	M	2,750	132	3,63,853
3.2	32 mm dia 1.6mm thick	M	330	193	63,674
3.3	50 mm dia 2.0mm thick	M	55	345	18,981
4	Supply, installation & testing of sheet steel raceways suspended from ceiling, as per details, fabricated from 2mm thick MS sheet with rust free treatment and painted as per approved shade with removable cover plate complete with counter sunk screws, bends, teejunctions, crossjunction etc, rendered electrically continous having side opening hinged cover as approved and of following sizes :-				
4.1	100mm wide and 75mm deep	M	11	800	8,805
4.2	Supply, installation, and testing of 3-compartment raceway of approximate size 275mm (W) x 75mm (H) fabricated from 2 mm thick galvanized steel, treated for rust free & anti-corrosion treatment, with minimum coating as per relevant I.S., and painted as per approved shade. The raceway shall be provided with openable hinged cover (s) and in 2.5m to 3.0 meter pieces. The overhead raceway is provided to fix the Light Fittings continuously on the platforms.	M	418	2,272	9,49,873
	Note: The rate is inclusive of all fixing arrangement, steel parts, welding work etc. required to suspend the raceway to platform steel structure. Contractor shall get the drawing / design of raceway approved from the Engineer before bulk fabrication.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
5	Supply & installation of 75mm x 75mm x 50mm deep G.I box,1.6 mm thick for Data & Telephone.	Nos.	11	109	1,201
	TOTAL FOR E.04				**53,30,017**
E.05	**INDOOR LIGHTING AND FANS**				
1.0	Supply, installation, testing & commissioning of light fittings including all accessories e.g. ballast, HPF condensors, lamps, holders, surface/recess mounting arrangement etc. including necessary supports, accessories and hardware as per specifications & as required at site and as below:				
A	**Luminaire minimum specifications and requirements**				
a)	Luminaires should operate at +/- 6% voltage fluctuation for continuous use to comply to IEC. PF > 0.95 for HF ballasts; for EM circuits PF > 0.85 with capacitor.				
b)	All the components including the internal wiring of the luminaries to be used shall be manufactured of material, which are of FR type. All luminaires shall be manufactured to relevant sections of IEC60598 or other approved international standards and the type tests for all luminaries shall be provided.				
c)	All internal wiring within the lighting fixtures shall be heat-resisting cables.				
d.	Light fixtures to be controlled by the suitable sensors for desired switching sequence / pattern and to contribute in making of an energy efficient system				
1.01	Supply, installation, testing and commissioning of 4' 28 W LED luminaire similar or superior as per approved make list. Luminaire should be suitable for surface mounting/ suspended made of extruded aluminium housing and CRCA front frame. The product should be suitable for direct installation on RCC with accessories with option of being suspended. (TYPE A - PUBLIC AREA, Platform Area, ASS Room, Mesh Room, Security Room, EL UPS Room, Corridor, Store Area etc.)				
a)	Supply of above given items	No	1,757	2,000	35,13,551
b)	installation, testing, commissioning of above given items	No	1,757	264	4,62,921

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.02	Supply, installation, testing and commissioning of 4', 28 W LED luminaire or superior as per approved make list. Luminaire should be suitable for surface mounting/suspended made of extruded aluminium housing and CRCA front frame. High efficiency covered luminiaire with opal diffuser. With minimum lumen output of 3250 lumens and efficacy > 60 Lm/W and CCT of 4000 K. Electronic driver should have a PF> 0.9 and THD < 25 %. (TYPE-B, Platform Edgeside)				
a)	Supply of above given items	Nos.	89	3,403	3,03,169
b)	installation, testing, commissioning of above given items	Nos.	81	164	13,307
1.03	Supply, installation, testing and commissioning of 135 mm dia. recessed 18 W LED downlighter with 1200 lumens output at 6500K color temparature and > 70 CRI. The fixture should be DLED comptact LED Engine with a die cast aluminium heat sink, a high efficacy diffuser and a PC reflector with steel clip. The fixture should have an integrated constant color driver. Fixture should be IP 20. or as per approved equivalent make list. (TYPE C, TOILET ROOM)				
a)	Supply of above given items	No	72	1,460	1,04,377
b)	installation, testing, commissioning of above given items	No	65	132	8,600
1.04	Supply, Installation, Testing & commissioning of 10W LED Bulkhead with a lumen package of 600 lumens in Cool White color. The fixture has a THD ≤ 20% and PF > 0.9 . Fixture is protected to IP 66 and IK 09 . Fixture has a housing of High pressure die cast aluminum and a front diffuser of Poly carbonate. (Type-D, LIFT AND SHAFT AREA)				
a)	Supply of above given items	No	7	1,322	8,725
b)	installation, testing, commissioning of above given items	No	7	99	655

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.05	Supply, Installation, Testing & commissioning of LED 2X2 recess mounting luminaire with Mid flux LED using efficient optics enclosed in a Metallic CRCA powder coated housing with high efficieny Lumio diffuser. It should be system lumen efficacy > 80Lumen/Watt with system level luminous flux of 3100 lumens and system wattage of 40W . 50,000 hours burning life for the system at 70% lumen maintenance with a Color rendering index > 80 and Color temperature 6500K.PF > 0.9 and THD<33%. Luminaire must be sealed from bottom and has an inbuilt gear. The luminaire should be IP 20 protected. Similar or superior as per approved list. (Type-E, SCR, TOM, EFO)				
a)	Supply of above given items	No	31	3,619	1,11,455
b)	installation, testing, commissioning of above given items	No	31	164	5,060
1.06	Supply, Installation, Testing & commissioning of 80 W LED High Bay with a system lumen output of >7300 lumens at 5700 color Temperature. The fixture is made of High Pressure Die Cast Aluminium and is protected to IP 65. Fixture has a high efficacy of 91 lm/W, a CRI > 70, PF > 0.9 and a THD < 20%. The fixture has a symmetric wide optics. Similar or equivalent as per approved list.(TYPE-F, TERRACE AREA)				
a)	Supply of above given items	No	7	14,263	94,136
b)	installation, testing, commissioning of above given items	No	7	1,427	9,417
2	**Bracket Fans**				
2.1	Supply and installations of 230 V, 1-phase, 1440 RPM, sweep of appx. 400mm Bracket fan including mounting bracket, blades, starters & other standard accessories complete as required.	No.	17	1,797	29,654
3	Supplying and installations of 230 V single phase, 1400 mm sweep ceiling fans with electronic regulators including all standard accessories complete, mounting of regulator on grid plate & MS BOX etc. and suitable length down rod, duly painted, not exceeding minimum fan height of 2.4 m from floor as required and as below.	No.	6	2,097	11,534
	TOTAL FOR E.05				**46,76,562**
E.06	**PROTECTIVE EARTHING**				
1	**50X6mm copper flat for Earth Mat @ ASS -1 Building**				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.1	Supply, laying, testing and commissioning of 50X6mm copper flat for earth mat (at 700 mm to 3000 mm deep as per approved drawing & calculations) as per specifications including lap (of not less than 150 mm) & cross weld joints and providing bitumin coat at every joint as required. Earthing risers from earth mat to be brought out as per approved drawings and specifications wherever required.	RMT	385	2,243	8,63,422
2	**30 mm dia Copper Rod for Vertical Electrodes**				
2.1	Supply, laying, testing and commissioning of 30 mm dia copper rod, laying of vertical earth electrodes 3 m deep from earth mat including weld joints with earth mat as per approved drawings and specifications. The weld joints to be provided with bitumin coats.	No.	22	15,844	3,48,576
3	**Extra for Bituminous Coating and Hessian Tape Wrap**	M	330	41	13,463
3.1	Extra for bituminous coating and hessian tape wrap or polyethylene faced hessian complete for buried earthing strips risers mentioned above in item 1.1 as per specifications and drawings as required.				
2	**MAINTENANCE FREE EARTHING**				
2.1	**Maintetance free earthing-**				
	Supply, installation and testing of copper bonded (25mmX 3Mtr) electrode chemical earth pit with hygroscopic condactive compound + soil conditioning gel including chamber with cover	NOS	7	6,737	44,463
3	**EARTHING STRIPS & CABLES**				
3.1	**Strips for Interconnecting the Earthing Stations, Panels, DBs etc**				
4	Supply and laying,Testing and commissioning of copper/GI Strips/wire for interconnecting the earthing stations ,panels,DBs etc. of the following sizes in built up trenches /surface/wall/ground complete with holes & fixing,jointing / terminating accessories as per specifications & drawing as required. (Quantity shall be paid as per the actual measurement as executed, however direct measurement shall not excced the quantity indicated in drawing approved .				
3.1	75 mm x 6 mm GI strip	M	11	293	3,226
3.2	50 mm x 6 mm GI strip	M	2,277	200	4,54,415
3.3	25 mm X 6 mm GI strip	M	6,958	110	7,67,122

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3.4	20 mm X 3 mm GI strip	M	11	63	691
3.5	8 SWG WIRE GI	M	190	15	2,938
3.6	70Sqmm single core Copper cable for clean earthing	M	165	542	89,508
	Note-1: In case of non availability of any of the sizes mentioned above, next higher size available in market shall be provided at the same rate.				
	Note-2: No additional payment will be made for providing Main Earth Terminals (made out of GI/Cu strips from within the above sizes). The METs will required to be fixed on walls as required and will be required to be provided with 12/16/20mm holes for connections of individual equipments including of other contractors'.				
4	Extra for bituminous coating and hessian tape wrap or polyethylene faced hessian complete for buried 50mm x 6mm or 75mm x 6mm strip as per specifications and drawings as required	M	1,012	41	41,285
5	Extra for GI / Electrolytic Copper test links/ termination With building pier continuity Conductor including termination plate, nut& bolts,fixing/welding etc as per specifications and as required.	No.	33	319	10,515
	TOTAL FOR E.06				**26,39,624**
E.07	**LIGHTNING PROTECTION**				
	Lightning Conductor Finials				
1.0	Supply and fixing Lightning Conductor Finials made of 25 mm dia 1mtr long copper tube having a single prong at the top with 85 mm dia 6 mm thick copper base plate, fixing accessories and clamping with down conductor as per specifications complete as required.	No.	11	817	8,987
2.0	**Stainless Steel horizontal & Vertical Conductor**				
	Supply, laying and fixing of the stainless stell horizontal & vertical conductor of following sizes on surface/wall/parapet/shaft complete with joints, bimetallic connectors, testing links & other fixing accessories and clamping/ connection with earth terminations as per specifications & drawing as required.				
2.1	25X6 mm thick SS Strip	M	1,980	463	9,16,908

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.2	25X3 mm thick SS Strip	M	110	232	25,470
3	**Testing Joints**				
	Supply and fixing of the testing joints made of 25 mm x 6 mm thick SS strip 125 mm long with 4 Nos. SS bolts, nuts, check nuts and spring washers complete as required.	M	44	269	11,837
4	**Maintetance free earthing-**				
	Supply, installation and testing of copper bonded (25mmX 3Mtr)electrode chemical earth pit with hygroscopic condactive compound + soil conditioning gel including chamber with cover	M	11	6,737	74,105
5	**Air Craft Warning Lights**				
	Supply, installation, testing & commissioning of air craft warning lights complete with non flickering type lights similar to GEC model ZH 752 or WIPRO model no. WAN 20001 or equivalent including lamps, mounting bracket, earthing, painting complete with accessories to automatically switch off lights. (Point wiring shall be done under subhead conduit wiring).	M	2	6,291	13,841
	TOTAL FOR E.07				**10,51,148**
E.08	**UNINTERRUPTED POWER SUPPLY SYSTEM**				
	Supply, Installation, Testing and Commissioning of **following rating online, UPS** system suitable for providing power supply to emergency lighting and Computerised Control panel load of approved make, suitable for incoming 415 volts, 3 phase +10 % - 20%, 50 Hz, supply and three phase output voltage, variation ± 1%, including transformer, rectifier/dual converter, static switch, inverter, filter, Bypass & static transfer switch for automatic switch over without giving any break of power, maintenance bypass switch, Micro processor/ software controlled annunciation,protection(including against input phase reversal), and menu run diagnostic module,associated cabling and connections/ terminations, erection including associated foundation/ masonorey or RCC work for mounting on base channels etc. complete as per specifications and as required.	Set	1	32,81,161	32,81,161

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	The UPS shall be a true parallel redundant with bypass with Individual Battery Bank on each UPS for 30 minutes (2X100% Redundancy on Battery Setup)				
8.1	2 X 80KVA UPS (PR System)				
8.2	Supply, Installation, Testing and Commissioning of 2V SMF VRLA lead acid sealed maintenance free battery (Design Life - 10years) suitable for 30 minutes backup to the UPS set. Battery shall comply with relevant regulations & Battery racks shall be made of acid resistant material. (80KVA UPS)				
	TOTAL FOR E.08				**32,81,161**
E.09	**DG SET WITH PLC BASED AMF LOGIC PANEL**				
A	Supplying, installation, testing & commissionin of Radiator Cooled type Diesel Generating Set comprising of multicylinder diesel oil engine with radiator, fly wheel, exhaust piping upto silencer, residential type silencer, electric starting equipments, batteries, battery charger, directly coupled to an alternator of suitable capacity at 0.8 P.F. 3 phase, 4 wire 50 Hz 415 volts, A.C supply complete with brass plate antivibration mountings foundations for installation of D.G. Set,terminating arrangement for outgoing cables, control panel,controlling MCCB etc, complete of exhaust pipe installation with support arrangement as required as per specifications, Drawings and specified ambient conditions				
	DG Sets shall be suitable for Auto Start, Auto Stop and Auto Load Management.				
	500 KVA D.G. set with canopy	Set	1	34,10,608	34,10,608
B	Supply, erection, testing and commissioning of floor mounted totally enclosed sheet steel AMF Panel with PLC suitable for automatic operation of 500 **k**VA DG set and equipped with automatic gas flooding using linear heat sensing tube type fire trace system or equivalent. The panel shall be suitable for 415 V, 3 phase, 4 wire system, **Copper bus bars** designation labels as per requirement, continuous earth bus, cable clamping supports, panel illuminating lamps, cable gland plates for incoming and outgoing feeders as per details below :	Set	1	1,13,315	1,13,315

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
(a)	INCOMING 1 nos. 1000 A, 50 kA, 4-pole ACB with microprocessor based over load and short circuit protection with time delay and earth fault IDMT release - all site settable				
(b)	**OUTGOING**				
	1no. 630 A, 50 kA, 4-pole MCCB with microprocessor based over load and short circuit protection with time delay and earth fault IDMT release - all site settable. (For Main Distribution panel).				
	1no. 400 A, 50 kA, 4-pole MCCB with microprocessor based over load and short circuit protection with time delay and earth fault IDMT release - all site settable. (For Main Distribution panel).				
(c)	1 No., 230V, AC operated integrated type Digital Multi function meter for measuring Frequency, Amperes ,Voltage, Energy & Power factor of appproved makes conforming to specifications, latest IEC/ EMC and EMI standards, with necessary Circuit MCBs and suitable size CTs for above two incomer metering supporting SCADA / BMS connectivity				
(d)	One set of ***"Battery charger"*** consisting of :				
(i)	Transformer/Rectifier				
(ii)	DC. Ammeter				
(iii)	DC. Voltmeter				
(iv)	Charging rate selector switch (OFF/Trickle/Boost.)				
(e)	One Mains supply Voltage monitor				
(f)	One set of DC Control relays incorporating engine Start/Stop, three attempts starting facility and failure to start lock out.				
(g)	One set of auxiliary relays for automatic closing and opening of the alternator contactor for automatic operation as required.				
(h)	6 nos. potential free contacts for BMS				
(I)	One selector switch Auto/Manual/ Test				
(j)	One set of the following :				
(i)	One Selector switch for engine control OFF/ON				
(ii)	Four Push buttons, Start, Stop, Reset, Test.				
(iii)	Two Indicating lamps "Load on set" "Load on Mains".				
(iv)	Five Indication on annunciator for shutdown for "Low lube oil pressure", "High water Temperature", "overspeed", "low fuel" & "set fails to starts".				
(k)	One counter to indicate number of times set has operated.				

(Attachment No-11 to Addendum No-5)
PART-D - STATION - LT

S.No.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
(l)	One **Hour meter** to indicate the number of hours set has operated				
(m)	The AMF panel shall include necessary internal wiring, control circuit fuses, labeling, name plates cable identity tags on both ends etc. complete as per specification and as required				
(n)	Power Pack for the PLC backup of the DG set with all arrangement, including battary, Control Circuits, Internal wiring, labeling, name plates cable identity tags on both ends etc. complete as per specification and as required				
C	**FUEL SYSTEM**				
a	Supplying, installation, testing and commissioning of heavy duty Hand cranking oil pump with 3 mtr. Long flexible oil hose.	Nos	2	1,145	2,290
b	Supplying, installation, testing and commissioning of 990 Day Oil fuel steel tank of under mentioned capacities made out of 5 mm thick M.S. sheet with float valve and low level alarm arrangement including fuel oil piping up to the set valves etc. complete as required.	Nos	2	8,357	16,714
c	Supplying, installation, testing and commissioning of Suitable rating Fuel Oil pump including foundations, piping, valves, indications, safety devices etc. complete as required.(Crompton / GE / Kirloskar make)	Nos	2	13,788	27,576
d	MS C class 25mm fuel pipe	Lum	1	2,683	2,683
	The Contractor scope of inspection and approval for getting the layout drawing, installation, license from Electrical Inspectorate local authority, explosive department,HERC for Campus complete as required for satisfatory function of the installation of above DG Sets				
	The contractor shall submit back-pressure calculations in support of exhaust pipe size for each DG Set.				
	TOTAL FOR E.09				**35,73,187**

(Attachment No-11 to Addendum No-5) PART-D - Station - Fire					
S.N.	**Description**	**Unit**	**Qty.**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
F.01.A	**FIRE DETECTION & ALARM SYSTEM**				
1	Supply, installation, testing and commissioning of plug-in type addressable analogue multi-criteria detectors below false ceiling including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	No.	110	1,544	1,69,798
2	Supply, installation, testing and commissioning of plug-in type addressable analogue multi-criteria detectors above false ceiling including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	No.	30	1,544	46,309
3	Supply, installation, testing and commissioning of plug-in type rate of rise cum fixed temperature addressable analogue Heat detectors including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	No.	10	1,433	14,334

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
4	Supply, installation, testing and commissioning of "2" Loop (750 Detectors, 400 Devices) (Fire Alarm Capability: 1 Loop x 99//125/150 detectors/ devices) wall recess mounting microprocessor based analogue addressable Fire Control Panel expandable by minimum 2 additional loops (Fire loop shall be closed type) with minimum 80 character LCD display, 4 access levels, 1000 events historical logging, flash E-PROM, 240 volts ac power supply, automatic battery charger, 24V SLA batteries suitable for operating the entire system including the talk back units and the hooters/strobes for a minimum of 4 hours in battery condition. The Panel shall have suitable power amplifiers for hooter/strobes. The Panel shall be capable of being Integrated with the BMS System and shall include cost of supply and installation of any additional modules or interfaces required for the same. The panel shall be complete of being Integrated with the BMS System and shall include cost of supply and installation of any additional modules or interfaces required for the same.The pannel shall be complete as per specifications and as required.	No.	1	7,88,822	7,88,822
5	Supply, installation, testing and commissioning of Repeater panel including the cost of mounting accessories complete as per specifications and as required	No.	1	27,409	27,409
6	Supply installation testing and commissioning of dust and vermin proof addressable analogue Manual Call Boxes to initiate audio visual alarm including the cost of mounting accessories complete as per specifications and as required.	No.	18	2,315	41,678
7	Supply installation testing and commissioning of addressable analogue Talk Back jacks with face plates for Fireman's Handsets to initiate audio conversation with Main Fire Alarm Panel including the cost of mounting accessories complete as per specifications and as required.	No.	6	5,042	30,254
8	Supply, installation, testing and commissioning of Wall/ Ceiling mounting strobes for visual indication including the cost of mounting accessories complete as per specifications and as required.	No.	18	1,213	21,831

(Attachment No-11 to Addendum No-5) PART-D - Station - Fire					
S.N.	**Description**	**Unit**	**Qty.**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
9	Supply, installation, testing and commissioning of Control Modules including the cost of mounting accessories complete as per specifications and as required.	No.	18	2,315	41,678
10	Supply, installation, testing and commissioning of Monitor Modules including the cost of mounting accessories complete as per specifications and as required.	No.	15	2,315	34,731
11	Supply, installation, testing and commissioning of Fault Isolator Modules including the cost of mounting accessories complete as per specifications and complete as required.	No.	15	2,095	31,424
12	Supply installation testing and commissioning of two way Talk Back handsets to initiate audio interface complete as required.	No.	4	9,765	39,061
13	Supply, installation, testing and commissioning of wall or ceiling mounted 240 Volt AC illuminated double sided pictorial exit signs provided with appropriate direction arrow painted in green on white with an 11W CFL Lamp including the cost of in-built rechargeable batteries with charger suitable for 90 minute operation and including the cost of accessories for surface/ recessed or ceiling suspended mounting complete as required.	No.	16	4,725	75,603
14	Supply, installation, testing and commissioning of Response Indicator Lamp assembly in a dust tight sheet steel enclosure as per detailed specifications including accessories for recess mounting as per approved sample as required.	No.	20	191	3,823
15	Supplying, Laying, Termination, Testing and commissioning of size **2C x 1.5** sq mm twisted pair Screened Fire Survival cables complying with BS 7846 catagory CWZ.	Mtrs.	3,100	189	5,86,916
16	Supplying, Laying, Termination, Testing and commissioning of size **2C x 2.5** sq mm twisted pair Screened Fire Survival cables complying with BS 7846 catagory CWZ.	Mtrs.	10	316	3,155

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
17	Supplying, installing, testing and commissioning of following sizes 16 gauge GI conduits recessed/surface as required including clamps, hardwares etc required for conduiting arrangement complete as per specifications. (Quoted price shall include GI flexible conduits to connect from ceiling to false ceiling)			-	-
a)	20 mm dia	Mtr.	100	185	18,482
b)	25 mm dia	Mtr.	2,200	197	4,33,872
	TOTAL FOR F.01 A				**24,09,178**
F.02	**FIRE HYDRANT SYSTEM**				
1	Supply, installation testing and commissioning of fire pumps, electrically driven generally as specified and shown in equipment schedule complete with:				
i)	all accessories				
ii)	vibration mounts				
iii)	test connection excluding starter panel				
iv)	The pump heads specified on the Drawings and / or Equipment Schedules are for guidance and information only and are calculated based on assumed equipment pressure drops. The exact pump head based on the pipe run and the offered equipment shall be carefully checked and re-calculated for each pump before ordering the equipment. Calculation shall be submitted for approval. No modification to the piping system shall be allowed without prior approval. Any additional cost for the modification of the system (pumps, motors, switchgears, cables, panel boards, switchboards, etc.) necessary to meet the specified duties, special conditions and the offered equipment shall be provided at no extra cost to the Employer.				

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
1.1	**Hydrant & Sprinkler Fire Pumps**				
	Supply, installation, testing and commissioning of electrically driven multistage, single outlet high pressure centrifugal type fire hydrant /sprinkler pump, suitable for automatic operation consisting of the following:				
	Horizontal multistage, single outlet, **Split casing** centrifugal pump, suitable for operation on 415 volts ± 6%, 3 phase, 50 HZ AC supply. The installation shall be complete with flexible coupling and coupling guard as required. Fire pump shall have CI casing, CS diffusers, bronze impeller (hard finished and dynamically balanced) and SS (304) shaft with mechanical seal, capable for **delivering 2850 LPM at outlet head of 70 mtrs.** to ensure a minimum pressure of 3.5 Kg/Sqcm at the farthest or topmost hydrant / sprinkler. The installation shall be complete with necessary pressure gauge on delivery side.				
	Squirrel cage induction motor, TEFC type suitable for operation on 415 volts, 3 phase 50 HZ A.C supply, for the above pump with synchronous speed of **2900 RPM,** conforming to IP 55 protection & class F insulation. The motor shall conform to IS 325-1978 (up to date).				
	Common base plate for (a) and (b) from M.S. Channel for required size.	Each	4	2,31,543	9,26,170
1.2	Supply, installation, testing and commissioning of **Jockey pump** (pressurisation pump) comprising of the following:				
	Vertical centrifugal pump, suitable for operation on 415 volts ± 6%, 3 phase, 50 HZ A.C supply. The installation shall be complete with Flexible coupling and coupling guard, complete as required.				
	The pump casing shall be SS, shaft shall be SS & impeller/ shaft sleeve/casing wearing ring shall be bronze. The pump shall be provided with mechanical seal The system shall be complete with necessary pressure gauge with gun metal shut off cock on delivery side.				

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Squirrel cage induction motor TEFC type for operation on 415 V, 3 phase 50 Hz AC supply for the above pump with a synchronous speed of **2900 RPM** as required.				
	Common base plate for (a) and (b) from M.S. channel as required size.				
	For pump defined above & of duty as follows :				
	Flow : **180 LPM**				
	Head : **70 MTRS**	Each	2	82,694	1,65,388
1.3	Supply, installation, testing, trial run and commissioning of hydrants all complete as required and as approved				
	Internal hydrants / landing valves generally as specified and all complete with:	Set	17	25,049	4,25,829
	i) 63mm dia Single headed landing valve IS marked (Stainless steel)				
	ii) First aid hose reel with 25 mm dia, 45 m long Reinforced Rubber Lined (RRL) as per IS 12585 rubber hose, ball valve, piping and 7-8 mm nozzle as required				
	iii) 63 mm synthetic synthetic hoses (UL Listed) with 63 mm instantaneous SS coupling, IS marked- 15 m x 2 lengths with suitable arrangement of connecting the hose pipe with coupling as required.				
	iv) 1 no. branch pipe and nozzle IS marked (Stainless steel)				
	v) Pressure gauge (SS casing) with stop cock.				
	vi) Glass door as per following descriptions :				
	Pre fabricated 4 mm thick glass door (with SS frame)				

(Attachment No-11 to Addendum No-5) PART-D - Station - Fire					
S.N.	**Description**	**Unit**	**Qty.**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
	Size 2100 x 900 in 2 mm thick stainless steel sheet				
	vii)Fire man AXE with heavy rubber handle as complet.				
1.4	Supplying and fixing of stainless steel hose cabinet of size 900 mm x 600 mm x 450 mm made of 2 mm thick with 6mm thick glazed glass doors including necessary locking arrangement suitable and including with external hydrants valves, with butterfly valve 2 nos 63mm dia synthetic hose pipe 15 m long, 1 no branch S.S. pipe with 4 nos MS angle (40 x 40 x 8) supports grouted in floor and duly coated with post office red external and white internal paint complete in all respects.	Each	2	10,585	21,170
1.5	Supply and Installation of Orific Plate complete as required -80 to150 mm Dia.	Each	11	1,544	16,980
1.6	Providing and fixing double flanged flexicion rubber expansion joint with unit control of standard length of a as per manufacturer specs tested to a pressure of 15kg/sqcm including rubber gasket, flanges,nuts ,bolts and washers complete as required.				
1.6.1	80 mm dia	Each	4	9,151	36,606
1.6.2	200 mm dia	Each	8	20,729	1,65,829
	TOTAL FOR F.02				**17,57,970**
F.03	**PIPING FOR FIRE FIGHTING SYSTEM**				

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3.1	Supply, fabricating, laying, testing, painting and commissioning of external piping (UNDERGROUND) generally as specified using heavy class G.I conforming to IS:3589 & IS1239 with all fittings at a depth of 1.0 M all complete with one protection layer of 4mm thick Pypkote or similar				
	i) All pipes and all heavy grade fittings conforming to IS:3589 & IS 1239 together with welded joints, flanges, gaskets, bolts & nuts, washers, fittings, adapter pieces etc.				
3.1.1	200 mm nominal bore	M	10	2,955	29,549
3.1.1	150 mm nominal bore	M	1,800	2,150	38,70,068
3.1.2	100 mm nominal bore	M	20	1,522	30,431
3.1.3	80 mm nominal bore	M	80	1,125	89,971
3.2	Excavation and backfilling as per general profiles and back filling for all kinds of soil.	Cu.m	3,500	121	4,24,495
3.3	Supply,fixing, testing and commisioning of Butterfly Valves PN 16,with Bronze/Gunmetal seat duly ISI marked with nuts bolts ,washers , Gaskets conforming to IS 13095 of Following size as required .				
3.3.1	250 nominal bore	Each	2	22,603	45,206
3.3.2	200 nominal bore	Each	3	16,208	48,624
3.3.3	150 nominal bore	Each	20	6,505	1,30,105

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3.3.4	100 nominal bore	Each	5	4,521	22,603
3.3.5	80 nominal bore	Each	20	3,528	70,565
3.3.6	65 nominal bore	Each	10	3,197	31,975
3.3.7	Providing , Installation , testing and commisioning of dual plate Non Return valve Confirming to IS :5312 complete with rubber gaskets ,GI bolts ,nuts washers etc as required of 150 mm dia	Each	5	14,685	73,425
3.3.8	Providing , Installation ,testing and commision of dual plate Non Return valve Confirming to IS :5312 complete with rubber gaskets ,GI bolts ,nuts washers etc as required of 80 mm dia	Each	2	12,349	24,698
3.3.9	Providing , Installation ,testing and commision of dual plate Non Return valve Confirming to IS :5312 complete with rubber gaskets ,GI bolts ,nuts washers etc as required of f 65 mm dia	Each	2	5,969	11,939
3.3.10	100 mm dia gun metal / ss Draw Out connection with foot valve for Fire Brigade.	Each	1	6,259	6,259
3.3.11	Constructing masonry chamber 90x90x100 cm, inside with 75 class designation brick work in cement mortar 1:5 (1 cement: 5 fine sand) for sluice valve, with C.I. surface box 100mm top diameter, 160mm bottom diameter and 180mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (one cement ratio two coarse sand ratio 4 graded stone aggregate 20mm nominal size) necessary excavation foundation concrete 1:5:10 (one cement ratio 5 fine sand ratio 10 graded stone aggregate 40mm nominal size) and inside plastering with cement morter 1:3 (1 cement ratio 3 coarse sand) 12mm thick finished with the flaoting coat of neat cement complete as per standard design				
	With F.P.S. bricks	Each	2	13,612	27,225
4	**INTERNAL PIPING**				

(Attachment No-11 to Addendum No-5) PART-D - Station - Fire					
S.N.	**Description**	**Unit**	**Qty.**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
4.1	Supply, fabrication & laying heavy grade IS marked G.I piping conforming to IS 1239 and IS 3589 complete with G.I fittings, pipe supports, clamps, painting of two coats of red enamel etc. as approved with welded jointing for Wet Riser system.				
4.1.2	25 mm nominal bore	RMT	500	342	1,70,900
4.1.3	32 mm nominal bore	RMT	250	441	1,10,258
4.1.4	40 mm nominal bore	RMT	150	496	74,424
4.1.5	50 mm nominal bore	RMT	100	695	69,463
4.1.6	65 mm nominal bore	RMT	50	816	40,796
4.1.7	80 mm nominal bore	RMT	300	1,025	3,07,621
4.1.8	100 mm nominal bore	RMT	250	1,411	3,52,827
4.1.9	150 mm nominal bore	RMT	2,500	2,205	55,12,917
4.1.10	200 mm nominal bore (6 mm wall thickness)	RMT	20	2,701	54,027
4.1.11	250 mm nominal bore (6 mm wall thickness)	RMT	10	3,363	33,629

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
5	supply, installaiton ,Providing, fixing, testing and commissioning of precharged air vessel (size 450 mm dia & 2000 mm height) for pressurization of hydrant / sprinkler system complete with adequate pressure switches (as per design/requirement) with valves to operate as per operating sequences including 25 mm dia drain valve, air release valve with stop cock on the top, 100 mm dia inlet with isolating valve duly painted from inside and outside complete as required.	Each	1	31,061	31,061
6	Providing and fixing **200 mm** MS body Pot Strainer with stainless steel perforated sheet basket tested to a pressure of 15kg/sqcm, including rubber gasket, flanges, nuts, bolts and washers, complete as required.	Each	2	25,690	51,380
7	Providing and fixing 80 **mm** MS body Pot Strainer with stainless steel perforated sheet basket tested to a pressure of 15kg/sqcm, including rubber gasket, flanges, nuts, bolts and washers, complete as required.	Each	1	7,167	7,167
8	Supply, installation, testing and commissioning fire brigade connection with 4 way 63mm valves inlets, stand post and 150 mm G.I. pipe for mounting the stand post etc. as specified all complete as approved . **Note:** The drawings of the proposed arrangement shall be provided by the contractor for approval of employer's representative.	Each	1	16,870	16,870
9	Supply, installation, testing and commissioning Siamese connection with 4-way 63-mm outlets with non-return valve and butterfly valve etc. complete as required at road level cabinets. **Note:** The drawings of the proposed arrangement shall be provided by the contractor for approval of employer's representative.	Each	2	22,823	45,647
10	Providing & fixing single acting Air release valve with brass gate valve, flanges/ union, suitable for wet riser system with all necessary connections.				
a)	25 mm dia	Each	4	1,985	7,939

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
11	The rate shall include supply and fixing **Gun metal ball valve** CI hand wheel suitable for pressure 15 Kg/sqcm. and confirming to relevant IS of the following size including providing necessary union/flange and making proper connection for air testing and drainage system.				
11.1	25 to 40 mm nominal bore	Each	3	2,315	6,946
11.2	50 mm nominal bore	Each	3	3,118	9,354
	TOTAL FOR F.03				**1,18,40,361**
F.04	**SPRINKLER SYSTEM**				
1	Supply, installation, testing and commissioning of 150 mm dia control valve inclusive of 1 no 150 mm dia butterfly valve, trainer, alarm valve with water motor gong, pressure gauges, test line with ball valve with necessary GI (H) Piping with threaded fittings of required pipe sizes complet. the item also includes providing and fixing 100 mm dia pressure gauges on sprinkler headers including ball valves, test control box brass strainer retard chamber	Set	1	55,129	55,129
2	Providing, fixing, testing and comissioning of UL listed Pendent/Upright type sprinkler head rated at 68 degree centigrade.	Each	550	331	1,81,926
3	Providing and fixing sprinkler drain with 25 mm dia ball valve.	Each	1	1,058	1,058
4	Providing and fixing UL listed Flow Switch of 80 / 100 / 150 mm dia on Sprinkler Header complete with flexible full bore paddle, U clamp and NO / NC contact terminals	N0	40	5,733	2,29,337
	TOTAL FOR F.04				**4,67,451**
F.05	**PORTABLE FIRE EXTINGUISHERS**				

(Attachment No-11 to Addendum No-5) PART-D - Station - Fire					
S.N.	**Description**	**Unit**	**Qty.**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
1	Supply and installation of portable fire Extinguishers as described below:				
1.1	9 litre capacity of water CO_2 type, IS marked, with discharge tube including clamps etc.	Each	12	1,874	22,493
1.2	Carbon dioxide extinguisher conforming to relevant IS with high pressure discharge tube, horn, control valve, IS marked including clamps etc.				
	4.5 kg capacity extinguisher	Each	40	4,521	1,80,824
1.3	Mechanical foam type 9.0 liter capacity fire extinguisher (for DG room)	Each	2	1,654	3,308
1.4	Providing and fixing fire extinguishers water type of Capacity 9 liter with internal plastic fitting and ISI marked as per IS-940 with Gun metal Cap Co2 cartridge and Initial refil.	Each	2	1,874	3,749
1.5	Providing and Fixing Co2 gas type trolley mounted fire extinguisher of capacity 22.5 kg with ISI marked and as Item IS 2878with discharge nozzle and initial refil.	Each	2	14,223	28,447
1.6	Providing and fixing trolley mounted fire extinguisher of capacity 50 liters with IS marked as per IS 13385 or Equivalent Standard with nozzle and Initial refil.	Each	1	6,505	6,505

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2	Providing and fixing set of 4 fire buckets capacity 9 ltrs fabricated from 24 gauge MS sheet brackets filled with jamuna sand, two coats of anti corrosive paint inside and outside and two coats of white enamel inside and two coats of postal red enamel outside with " FIRE" marked on each bucket, including M.S. fabricated 4 bucket standard size with 4 hooks. For Hanging buckets including painting with two coats of anti corrosive primer and two coats of postal red enamel on all surfaces of approved quality and make complete in all respects.	No.	4	1,991	7,962
	TOTAL FOR F.05				**2,53,287**
F.06 A	**CLEAN AGENT BASED PANEL FLOODING SYSTEM FOR ELECTRICAL PANELS.**				
	Supply, fixing, testing and commissioning of UL 521, UL listed Polymer Tube Detection based Clean Agent **Fire Suppression** System for Electrical Panels, consisting of the following components:				
1.1	Direct Low Pressure Clean Agent system **10 LBS** capacity, complete with Clean agent) **(NOVEC 1230 or equivalent)**, D.O.T/TC approved Cylinder, nickel plated brass valve with slip on union connector, isolation valve, plug pressure switch port and 195 psi Pressure gauge fittings, operating pressure 195 psi (13.45 Bar) at 70 Deg F, supplied complete with Bolt Pattern Bracket and:**INCLUDING**	NO.	8	87,435	6,99,479
	Fill Port				
	Outlet Port				
	End of Line Adaptor				
	Pressure switch				
1.2	Flexible 4/6mm UL 521, UL listed Polymer Detection Tube 195 Deg C rated complete with all necessary fittings & supports.O make each entire system functional - 2 Nos.	Mtrs.	400	1,047	4,18,982
1.3	System Indication & Control Unit (SICU) integrated panel for indicating the Health and operational status of the system, complete with ports to interface pressure switch, Audio visual Alarm unit, and output to FACP and BMS/ SCADA System including all necessary accessories.	NO.	8	15,436	1,23,489

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2	Direct Low Pressure Clean Agent system **5 LBS** capacity, complete with Clean agent **(NOVEC 1230 or equivalent)**, D.O.T/TC approved Cylinder, nickel plated brass valve with slip on union connector, isolation valve, plug pressure switch port and 195 psi Pressure gauge fittings, operating pressure 195 psi (13.45 Bar) at 70 Deg F, supplied complete with Bolt Pattern Bracket and:**INCLUDING**	NO.	8	80,819	6,46,555
	Fill Port				
	Outlet Port				
	End of Line Adaptor				
	Pressure switch				
2.1	Flexible 4/6mm UL 521, UL listed Polymer Detection Tube 195 Deg C rated complete with all necessary fittings & supports.o make each entire system functional - 2 Nos.	Mtrs.	400	1,047	4,18,982
2.2	System Indication & Control Unit (SICU) integrated panel for indicating the Health and operational status of the system, complete with ports to interface pressure switch, Audio visual Alarm unit, and output to FACP and BMS/ SCADA System including all necessary accessories.	NO.	8	15,436	1,23,489
	NOTE: The items indicated above are notable items. The vendor to include all allied and implid items in required quantity at no extra cost.				
	TOTAL FOR F.06 A				**24,30,976**
F.07	**CLEAN AGENT FIRE SUPPRESSION SYSTEM - TOTAL FLOODING**				
	SIGNALLING EQUIPMENT ROOM (SER), TELECOM EQUIPMENT ROOM (TER) AND S&T UPS ROOM				
1	80 Ltr Cylinder/Valve Assembly & Pressure Gauge (CCOE approved) including piping in compliance to the requirements specified in clause no.4.2.1 of NFPA-2001	Nos.	3	1,23,697	3,71,090
2	Clean Agent (FM200/Novec 1230/Equivalent) filled in above cylinder (Kgs)	Kgs	250	3,258	8,14,464

(Attachment No-11 to Addendum No-5)
PART-D - Station - Fire

S.N.	Description	Unit	Qty.	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3	Master cylinder kit comprising Solenoid actuator, Manual actuator, adapters, discharge hose, warning sign etc.	Nos.	3	67,193	2,01,580
4	Discharge nozzles	Nos.	3	6,872	20,616
5	Cylinder bracket	Nos.	3	1,909	5,727
6	Gas release Panel including smoke detector ,MCP , Abort switch & Strobe cum sounder	Nos.	3	2,41,477	7,24,431
	TOTAL FOR F.07				**21,37,908**
F.08	**MISCELLANEOUS FIRE SERVICES EQUIPMENT**				
1	Self- contained open circuit type compressed air Breathing apparatus set confirming to EN-137:1993 , standard complete with one spare cylinders,	Set	2	1,21,284	2,42,568
1.1	Air cylinder with valve				
1.2	Back plate with body harness				
1.3	Face mask				
1.4	Pressure reducer				
1.5	Lung demand valve				
1.6	Pressure gauge & warning whistle				
1.7	Hoses				
1.8	Carrying case				
1.9	Spare air cylinder				
1.10	One wall mounted cabinet to store the above breathing apparatus & associated equipments				
	TOTAL FOR F.08				**2,42,568**

(Attachment No-11 to Addendum No-5) PART-D - Station - Fire					
S.N.	**Description**	**Unit**	**Qty.**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
F.09	**TRANSFORMERS PROTECTION SYSTEM :**				
1	Design, Supply, Installation, Testing & Commissioning of fire protection system for transformers comprising of the following:				
1.1	45 Kg capacity CO_2, IHP Valve Assembly with automatic valve, push in connector for tube, 45 Kg CO_2 gas & mounting bracket.	Nos.	2	**89,082**	**1,78,164**
1.2	End of Line adapter	Nos.	2	**3,818**	**7,636**
1.3	Pressure Switch	Nos.	2	**8,272**	**16,544**
1.4	Linear pneumatic heat Detection Tube with all necessary fittings & supports.	RM	40	**1,527**	**61,085**
1.5	Master Control Unit for controlling each system, complete with pressure switches, buzzers and electronic hooters, including all necessary accessories + electrical wiring to make each entire system functional.	Nos.	2	**15,271**	**30,542**
1.6	Auto weight measuring unit for cylinders with automatic audio/visual alarm.	Nos.	2	**13,999**	**27,997**
1.7	Discharge Hose With Two nozzle Kit	Set	2	**26,769**	**53,538**
	TOTAL FOR F.09				**375506**
F.10	**VESDA SYSTEM FOR SER,TER,UPS ,SCR & UPS & EM ROOM**				

(Attachment No-11 to Addendum No-5) PART-D - Station - Fire					
S.N.	**Description**	**Unit**	**Qty.**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
1	Laser-Based Absolute Smoke Detection system with single inlet aspiration detector for Up to 250 m2 (2500 sq. ft.) coverage; Wide sensitivity range - 0.025%–20% obs/m; 3 alarm levels ; High efficiency aspirator; Clean air barrier optics protection; Easy to replace dual stage filter; 3 Nos of inbuilt potential free relay outputs;supports linear pipe length of 25m or branched pipe up to 30m; supports 10 Nos of EN54 Class A sampling points, AutoLearn for automatic setup of alarm threshold, Referencing & Event log; . Approvals-UL, ULC, FM, ActivFire, VdS, CE , EN54-20. **VESDA Laser Focus Detector with display - VLF 250 (SER,TER,UPS & UPS & EM ROOM)**	Nos.	5	2,52,301	12,61,503
2	Capilllary sampling point set for sampling from below false ceiling (room) **E700-TA+CSC+CT+SP+SPLR**	Nos.	10	3,161	31,611
3	Power Supply units for VLF detectors - Power supply unit operate on 230 volts AC mains input & provide 24 to 30 volt DC output for powering up the detector, support battery backup in case of AC mains failure & have built in charging circuit for batterys. **VESDA Model - VPS 220E**	Nos.	5	15,577	77,883
4	Sampling Pipe - Smooth bore UPVC or CPVC or ABS Pipe 25mm Outer Dia & 19 to 21mm Inner Dia with all required bends joints & accesorys (approx qty of pipe)	RM	150	211	31,688
	TOTAL FOR F.10				**14,02,685**
	TOTAL				**23317891**

(Attachment No-11 to Addendum No-5)
PART-D AAREY STATION BMS

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
C	**BUILDING MANAGEMENT SYSTEM (BMS)**				
1	**Workstation in Station Control Room (SCR) Aarey Station**				
1.1	BMS Workstation shall comprise of the following minimum hardware: Intel Dual Core 3.2 GHz processor, 4 GB of RAM, Dual Screen 22" LED Color Display, 108 Keys - Keyboard, Optical Scrolling Mouse and Pad, 500 GB HDD 2 SATA Hard Disk Drive DVRCombo Drive, Built in dual gigabit port RAID controller, Graphics Card – Nvidia Quadro K6000 graphics or equivalent for High Quality BMS Graphics, Removable storage device (DVD - Read/ Write), Minimum 8 X Speed. 2 Nos. USB 2.0 port, 1 Centronic parallel port Minimum 4 USB port, 2parallel Port, 2 Serial Port, Dual LAN Card, License copy of MS office & antivirus software and with all the required software SQL server Fully Redundant Power Supply & Fan Unit 100/1000Mbps network card as per Tender Specifications/relevant standards/as per direction of engineer-in-charge. 132 Column 240 CPS Printer 500 VA UPS with half an hour battery backup	No	1	1,69,690	1,69,690

(Attachment No-11 to Addendum No-5)
PART-D AAREY STATION BMS

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2	**BMS Equipment & Local/Distributed IO's**				
2.1	**PROGRAMMABLE & APPLICATION SPECIFIC CONTROLLER (PLC) - UL LISTED** SITC of Programmable and Application specific 32 bit, Supplyig, Installing, Testing & Commisioning of Programmable Logic Controllers with following specifications 1) Two identically- configured PLC processors are connected in a "Hot Standby" arrangement as "Master" and "Standby" so that when a component of the Master PLC fails, the standby PLC will take over automatically without interrupting the plant operation. 2) 32 bit CPU module with Ethernet Port for Programming / SCADA applications 3) Program Execution watching 4) Built-in hardware real-time clock 5) Semi conductor memory 6) Input supply 240V 7) Power consumption not more than 5kVA 8) CPU Processor module with Ethernet Port for Programming / SCADA applications The PLCs will be able to continuously operate under the following environment conditions a) Operating temperature: 0 to 40 deg. C b) Relative humidity: upto 95% All the PLCs and allied equipments shall be supplied, installed and commisioned with metal enclosure complying to the Electro - Magnetic Compatibility as per the Technical Specification- with metal enclosure complying to the Electro - Magnetic Compatibility as per the Technical Specification-BMS Systems. The CPU shall have the following key features - a) Industrial type and 2 identical CPU's b) RS 485 port c) Separate Hard disk (Internal Memory) for individual CPU's All PLC Controller input modules served equipment from outside are protected against voltage transients. All input/output modules are galvanically separated from CPU & internal bus. It is protected against short circuit and it is connected via separate terminal strip. PLCs shall be designed by taking 30% of spares in I/O's signals with Mounting cabinet. The PLC shall be designed to handle the IOs in accordance with the IO signals given below.	LOT	1	83,27,938	83,27,938

(Attachment No-11 to Addendum No-5)
PART-D AAREY STATION BMS

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
2.2	The same shall be consdered as a cumulative no of IOs as per the RIOs detailed below PLC for Station - Supply, Testing and Commissioning of Redundant Remote Input Output modules including IO racks compatible for communication protocols like (Modbus, Profibus, Ethernet, TCP-IP etc.,) with PLC's or Operating System. It shall be of communicating all station I/O's with the LSC. It should be supplied with wheather proof tight enclosure and shall comply to intrinsically safe if used in Hazardous area. Shall be of IP 55 and RIO cubicle shall be mounted on the base frame made of galvanised sheet channel with a minimum height of 100mm. The RIO's will be able to continuously operate under the following environment conditions. a) Operating Temperature: 0 to 40 deg. C b) Relative Humidity: upto 95% All the RIOs, allied equipments including interconnections shall be supplied, installed, tested and commisioned with metal enclosure complying to the Electro - Magnetic Compatibility as per the Technical Specification - BMS Systems, Analogue Input, Analogue Output, Digital Input, Digital Output, Soft IO, etc. shall accomodate complete integration upto 1000 points Touch Screen LCD type Local control Panel directly mounted on the PLC Housing itself, with screen Guard protection A By-pass switche/s shall be provided to completely by-pass the PLC in the event of a total failure of the PLC and associated equipment to enable the normal operation of the equipment controlled by the PLC. Panels shall be fitted with a suitable pocket to contain circuit diagrams and other relevant definitive design drawings.				

(Attachment No-11 to Addendum No-5)
PART-D AAREY STATION BMS

S.N.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
3	**LASER PRINTER**				
3.1	A hard-copy multi-color graphics Laser Printer shall be provided for recording graphic displays and associated dynamic data. Printer shall meet minimum requirements as follows: Print speed – Black: up to 22 ppm; color: up to 4 ppm First page out – 18 seconds black, 29 seconds color Resolution- 600 by 600 dpi Hi-Speed USB 2.0, IEEE 1284-B compliant parallel port Languages – PCL 6 and Postscript level 3 emulation with automatic language switching Font capabilities – 80 TrueType TM internal scalable PCL 6 fonts; 80 TrueType internal scalable HP postscript fonts	No	1	48,383	48,383
4	**SENSORS AND FIELD DEVICES**				
4.1	Supplying, Installing, Testing and Commissioning of the following sensors / transducers / transmitters				
a	UL Listed Current Relay with built in LEDs for On / Off commands Status	No	15	1,734	26,015
b	Water Level Switches for indicating Level Status in sumps.	No	6	9,524	57,145
c	Differential Pressure Switch across the Pumps for indicating the Pump status of Pumps complete with all accessories	No	9	14,514	1,30,630
d	DC Voltage Transducer	No	2	14,378	28,755
e	Level Sensor	No	2	62,910	1,25,820

(Attachment No-11 to Addendum No-5) PART-D AAREY STATION BMS					
S.N.	**Description**	**Unit**	**Qty**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
f	Flow Switch	No	6	4,094	24,562
5	**WIRING AND CONDUITING**				
	1100v grade armoured XLPE FR ZH Copper (CU) Conductor STP Cable screend control cables on existing trays/walls/columns/indoor/trenches including the cost of support with suitable clamps, hooks, bolts etc and including the cost of proper dressing of cables.				
5.1	2C X 1.5 Sq.mm	Mtr	400	125	49,988
5.2	4C X 1.5 Sq.mm.	Mtr	200	191	38,138
5.3	12C X 1.5 Sq. mm	Mtr	110	504	55,461
	1100v grade SS armoured Fire Survival Cable tested to IEC-331 for circuit integrity under fire at 750 deg C for three hours, ZH Copper (CU) Conductor STP Cable screend control cables on existing trays/walls/columns/indoor/trenches including the cost of support with suitable clamps, hooks, bolts etc and including the cost of proper dressing of cables.				
5.4	2C X 1.5 Sq.mm	Mtr	300	142	42,662
5.5	4C X 1.5 Sq.mm.	Mtr	150	221	33,128
5.6	12C X 1.5 Sq. mm	Mtr	100	560	56,021
5.7	Supply and laying of 4 pair cat-5 cable as required in heavy guage GI Conduit	Mtrs	600	49	29,108

(Attachment No-11 to Addendum No-5) PART-D AAREY STATION BMS					
S.N.	**Description**	**Unit**	**Qty**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
5.8	Flexible PVC Flexible conduit for termination in the PLC Panels	Mtrs	550	41	22,438
					92,65,883

(Attachment No-11 to Addendum No-5) PART-D - VAC WORKS (Basement Ventilation for At Grade Aarey Station)					
Sl.No	**Item Description**	**Unit**	**Qty**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
H.04	**Aarey Basement Ventilation And Smoke Extraction (JetVent Fan)**				
a	**Design, Supply , Installation & Testing of Basement Ventialtion :**				
	Supply, erection, testing & commissioning of high efficiency Vane axial flow fans complete with hot deep galvanized steel casing, backward curve aerofoil impeller for atleast 70% efficiency, motor with Class 'H' insulation for smoke extraction (shall be capable of working at 300 deg. C for two hrs. continuously). The entire fan shall be factory assembled. Each fan & motor assembly shall be suitable for operation on 415 ± 10%V, 50 Hz, 3-ph AC power supply and capable to withstand 300 deg. C temperature for minimum duration of two hrs. The fan shall have to be AMCA certified for performance and sound bearing AMCA seal. Minimum efficiency of the Axial fan should be 70%.The fan should be EN certified and CE labeled or UL listed. The fan noise level cannot exceed 80 dba @ 3 m from the fan in hemispherical surface. The fan supports and fasteners shall have to galvanized. Fan shall have the following parameters:				
	capacity each : 16,600 CFM, 15 mm w.c. Static pressure	No	8	2,23,758	17,90,061
	The static requirement needs to be checked after the final installation drawings are ready.				
b	**Vane Axial flow fans for the fresh air requirement Lower basement**				
	Supply, erection, testing & commissioning of high efficiency tube axial flow fans complete with hot deep galvanized steel casing, backward curve aerofoil impeller for maximum efficiency, motor with Class 'F' insulation. The entire fan shall be factory assembled. Each fan & motor assembly shall be suitable for operation on 415 ± 10%V, 50 Hz, 3-ph AC power supply. The fan noise level cannot exceed 80 dba @ 3 m from the fan in hemispherical surface. The fan supports and fasteners shall have to galvanized. The fan shall have to be AMCA certified for performance and sound bearing AMCA seal. Minimum efficiency of the Axial fan should be 70%.Fan shall have the following parameters:				
	capacity each : 16,600 CFM, 15 mm w.c. Static pressure	No	4	1,33,623	5,34,492
	The static requirement needs to be checked after the final installation drawings are ready.				

(Attachment No-11 to Addendum No-5) PART-D - VAC WORKS (Basement Ventilation for At Grade Aarey Station)					
Sl.No	**Item Description**	**Unit**	**Qty**	**Unit Price (Rs)**	**Total Amount (Rs)**
1	**2**	**3**	**4**	**5**	**6**
c	**Impulse Jet Fans**				
	Supply, erection, testing & commissioning of jet fan as per specification suitable for normal ventilation & smoke extraction application. Minimum diameter of jet fan shall be 350 mm. Each fan shall be complete with motor & impeller. Unit shall be complete with silencer at suction & delivery side. The entire unit shall be factory assembled. Complete fan assembly shall be certified as "Tested for 300 deg. C for two hrs. operation". The motor shall be suitable for operation on 415 ± 10%V, 50 Hz, 3-ph air supply. The fan shall operate at dual speed deliverying at least 10 N at low speed and 40 N at the higher speed. Capacity - 4314/2157 CFM	No	16	1,03,132	16,50,104
d	**Carbon Monoxide Sensors**				
	Supply, erection, testing & commissioning of CO sensors for sensing carbon momoxide in basement. The sensors shall operate within the measuring range of 0-300 ppm CO, IP 44 protected housing, electro-chemical sensor cell, proportional output, 2-wire loop current connection. Response time shall not be more than 90 secs. Sensor cell shall be filled replacable plug in type. The unit shall be capable of working during fire also and capable of operation in 24V DC/AC power supply.	NO	8	15,908	1,27,260
e	Supply, erection, testing & commissioning of CFD analysis for optimal locations, number & configuration of jet fans for design of ductless ventilation system for car parking area in the basement.	1 Set	1	1,01,000	1,01,000
	TOTAL				**42,02,917**

(Attachment No-11 to Addendum No-5)
PART-D AAREY STATION PLUMBING PUMPS

S.No.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Plumbing Works				
1	Submersible sump pumps				
1.1	Supply, Installation, Testing and Commissioning of following submersible sump pumps for dewatering with 40 mm thick solid handling capacity suitable for operation on 415+1-10%V pH 50 cycle A/C power supply & lifting arrangement.	SET	2	63,270	1,26,541
	Type of pump : submersible pump				
	Capacity : 180 lpm				
	Head : 8-10 m				
	Motor RPM : 2900				
	Each set consists of 2 pumps (1 Working + 1 Stand by). At any given time, only one pump need operate. Both the pumps must operate alternatively in service.				
1.2	Supply,Installation ,testing and commissioning of level controller switch for automatic operation of sump pumps complete with sensors,switches,relays all wiring from the sensors to the control unit to motor control centre of the various pumps and to the various alarm and indicating devices.	SET	2	14,632	29,263
2	Transfer pump				
2.1	Supply,installation, testing & commissioning of vertical inline multistage pumping set with stainless steel-316 body,stainless steel- 316 impeller, stainless steel 304 casing, shall of stainless steel-316 and C.I base & head with mechanical seal, Connected to a TEFC induction motor suitable for 415+1-10% volts , 3 phase 50 cycles A.C supply with 150mm dia pressure guage with gunmetal isolation cock,vibration eliminating under foundations, 80x40 mm I section base plate boted to cement concrete foundations complete .	SET	1	2,01,943	2,01,943
	Type of pump : (Underground Water tank to station overhead tank)				
	Pump capacity - 300 lpm				
	Head - 50 m				
	RPM - 2900				

(Attachment No-11 to Addendum No-5)
PART-D AAREY STATION PLUMBING PUMPS

S.No.	Description	Unit	Qty	Unit Price (Rs)	Total Amount (Rs)
1	2	3	4	5	6
	Each set consists of 2 pumps (1 Working + 1 Stand by). At any given time, only one pump need operate. Both the pumps must operate alternatively in service.				
2.2	Providing and fixing horizontal monoblock pumping set with C.I body and bronze impeller, shaft of SS-316 and M.S base & Head, mechanical seal, connected to a TEFC induction motor suitable for 400/440 volts, 3 phase 50 cycles A.C supply with 150 mm dia pressure guage with gunmetal isolation cock,vibration eliminating pads under foundations,80x40 mm M.S section base platebolted to cement concrete foundations complete				
a)	Capacity - 300 lpm				
	Head - 22 m				
	RPM - 2900				
	Each set consists of 2 pumps (1 Working + 1 Stand by). At any given time, only one pump need operate. Both the pumps must operate alternatively in service.	SET	1	1,29,083	1,29,083
b)	Capacity - 250 lpm				
	Head -40 m				
	RPM - 2900				
	Each set consists of 2 pumps (1 Working + 1 Stand by). At any given time, only one pump need operate. Both the pumps must operate alternatively in service.	SET	1	1,80,715	1,80,715
2.3	Supply,Installation ,testing and commissioning of level controller switch for automatic operation of sump pumps complete with sensors,switches,relays all wiring from the sensors to the control unit to motor control centre of the various pumps and to the various alarm and indicating devices.	SET	2	14,632	29,263
	TOTAL OF SUBHEAD PUMPS				**6,96,808**

MUMBAI METRO LINE 3
(COLABA-BANDRA-SEEPZ)

CONTRACT NO: MM 3-CBS-DEM

Design, Manufacture, Supply, Installation, Testing and Commissioning of E&M works comprising of Electrical Sub Stations with HT and LT works, Ventilation and Air Conditioning Systems (VAC), Fire Detection Systems, Fire Suppression (Fire Fighting) Systems, Building Management System (BMS), EOT cranes, Air-Compressors including compressed air piping works and Plumbing Pumps for the Depot Buildings including OCC and at grade Aarey Station for "Mumbai Metro Line -3"

VOLUME 5 OF 6

TENDER DRAWINGS

DECEMBER - 2017

Mumbai Metro Rail Corporation Ltd.
MMRDA Building,
Bandra - Kurla Complex,
Bandra (East), Mumbai – 400051, India

Composition of Documents

Volume 1	**Bidding Procedure**
Section I	Notice Inviting Tender (NIT)
Section II	Instructions To Tenderer
Section III	Form of Tenders
Volume 2	**Conditions of Contract and Contract Forms**
Section IV	General Conditions of Contract (GCC)
Section V	Special Conditions of Contract (SCC)
Volume 3	**Employer's Requirement- General Specification**
Volume 4	**Employer's Requirement – Technical Specifications**
Section VI – A	Electrical - HT
Section VI – B	Electrical - LT
Section VI – C	Ventilation & Air Conditioning (VAC)
Section VI – D	Fire Alarm and Detection System (FADS)
Section VI – E	Fire Suppression (Fire Fighting System)
Section VI – F	Building Management System (BMS)
Section VI – G	EOT Cranes (Electric Over Head Travelling Crane)
Section VI – H	Air Compressor (Compressed Air System)
Section VI – I	Plumbing Pumps (Drinking, Treated and Sewer)
Volume 5	**Tender Drawings**
Section VII – A	Electrical - HT
Section VII – B	Electrical - LT
Section VII– C	Ventilation & Air Conditioning (VAC)
Section VII – D	Fire Alarm and Detection System (FADS)
Section VII – E	Fire Suppression (Fire Fighting System)
Section VII – F	Building Management System (BMS)
Section VII – G	EOT Cranes (Electric Over Head Travelling Crane)
Section VII– H	Air Compressor (Compressed Air System)
Section VII – I	Plumbing Pumps (Drinking, Treated and Sewer)
Section VII – J	Civil Tender Drawings (Architectural / Utility)
Volume 6	**Bill of Quantities**

DEPOT TENDER DRAWING LIST					
SR NO	**WORK AREA**	**DRAWING NO**	**DISCRIPTION**	**REVISION / STATUS**	**MONTH/YEAR**
1	**HT**	MM3-GC-DEL-GD-08-D09-1001	TYPICAL HT & LT CABLE ROUTE LAYOUT	R1	Dec-17
		MM3-GC-DEL-GD-08-D09-1002	TYPICAL 33KV DISTRIBUTION SCHEME	R2	Dec-17
2	**LT**	MM3-GC-DEL-GD-08-D09-1003	ASS-1 MAIN SCHEMATIC DIAGRAM - AAREY DEPOT	R2	Dec-17
		MM3-GC-DEL-GD-08-D09-1004	ASS-2 MAIN SCHEMATIC DIAGRAM - AAREY DEPOT	R2	Dec-17
		MM3-GC-DEL-GD-08-D09-1005	MAIN SCHEMATIC DIAGRAM FOR AAREY STATION	R2	Dec-17
		MM3-GC-DEL-GD-08-D09-1006	TYPICAL YARD & STREET LIGHTING AAREY DEPOT	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1007	TYPICAL LIGHTING SHED 1	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1008	TYPICAL LIGHTING SHED 2	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1009	TYPICAL LIGHTING SHED 3	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1010	MAINTENANCE INSPECTION WORKSHOP & CENTRAL STORE BUILDING LIGHTING GROUND FLOOR	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1011	MAINTENANCE INSPECTION WORKSHOP & CENTRAL STORE BUILDING LIGHTING FIRST FLOOR	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1012	TYPICAL LIGHTING STATION BASEMENT	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1013	TYPICAL LIGHTING STATION CONCOURSE	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1014	TYPICAL LIGHTING STATION DECK LEVEL	DELETED	Apr-17
		MM3-GC-DEL-GD-08-D09-1015	TYPICAL LIGHTING STATION PLATFORM	DELETED	Apr-17
3	**VAC**	MM3-GC-DVA-GD-08-D24-0001	TYPICAL VRF SCHEMATIC FOR WORKSHOP BUILDING	R1	Dec-17
		MM3-GC-DVA-GD-08-D24-0002	TYPICAL VENTILATION AND CEILING FAN DEPOT AREA	DELETED	Jun-17
		MM3-GC-DVA-GD-08-D24-0003	TYPICAL OCC BUILDING CHILLER AND AHU SYSTEM LINE DIAGRAM SHEET 1/2	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0004	TYPICAL CHILLER PLANT LAYOUTDETAIL A-A' SHEET 2/2	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0005	SCHEMATIC DRAWING FOR CENTRAL AIR-CONDITIONING 1/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0006	SCHEMATIC DRAWING FOR CENTRAL AIR-CONDITIONING 2/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0007	SCHEMATIC DRAWING FOR CENTRAL AIR-CONDITIONING 3/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0008	SCHEMATIC DRAWING FOR CENTRAL AIR-CONDITIONING 4/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0009	SCHEMATIC DRAWING FOR CENTRAL AIR-CONDITIONING 5/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0010	SCHEMATIC DRAWING FOR CENTRAL AIR-CONDITIONING 6/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0011	SCHEMATIC DRAWING FOR CENTRAL AIR-CONDITIONING 7/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0012	TYPICAL OCC BUILDING CHILLER AND AHU PIPING LINE DIAGRAM	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0013	TYPICAL OCC BUILDING CHILLER AND AHU PIPING LINE DIAGRAM	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0014	SCHEMATIC DRAWING FOR CHILLED WATER PIPING SHEET 1/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0015	SCHEMATIC DRAWING FOR CHILLED WATER PIPING SHEET 2/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0016	SCHEMATIC DRAWING FOR CHILLED WATER PIPING SHEET 3/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0017	SCHEMATIC DRAWING FOR CHILLED WATER PIPING SHEET 4/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0018	SCHEMATIC DRAWING FOR CHILLED WATER PIPING SHEET 5/7	DELETED	May-17

DEPOT TENDER DRAWING LIST					
SR NO	**WORK AREA**	**DRAWING NO**	**DISCRIPTION**	**REVISION / STATUS**	**MONTH/YEAR**
3	VAC	MM3-GC-DVA-GD-08-D24-0019	SCHEMATIC DRAWING FOR CHILLED WATER PIPING SHEET 6/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0020	SCHEMATIC DRAWING FOR CHILLED WATER PIPING SHEET 7/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0021	SCHEMATIC DRAWING FOR VENTILATION DUCTING SHEET 1/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0022	SCHEMATIC DRAWING FOR VENTILATION DUCTING SHEET 2/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0023	SCHEMATIC DRAWING FOR VENTILATION DUCTING SHEET 3/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0024	SCHEMATIC DRAWING FOR VENTILATION DUCTING SHEET 4/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0025	SCHEMATIC DRAWING FOR VENTILATION DUCTING SHEET 5/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0026	SCHEMATIC DRAWING FOR VENTILATION DUCTING SHEET 6/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0027	SCHEMATIC DRAWING FOR VENTILATION DUCTING SHEET 7/7	DELETED	May-17
		MM3-GC-DVA-GD-08-D24-0028	TYPICAL VENTILATION SCHEMATIC FOR WORKSHOP BUILDING	R0	Dec-17
		MM3-GC-DVA-GD-08-D24-0029	TYPICAL VENTILATION SCHEMATIC FOR OCC BUILDING	R0	Dec-17
		MM3-GC-DVA-GD-08-D24-0030	TYPICAL CHILLED WATER SCHEMATIC FOR OCC BUILDING (Sheet 1 of 2)	R0	Dec-17
		MM3-GC-DVA-GD-08-D24-0031	TYPICAL CHILLED WATER SCHEMATIC FOR OCC BUILDING (Sheet 2 of 2)	R0	Dec-17
		MM3-GC-DVA-GD-08-D24-0032	TYPICAL CONDENSER WATER SCHEMATIC FOR OCC BUILDING	R0	Dec-17
4	FADS	MM3-GC-DFF-GD-08-D10-0004	TYPICAL SINGLE LINE DIAGRAM FIRE ALARM SYSTEM (DEPOT)	R1	Dec-17
		MM3-GC-DFF-GD-08-D10-0005	TYPICAL SINGLE LINE DIAGRAM FIRE ALARM SYSTEM (OCC & INFRA BUILDING)	R1	Dec-17
		MM3-GC-DFF-GD-08-D10-0006	SCHEMATIC DIAGRAM - FIRE ALARM SYSTEM ELEVATED STATIONS (TYPICAL)	R0	Nov-17
5	FIRE SUPPRESSION	MM3-GC-DFF-GD-08-D10-0001	FIRE SUPPRESSION SYSTEM	R1	Dec-17
		MM3-GC-DFF-GD-08-D10-0002	TYPICAL FIRE SUPPRESSION SYSTEM FOR DEPOT	R1	Dec-17
		MM3-GC-DFF-GD-08-D10-0003	SCHEMATIC DIAGRAM - FIRE FIGHTING SYSTEM ELEVATED STATIONS (TYPICAL)	R0	May-17
		MM3-GC-DFF-GD-08-D10-0007	TYPICAL SCHEMATIC DIAGRAM OF CLEAN GAS AGENT	R0	May-17
6	BMS	MM3-GC-DBM-GD-08-D23-0001	TYPICAL BMS ARCHITECTURAL DRAWING	R2	Dec-17
7	EOT	MM3-GC-DIM-GD-08-D07-0103	TYPICAL EOT SCOPE OF WORK DEM & CIVIL (MAINTENANCE & INSPECTION WORKSHOP AND CENTRAL STORE)	**DELETED**	Jul-17
		MM3-GC-DIM-GD-08-D07-0104	TYPICAL EOT SCOPE OF WORK DEM & CIVIL (UNDERFLOOR WHEEL LATE (UFWL)	R0	Jul-17
		MM3-GC-DIM-GD-08-D07-0105	TYPICAL EOT SCOPE OF WORK DEM & CIVIL (INFRASTRUCTURE MAINTENANCE VEHICULAR & WORKTRAIN WORKSHOP)	R1	Nov-17
		MM3-GC-DIM-GD-08-D07-0106	TYPICAL EOT SCOPE OF WORK DEM & CIVIL (MAINTENANCE & INSPECTION WORKSHOP AND CENTRAL STORE)	R1	Nov-17
8	AIR COMPRESSOR	MM3-GC-DIM-GD-08-D07-0101	COMPRESSED AIR LINE FOR MAINTENANCE T INSPECTION WORKSHOP & CENTRAL STORE	R1	Nov-17
		MM3-GC-DIM-GD-08-D07-0102	COMPRESSED AIR LINE FOR UNDER FLOOR WHEEL LATHE, HEAVY WASHING SHED, WORKTRAIN WORK SHOP	R0	Jul-17

DEPOT TENDER DRAWING LIST					
SR NO	**WORK AREA**	**DRAWING NO**	**DISCRIPTION**	**REVISION / STATUS**	**MONTH/YEAR**
9	**PLUMBING PUMPS**	MM3-GC-DPL-GD-8-D11-0001	PLUMBING PUMP DEPOT	R1	Dec-17
		MM3-GC-DPL-GD-8-D11-0002	PLUMBING PUMP AAREY STATION	R1	Dec-17
		MM3-GC-DPL-GD-8-D11-0003	SCOPE OF WORK E&M AND CIVIL PLUMBING WORK	R1	Dec-17
10	**CIVIL TENDER DRAWINGS**	**ARCHITECTURAL**			
		MM3-GC-DTR-GD-8-D03-2001	AAREY DEPOT LAYOUT	R1	Nov-17
		MML3-CBS/MMRC/IC/DEP/AR/101	OCC, ADMINISTRATION AND PTR BUILDING GROUND FLOOR PLANE	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/102	OCC, ADMINISTRATION AND PTR BUILDING FIRST FLOOR PLAN	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/103	OCC, ADMINISTRATION AND PTR BUILDING SECOND FLOOR PLAN	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/104	OCC, ADMINISTRATION AND PTR BUILDING THIRD FLOOR PLAN	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/105	OCC, ADMINISTRATION AND PTR BUILDING FOURTH FLOOR PLAN	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/106	OCC, ADMINISTRATION AND PTR BUILDING FIFTH FLOOR PLAN	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/107	OCC, ADMINISTRATION AND PTR BUILDING SIXTH FLOOR PLAN	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/108	OCC, ADMINISTRATION AND PTR BUILDING SECTION A-A, SECTION B-B	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/109	OCC, ADMINISTRATION AND PTR BUILDING SECTION C-C, SECTION D-D	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/110	OCC, ADMINISTRATION AND PTR BUILDING ELEVATIONS	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/111	OCC, ADMINISTRATION AND PTR BUILDING 3 DIMENSIONAL VIEW 1	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/112	OCC, ADMINISTRATION AND PTR BUILDING 3 DIMENSIONAL VIEW 2	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/113	OCC, ADMINISTRATION AND PTR BUILDING 3 DIMENSIONAL VIEWS	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1001	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING PLANS	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1002	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING GROUND FLOOR BLOWN UP PLAN WORKSHOP	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1003	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING FIRST FLOOR BLOWN UP PLAN WORKSHOP	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1004	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING CENTRAL STORE , WORKSHOP BLOWN UP PLANS	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1005	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING SECTION A-A, SECTION B-B	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1006	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING SECTION B-B, SECTION D-D	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1701	GROUND FLOOR PLAN OF INFRASTRUCTURE MAINTENANCE BUILDING	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1702	FIRST FLOOR PLAN OF INFRASTRUCTURE MAINTENANCE BUILDING	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1703	ROOF LVL PLAN PLAN OF INFRASTRUCTURE MAINTENANCE BUILDING	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1704	SECTIONS OF INFRASTRUCTURE MAINTENANCE BUILDING	DELETED	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/101	OCC AND INFRASTRUCTURE BUILDING - GROUND FLOOR	R0	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/102	OCC AND INFRASTRUCTURE BUILDING - FIRST FLOOR	R0	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/103	OCC AND INFRASTRUCTURE BUILDING - SECOND FLOOR	R0	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/104	OCC AND INFRASTRUCTURE BUILDING - THIRD FLOOR	R0	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/105	OCC AND INFRASTRUCTURE BUILDING - TERRACE LEVEL PLAN	R0	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/106	OCC AND INFRASTRUCTURE BUILDING - SECTION	R0	Dec-17

DEPOT TENDER DRAWING LIST					
SR NO	**WORK AREA**	**DRAWING NO**	**DISCRIPTION**	**REVISION / STATUS**	**MONTH/YEAR**
10	CIVIL TENDER DRAWINGS	MML3-CBS/MMRC/IC/DEP/AR/1001	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING PLANS	P	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/1002	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING GROUND FLOOR PLAN 1/3	P	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/1003	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING FIRST FLOOR PLAN 2/3	P	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/1004	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING BLOWN UP PLANS 3/3	P	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/1006	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING SECTION-A-A	P	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/1006	MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING SECTION-B-B	P	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/701	COVERED STABLING SHED 1 - GROUND FLOOR PLAN	R1	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/702	COVERED STABLING SHED 1 - SECTION	R1	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/703	COVERED STABLING SHED 1 - ROOF PLAN	R1	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/801	COVERED STABLING SHED 2 - GROUND FLOOR PLAN	R1	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/802	COVERED STABLING SHED 2 - SECTION	R1	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/803	COVERED STABLING SHED 2 - ROOF PLAN	R1	Dec-17
		MML3-CBS/MMRC/IC/DEP/AR/1501	AAREY DEPOT STATION & ASS 27 BASEMENT LEVEL PLAN	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1502	AAREY DEPOT STATION & ASS 27 PLATFORM LEVEL PLAN	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1503	AAREY DEPOT STATION & ASS 27 CONCOURSE LEVEL PLAN	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1504	AAREY DEPOT STATION & ASS 27 DECK LEVEL PLAN	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1505	AAREY DEPOT STATION & ASS 27 SECTIONS	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1101	UNDER FLOOR WHEEL LATHE PLAN & SECTIONS	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/1201	HEAVY WASHING SHED PLAN AND SECTION	R0	Dec-16
		MML3-CBS/MMRC/IC/DEPOT/AR/2001	U.G. TANK BUILDING LOWER,UPPER & TERRACE PLAN,	R0	Dec-16
		MML3-CBS/MMRC/IC/DEPOT/AR/2002	U.G. TANK BUILDING LOWER,UPPER & TERRACE PLAN,	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/AR/2101	OVERHEAD WATER TANK PLAN, SECTION, ELEVATION	R0	Dec-16
		MML3-CBS/MMRC/IC/DEPOT/AR/1401	PLAN & SECTIONS AUTOMATIC TRAIN WASH GENERAL ARRANGEMENT	R0	Dec-16
		UTILITY			
		MML3-CBS/MMRC/IC/DEP/UT/201	ALIGNMENT OF SEWER LINE	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/UT/202	WATER HARVESTING SYSTEM	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/UT/203	DRINKING WATER LINE	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/UT/204	X-SECTION OF INTERNAL ROAD FOUNDATION LAYOUT	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/UT/205	ALIGNMENT OF STROM WATER DRAIN	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/UT/206	ALIGNMENT OF SERVICE WATER NETWORK	R0	Dec-16
		MML3-CBS/MMRC/IC/DEP/UT/207	ALIGNMENT OF UTILITY DUCTS	R0	Dec-16

Attachment No. 12 To Addendum No. 5

TYPICAL HT & LT CABLE ROUTE LAYOUT

LT CABLE TRENCH DETAILS

TRENCH NO	FROM	TO
T-01	AUXILIARY SUBSTATION - 2	MAINTENANCE FACILITY WORKSHOP BUILDING , UFWL SHED, HEAVY WASH PLANT, STABLING SHEAD -2, AUTOCOACH WASHPLANT
T-02	MAINTENANCE FACILITY WORKSHOP BUILDING (10) TRENCH JNCTION	MAINTENANCE FACILITY WORKSHOP BUILDING INSIDE TRENCH (10)
T-03	MAINTENANCE FACILITY WORKSHOP BUILDING TRENCH JNCTION	UFWL SHED, HEAVY WASH PLANT, STABLING SHEAD -2, AUTO COACH WASHPLANT
T-04	TRENCH JUNCTION NEAR HWP	UFWL SHED, HEAVY WASH PLANT,
T-05	TRENCH JUNCTION HWP	STABLING SHEAD -2, AUTOCOACH WASHPLANT
T-06	TRENCH JUNCTION NEAR HWP END	STABLING SHEAD -2,
T-07	TRENCH JUNCTION NEAR HWP END	STABLING SHED-2, AUTO COACH WASHPLANT
T-08	TRENCH JUNCTION STATION SIDE	STABLING SHEAD -2
T-09	TRENCH JUNCTION STATION SIDE	AUTO COACH WASHPLANT
T-10	AUXILIARY SUBSTATION - 2	STABLING SHED -1, FIRE PUMP ROOM
T-11	TRENCH JUNCTION STABLING SHEAD END	FIRE PUMP ROOM , ACCESS CONTROL BUILDING
T-12	AUXILIARY SUBSTATION - 1	FIRE PUMP ROOM , ACCESS CONTROL BUILDING
T-13	AUXILIARY SUBSTATION - 1	TREATMENT PLANT(25)

LEGEND

	HT CABLE TRENCH ROUTE
	LT CABLE TRENCH ROUTE
	HUME PIPE ROUTE

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			REVISED AS PER ARCHITECT CIVIL LAYOUT

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-DEC-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: DEPOT GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL HT & LT CABLE ROUTE LAYOUT

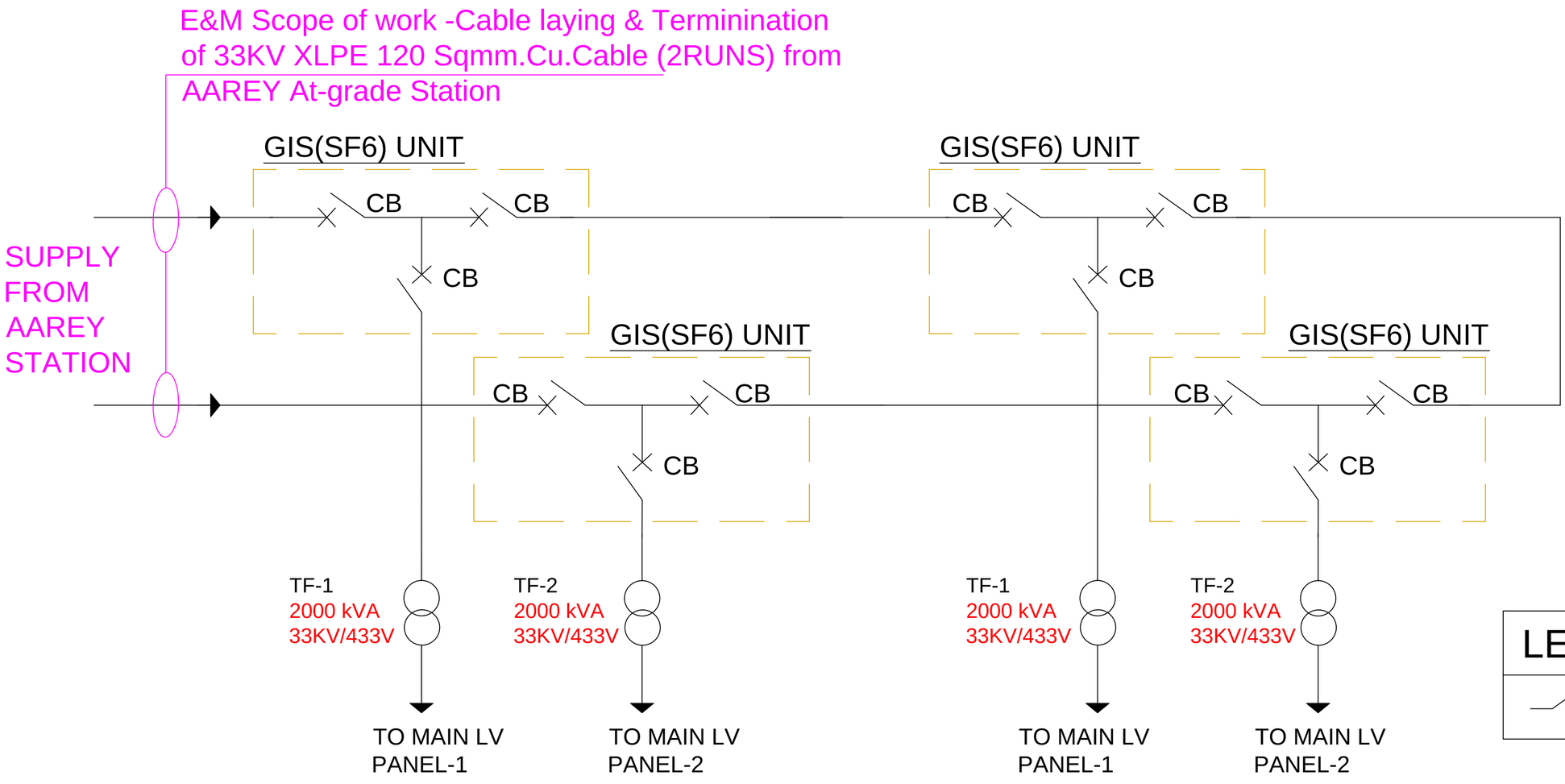
SCALE: 1:1000

DRAWING NO: MM3-GC-DEL-GD-08-D09-1001

MUMBAI METRO LINE-3 GENERAL CONSULTANT

Attachment No.12 of Addendum No. 5

TYPICAL 33KV RING MAIN SYSTEM & 33KV /433V SUBSTATION AT AAREY DEPOT



DEPOT ASS-1

DEPOT ASS-2

LEGENDS:-	
	Circuit Breaker

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R2	11-12-17			Technical Detail Updated
R1	24-08-17			Technical Detail Updated

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL 33KV DISTRIBUTION SCHEME

SCALE: NTS

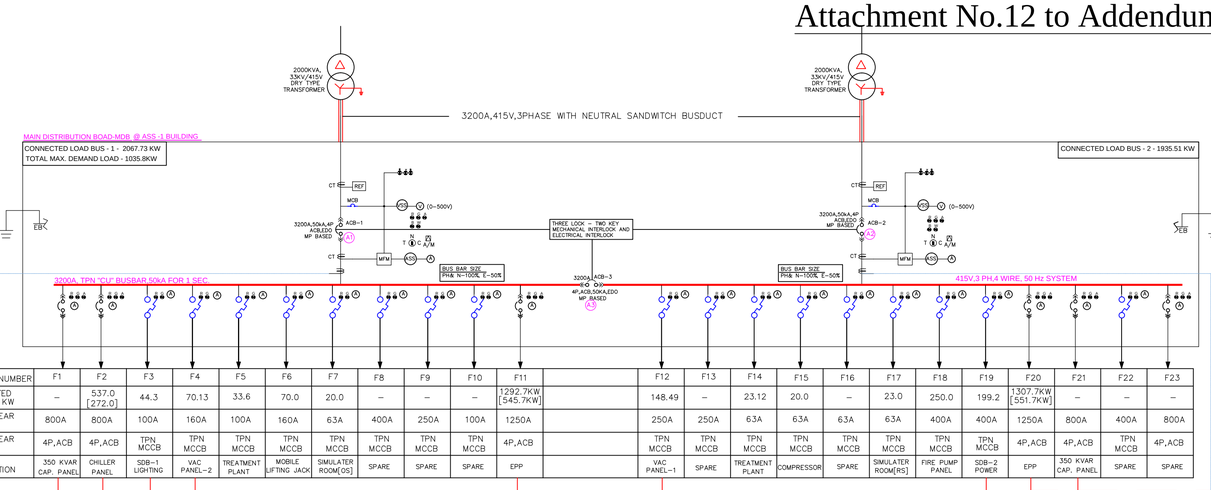
DRAWING NO: MM3-GC-DEL-GD-08-D09-1002

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

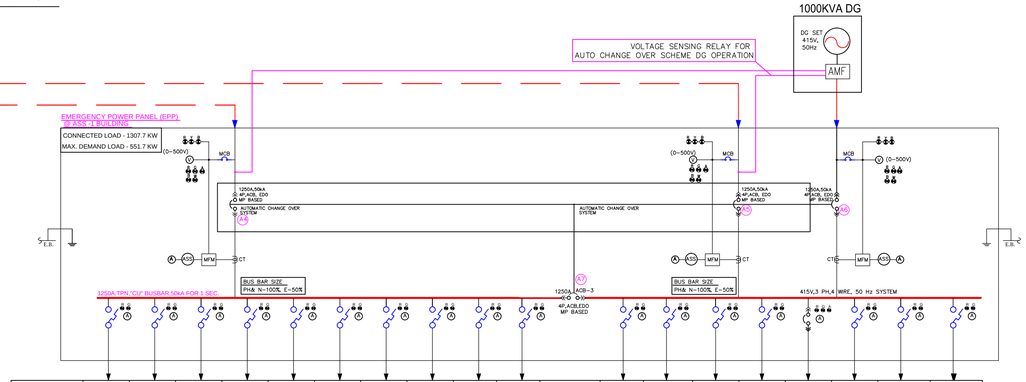
11-12-2017

F E D C B A

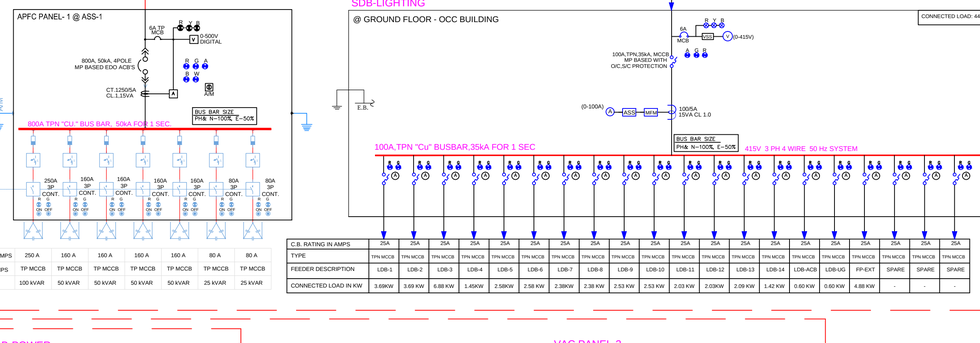
Attachment No.12 to Addendum No.5



FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11		F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23
CONNECTED LOAD IN KW	–	537.0 [272.0]	44.3	70.13	33.6	70.0	20.0	–	–	–	1292.7KW [545.7KW]		148.49	–	23.12	20.0	–	23.0	250.0	199.2	1307.7KW [551.7KW]	–	–	–
SWITCHGEAR RATING	800A	800A	100A	160A	100A	160A	63A	400A	250A	100A	1250A		250A	250A	63A	63A	63A	63A	400A	400A	1250A	800A	400A	800A
SWITCHGEAR TYPE	4P,ACB	4P,ACB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	4P,ACB		TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	4P,ACB	4P,ACB	4P,ACB	TPN MCCB	4P,ACB
FEEDER DESCRIPTION	350 KVAR CAP. PANEL	CHILLER PANEL	SDB–1 LIGHTING	VAC PANEL–2	TREATMENT PLANT	MOBILE LIFTING JACK	SIMULATER ROOM[OS]	SPARE	SPARE	SPARE	EPP		VAC PANEL–1	SPARE	TREATMENT PLANT	COMPRESSOR	SPARE	SIMULATER ROOM[RS]	FIRE PUMP PANEL	SDB–2 POWER	EPP	350 KVAR CAP. PANEL	SPARE	SPARE

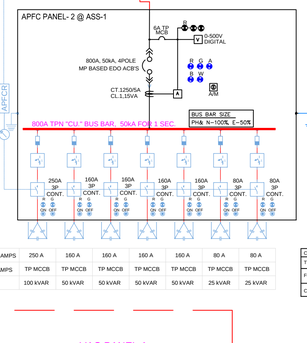


FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10		F11	F12	F13	F14	F15	F16	F17	F18
CONNECTED LOAD IN KW	15.0KW	15.0KW	21.0KW	40KW	200KW	148.9KW	6.0	15.0	–	–		15.0KW	15.0KW	40KW	200KW	537KW [272KW]	40.27	–	–
SWITCHGEAR RATING	40A	40A	63A	160A	400A	250A	63A	63A	400A	160A		40A	40A	160A	400A	800A	100A	400A	63A
SWITCHGEAR TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB		TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	4P,ACB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	LIFT–1	LIFT–2	ESDB–1	40KVA UPS E&M	200KVA UPS S&T	VAC PANEL	DCDB CHARGER	EOT CRANE	SPARE	SPARE		LIFT–3	LIFT–4	40KVA UPS E&M	200KVA UPS S&T	CHILLER PANEL	WATER PUMP PANEL	SPARE	SPARE

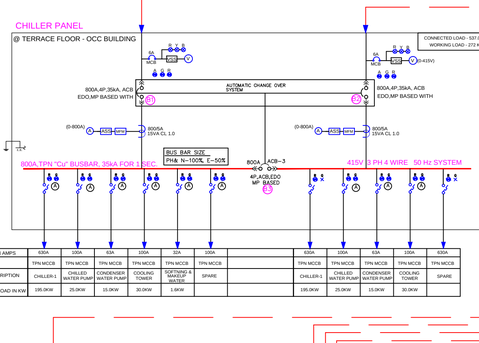


MCCB RATING IN AMPS	250 A	160 A	160 A	160 A	160 A	80 A	80 A
TRIP SETING IN AMPS	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB
KVAR RATING	100 kVAR	50 kVAR	50 kVAR	50 kVAR	50 kVAR	25 kVAR	25 kVAR

C.B. RATING IN AMPS	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A
TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	LDB-1	LDB-2	LDB-3	LDB-4	LDB-5	LDB-6	LDB-7	LDB-8	LDB-9	LDB-10	LDB-11	LDB-12	LDB-13	LDB-14	LDB-ACB	LDB-UG	FP-EXT	SPARE	SPARE	SPARE
CONNECTED LOAD IN KW	3.69KW	3.69 KW	6.88 KW	1.45KW	2.58KW	2.58 KW	2.38KW	2.38 KW	2.53 KW	2.53 KW	2.03 KW	2.03KW	2.09 KW	1.42 KW	0.60 KW	0.60 KW	4.88 KW	-	-	-



MCCB RATING IN AMPS	250 A	160 A	160 A	160 A	160 A	80 A	80 A
TRIP SETING IN AMPS	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB
KVAR RATING	100 kVAR	50 kVAR	50 kVAR	50 kVAR	50 kVAR	25 kVAR	25 kVAR



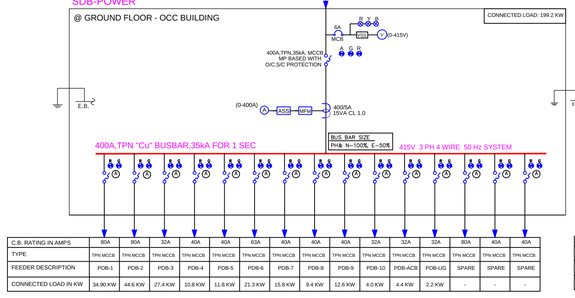
C.B. RATING IN AMPS	630A	100A	63A	100A	32A	100A		630A	100A	63A	100A	630A
TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB		TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	CHILLER-1	CHILLED WATER PUMP	CONDENSER WATER PUMP	COOLING TOWER	SOFTWARE & ENVELOP WATER	SPARE		CHILLER-2	CHILLED WATER PUMP	CONDENSER WATER PUMP	COOLING TOWER	SPARE
CONNECTED LOAD IN KW	195.0KW	25.0KW	15.0KW	30.0KW	1.9KW			195.0KW	25.0KW	15.0KW	30.0KW	-

ELECTRICAL & MECHANICAL INTERLOCK AT MAIN LT PANEL (2/3 INTERLOCK)

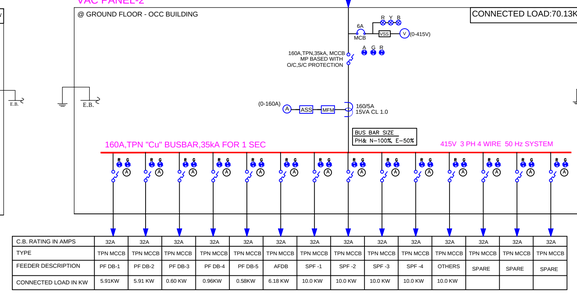
SL.NO	FROM TRANSFORMER–1 INCOMER ACB–1(A1)	FROM TRANSFORMER–2 INCOMER ACB–2(A2)	BUS–COUPLER ACB–3(A3)
1	ON	ON	OFF
2	ON	OFF	ON
3	OFF	ON	ON

ELECTRICAL & MECHANICAL INTERLOCK AT EMERGENCY PANEL

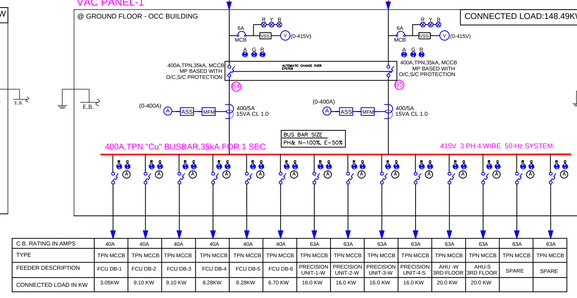
SL.NO	NORMAL INCOMER ACB–4(A4)	NORMAL INCOMER ACB–5(A5)	DG INCOMER ACB–6(A6)	BUS COUPLER ACB–7(A7)
1	ON	ON	OFF	OFF
2	ON	OFF	OFF	ON
3	OFF	ON	OFF	ON
4	OFF	OFF	ON	ON



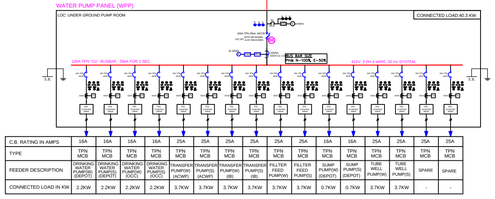
C.B. RATING IN AMPS	80A	80A	32A	40A	40A	63A	40A	40A	40A	40A	32A	32A	32A	80A	40A	40A
TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	PDB-1	PDB-2	PDB-3	PDB-4	PDB-5	PDB-6	PDB-7	PDB-8	PDB-9	PDB-10	PDB-ACB	PDB-UG	SPARE	SPARE	SPARE	SPARE
CONNECTED LOAD IN KW	34.90 KW	44.6 KW	27.4 KW	10.8 KW	11.8 KW	21.3 KW	15.8 KW	9.4 KW	12.6 KW	4.0 KW	4.4 KW	2.2 KW	-	-	-	-



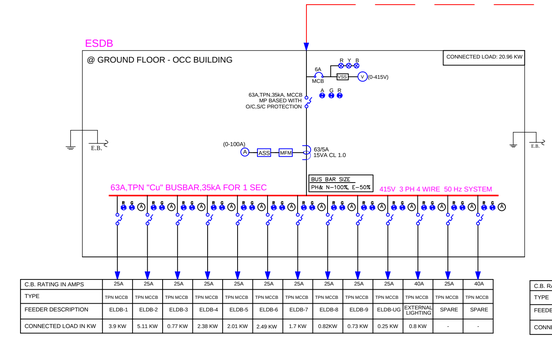
C.B. RATING IN AMPS	32A	32A	32A	32A	32A	32A	32A	32A	32A	32A	32A	32A	32A	32A	32A	32A
TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	PF DB-1	PF DB-2	PF DB-3	PF DB-4	PF DB-5	AFDB	SPF -1	SPF -2	SPF -3	SPF -4	OTHERS	SPARE	SPARE	SPARE		
CONNECTED LOAD IN KW	5.91KW	5.91 KW	0.60 KW	0.96KW	0.58KW	6.18 KW	10.0 KW	10.0 KW	10.0 KW	10.0 KW	10.0 KW					



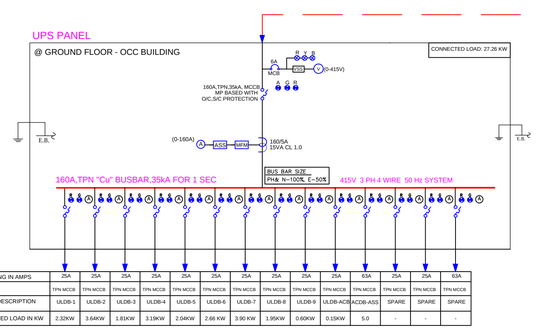
C.B. RATING IN AMPS	40A	40A	40A	40A	40A	40A	63A	63A	63A	63A	63A	63A	63A	63A
TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	FCU DB-1	FCU DB-2	FCU DB-3	FCU DB-4	FCU DB-5	FCU DB-6	PRECISION UNIT-1-W	PRECISION UNIT-2-W	PRECISION UNIT-3-W	PRECISION UNIT-4-S	AHU -W/ 3RD FLOOR	AHU-S 3RD FLOOR	SPARE	SPARE
CONNECTED LOAD IN KW	3.09KW	9.10 KW	9.10 KW	8.28KW	8.28KW	6.70 KW	16.0 KW	16.0 KW	16.0 KW	16.0 KW	20.0 KW	20.0 KW		



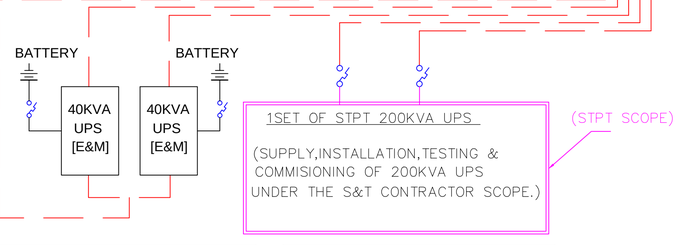
C.B. RATING IN AMPS	16A	16A	16A	16A	25A	25A	25A	25A	25A	16A	16A	25A	25A	25A	25A	25A
TYPE	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB	TPN MCB
FEEDER DESCRIPTION	DRINKING WATER PUMP(S) (DEPOT)	DRINKING WATER PUMP(S) (DEPOT)	DRINKING WATER PUMP(S) (DCC)	DRINKING WATER PUMP(S) (DCC)	TRANSFER PUMP(S) (ACWP)	TRANSFER PUMP(S) (ACWP)	TRANSFER PUMP(S) (IB)	TRANSFER PUMP(S) (IB)	FILLTER FEED PUMP(S)	FILLTER FEED PUMP(S)	SUMP PUMP(S) (DEPOT)	SUMP PUMP(S) (DEPOT)	TUBE WELL PUMP(S)	TUBE WELL PUMP(S)	SPARE	SPARE
CONNECTED LOAD IN KW	2.2KW	2.2KW	2.2KW	2.2KW	3.7KW	3.7KW	3.7KW	3.7KW	3.7KW	3.7KW	0.7KW	0.7KW	3.7KW	3.7KW	-	-



C.B. RATING IN AMPS	25A	25A	25A	25A	25A	25A	25A	25A	25A	40A	25A	40A
TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	ELDB-1	ELDB-2	ELDB-3	ELDB-4	ELDB-5	ELDB-6	ELDB-7	ELDB-8	ELDB-9	ELDB-UG	EXTERNAL LIGHTING	SPARE	SPARE
CONNECTED LOAD IN KW	3.9 KW	5.11 KW	0.77 KW	2.38 KW	2.01 KW	2.49 KW	1.7 KW	0.82KW	0.73 KW	0.25 KW	0.8 KW	-	-



C.B. RATING IN AMPS	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	63A	25A	25A	63A
TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	ULDB-1	ULDB-2	ULDB-3	ULDB-4	ULDB-5	ULDB-6	ULDB-7	ULDB-8	ULDB-9	ULDB-ACB	ACDB-ASS	SPARE	SPARE	SPARE
CONNECTED LOAD IN KW	2.32KW	3.64KW	1.81KW	3.19KW	2.04KW	2.66 KW	3.90 KW	1.95KW	0.60KW	0.15KW	5.0	-	-	-



ELECTRICAL & MECHANICAL INTERLOCK AT VAC PANEL (1/2 INTERLOCK)

SL.NO	VAC PANEL INCOMER–1 MCCB–1(B4)	VAC PANEL INCOMER–2 MCCB–2 (B5)
1	ON	OFF
2	OFF	ON

ELECTRICAL & MECHANICAL INTERLOCK CHILLER PANEL (2/3 INTERLOCK)

SL.NO	CHILLER INCOMER–1 MCCB–1(B1)	CHILLER INCOMER–2 MCCB–2 (B2)	BUS–COUPLER MCCB–3(B3)
1	ON	ON	OFF
2	ON	OFF	ON
3	OFF	ON	ON

LEGEND:-

	AIR CIRCUIT BREAKER	R G A	ON,OFF,TRIP
MCCB	MOULDED CASE CIRCUIT BREAKER	Cu	COPPER
MCB	MINIATURE CIRCUIT BREAKER	kA	KILO AMPERES
A	AMMETER DIGITAL	TP	TRIPLE POLE
V	VOLTMETER DIGITAL	TPN	TRIPLE POLE & NEUTRAL
CT	CURRENT TRANSFORMER	4P	FOUR POLE
VTPN	VERTICAL TRIPLE POLE & NEUTRAL	kVA	KILO VOLT AMPERE
	EARTH CONNECTION	E.B.	EARTH BUS
R Y B	PHASE INDICATION LAMP	MDO	MANUAL DRAWOUT
TM	THERMAL MAGNETIC RELEASE	MP	MICROPROCESSOR RELEASE

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R2	11-12-17			Technical detail updated
R1	24-08-17			Technical detail updated

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		
11-12-2017		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: GENERAL PANEL DRAWING

DRAWING TITLE: ASS -1 MAIN SCHEMATIC DIAGRAM AAREY DEPOT

SCALE: NTS

DRAWING NO: MM3-GC-DEL-GD-8-D09-1003

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D C B A

Attachment No.12 to Addendum No.5

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	DRAWOUT AIR CIRCUIT BREAKER	MFM	MULTY FUNCTION METER
	MCCB	T ⊙ C	TRIP-NEUTRAL-CLOSE BREAKER CONTROL SWITCH
	MINIATURE CIRCUIT BREAKER	A/M	AUTO/MANUAL SELECTOR SWITCH
V	VOLT METER		TRIP INDICATING LAMP
VSS	VOLT METER SELECTOR SWITCH		BREAKER ON INDICATING LAMP
A	AMMETER		BREAKER OFF INDICATING LAMP
ASS	AMMETER SELECTOR SWITCH		TRIP CIRCUIT HEALTHY INDICATING LAMP
	CURRENT TRANSFORMER		SPRING CHARGED INDICATING LAMP
	PHASE INDICATING LAMP	REF	RESTRICTED EARTH FAULT RELAY
MP	MICROPROSSER BASED		MECHANICAL AND ELECTRICAL INTERLOCK
TM	THERMAL MAGNETIC TYPE	LPDB	LIGHTING AND POWER DISTRIBUTION BOARD

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R2	11-12-17			Technical detail updated
R1	24-08-17			Technical detail updated

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: GENERAL PANEL DRAWING

DRAWING TITLE: ASS -2 MAIN SCHEMATIC DIAGRAM AAREY DEPOT

SCALE: NTS

DRAWING NO: MM3-GC-DEL-GD-8-D09-1004

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D 11-12-2017 C B A

Attachment No.12 To Addendum No.5

ELECTRICAL & MECHANICAL INTERLOCK AT MAIN LT PANEL(MDB) 2/3 INTERLOCK			
SL.NO	NORMAL INCOMER ACB-1(A1)	NORMAL INCOMER ACB-2(A2)	BUS COUPLER ACB-3(A3)
1	ON	ON	OFF
2	OFF	ON	ON
3	ON	OFF	ON

800KVA 33KV/415V DRY TYPE TRANSFORMER-1

DETAIL – A REFER NOTE

800KVA 33KV/415V DRY TYPE TRANSFORMER-2

MAIN DISTRIBUTION BOARD-MDB @ ASS

CONNECTED LOAD BUS-1 – 452.03KW
TOTAL MAX. DEMAND LOAD – 496.06KW

CONNECTED LOAD BUS-2 – 530.07

1250A 4P,ACB,EDO MP BASED

THREE LOCK – TWO KEY ARRANGEMENT FOR ELECTRICAL INTERLOCK

BUS BAR SIZE PH& N–100%, E–50%

415V,3 PH,4 WIRE, 50 Hz SYSTEM

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8
CONNECTED LOAD IN KW	-	67.5	17.46	120	361.52	74.75	-	-
SWITCHGEAR RATING	400 A	200 A	125 A	250 A	630 A	160 A	400 A	200 A
SWITCHGEAR TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB 4P MCCB	4P MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	APFC PANEL	ACPP	WPP	ESCAL POWER PANEL	EPP	ELP 80KVA UPS	SPARE	SPARE

FEEDER NUMBER	F9	F10	F11	F12	F13	F14	F15	F16
CONNECTED LOAD IN KW	361.52	73	16	203	60	-	-	-
SWITCHGEAR RATING	630 A	160 A	125 A	400 A	200 A	200 A	250 A	400 A
SWITCHGEAR TYPE	4P MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	EPP	MLP	PA PANEL	FIRE PUMP PANEL	P D AREA	SPARE	SPARE	APFC PANEL

EMERGENCY POWER PANEL (EPP)
@ ASS –2 BUILDING
CONNECTED LOAD 414.34KW
MAX.DEMAND LOAD 255.17KW

630A,TPN, 35kA, MCCB

AUTOMATIC CHANGE OVER SYSTEM

630 A,TPN "Cu" BUSBAR, 35kA, FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23
CONNECTED LOAD IN KW	54	12	12	12	12	12	12	8	8	22	44.76	-	-	-	12	12	12	54	72	44.76	-	-	-
SWITCHGEAR RATING	125A	40A	40A	40A	40A	40A	40A	63A	63A	63A	125 A	125 A	40 A	40 A	40A	40A	40A	125A	160A	125 A	160A	40A	40A
SWITCHGEAR TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	S&T UPS	ELEVAT-1	ELEVAT-2	ELEVAT-3	ELEVAT-4	ELEVAT-5	ELEVAT-6	AC-DB	DC-DB	AC (SER,TER)	BAS,EX. PANEL-1	SPARE	SPARE	SPARE	ELEVAT-7	ELEVAT-8	ELEVAT-9	S&T UPS	80KVA UPS	BAS,EX. PANEL-2	SPARE	SPARE	SPARE

500KVA DG
DG SET 415V, 50Hz

1NO 1000A,4P,INCOMER ACB&
1NO 630A,4P,OUTGOING MCCB,
1NO 400A,4P,OUTGOING MCCB
ARRANGEMENT REQUIRED IN AMF PANEL

VOLTAGE SENSING RELAY FOR AUTO CHANGE OVER SCHEME DG OPERATION

ELECTRICAL & MECHANICAL INTERLOCK AT EMERGENCY PANEL				
SL.NO	NORMAL INCOMER MCCB-1(B1)	NORMAL INCOMER MCCB-2(B2)	DG INCOMER MCCB-3(B3)	BUS COUPLER MCCB-4(B4)
1	ON	ON	OFF	OFF
2	OFF	ON	OFF	ON
3	ON	OFF	OFF	ON
4	OFF	OFF	ON	ON

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	DRAWOUT AIR CIRCUIT BREAKER	MFM	MULTY FUNCTION METER
	MCCB	N T C	TRIP=NEUTRAL=CLOSE BREAKER CONTROL SWITCH
	MINIATURE CIRCUIT BREAKER	A/M	AUTO/MANUAL SELECTOR SWITCH
V	VOLT METER		TRIP INDICATING LAMP
VSS	VOLT METER SELECTOR SWITCH		BREAKER ON INDICATING LAMP
A	AMMETER		BREAKER OFF INDICATING LAMP
ASS	AMMETER SELECTOR SWITCH		TRIP CIRCUIT HEALTHY INDICATING LAMP
	CURRENT TRANSFORMER		SPRING CHARGED INDICATING LAMP
	PHASE INDICATING LAMP	REF	RESTRICTED EARTH FAULT RELAY
MP	MICROPROSSER BASED		MECHANICAL AND ELECTRICAL INTERLOCK
TM	THERMAL MAGNETIC TYPE	LPDB	LIGHTING AND POWER DISTRIBUTION BOARD

APFC PANEL- 1 @ ASS-STATION

6A TP MCB, 0-500V DIGITAL, 400A,TPN, 36kA, MCCB, CT.400/5A CL.1.15VA, APFCR, A/M

400A TPN CU. BUS BAR, 36KA FOR 1 SEC

MCCB RATING IN AMPS	125 A	80 A	80 A	63 A	63 A	63 A
TRIP SETING IN AMPS	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB
KVAR RATING	37.5 KVAR	25 KVAR	25 KVAR	12.5 KVAR	12.5 KVAR	12.5 KVAR

WATER PUMP PANEL (WPP)
CONNECTED LOAD:–17.5KW

125A,TPN, 35kA, MCCB, 125/5A 15VA CL 1.0

125 AMPS TPN BUSBAR 'Cu' 35 kA FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
CONNECTED LOAD IN kW	3.75	3.75	-	1.0	1.0	1.0	1.0	-	-	3.0	3.0	-
SWITCHGEAR RATING	40 A	40 A	40 A	5 - 32 A	5 - 32 A	5 - 32 A	5 - 32 A	5 - 32 A	5 - 32 A	16 A	16 A	16 A
SWITCHGEAR TYPE	TP MCCB	TP MCCB	TP MCCB	TP MCB	TP MCB	TP MCB	TP MCB	TP MCB	TP MCB	TP MCB	TP MCB	DP MCB
FEEDER DESCRIPTION	SUBMERSIBLE PUMP-1	SUBMERSIBLE PUMP-2	SPARE-	MONO BLOCK PUMP-1	MONO BLOCK PUMP-2	SUMP PUMP-1	SUMP PUMP-1	SPARE	SPARE	WATER TRANS PUMP-1	WATER TRANS PUMP-1	SPARE

ESCALATOR POWER PANEL (ESPP)
CONNECTED LOAD-120KW

250A,TPN, 35kA, MCCB, 250/5A 15VA CL 1.0

250 AMPS TPN BUSBAR 'Cu' 35 kA FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8
CONNECTED LOAD IN kW	20	20	20	20	20	20	-	-
SWITCHGEAR RATING	63 A	63 A	63 A	63 A	63 A	63 A	63 A	63 A
SWITCHGEAR TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	ESCALATOR-1	ESCALATOR-2	ESCALATOR-3	ESCALATOR-4	ESCALATOR-5	ESCALATOR-6	SPARE	SPARE

PASSENGER AMENITIES PANEL (PAP)
CONNECTED LOAD-16KW

125A,TPN, 35kA, MCCB, 100/5A 15VA CL 1.0

125 AMPS TPN BUSBAR 'Cu' 35kA FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
CONNECTED LOAD IN kW	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A
SWITCHGEAR RATING	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
SWITCHGEAR TYPE	CONC. RET AREA	CONC. RET AREA	CONC. RET AREA	CONC. RET AREA	CONC. RET AREA	STATION OUT ADD	STATION OUT ADD	SPARE	SPARE	SPARE
FEEDER DESCRIPTION										

APFC PANEL- 2 @ ASS-STATION

6A TP MCB, 0-500V DIGITAL, 400A,TPN, 50kA, MCCB, CT.400/5A CL.1.15VA, APFCR, A/M

400A TPN CU. BUS BAR, 36KA FOR 1 SEC

MCCB RATING IN AMPS	125 A	80 A	80 A	63 A	63 A	63 A
TRIP SETING IN AMPS	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB
KVAR RATING	37.5 KVAR	25 KVAR	25 KVAR	12.5 KVAR	12.5 KVAR	12.5 KVAR

FIRE PUMP PANEL (FPP)
CONNECTED LOAD–206KW
WORKING LOAD–100 KW

400A,TPN, 35kA, MCCB, 400/5A 15VA CL 1.0

400 AMPS TPN BUSBAR 'Cu' 35 kA FOR 1 SEC

FEEDER NUMBER	F1	F2	F3	F4	F5	F6
CONNECTED LOAD IN kW	50 kW	50 kW	50 kW	50 kW	3.0 kW	3.0 kW
SWITCHGEAR RATING	160 A	160 A	160 A	160 A	40 A	40 A
SWITCHGEAR TYPE	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB	TP MCCB
FEEDER DESCRIPTION	FIRE HYDRANT-1	FIRE HYDRANT-2 (STANDBY)	FIRE SPRINKLE-1	FIRE SPRINKLE-2	JOCKEY PUMP	JOCKEY PUMP (STANDBY)

AC POWER PANEL (ACPP)
CONNECTED LOAD –67.5KW

200A,TPN, 35kA, MCCB, 200/5A 15VA CL 1.0

200 AMPS TPN BUSBAR 'Cu' 35 kA FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
CONNECTED LOAD IN kW	21.6	21.6	21.6	2.40	0.20	0.10	-	-	-	-	-
SWITCHGEAR RATING	63 A	63 A	63 A	63 A	6 A	6 A	63A	6 A	6 A	6 A	6 A
SWITCHGEAR TYPE	TP MCB	TP MCB	TP MCB	TP MCB	DP MCB	DP MCB	TP MCB	DP MCB	DP MCB	DP MCB	DP MCB
FEEDER DESCRIPTION	OUT DOOR UNIT-1	OUT DOOR UNIT-2	OUT DOOR (STANDBY)	ACDB	IN DOOR	IN DOOR (STANDBY)	SPARE	FCU	SPARE	SPARE	SPARE

MAIN LIGHTING PANEL (MLP)
CONNECTED LOAD –73.0KW

160A,TPN, 35kA, MCCB, 160/5A 15VA CL 1.0

160 AMPS TPN BUSBAR 'Cu' 35 kA FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
CONNECTED LOAD IN kW	5.0	5.0	5.0	5.0	5.0	8.0	8.0	13.0	13.0	6.0	-	-	-
SWITCHGEAR RATING	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A	40 A
SWITCHGEAR TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	BA, LDB-1 TYPE-1	BA, LDB-2 TYPE-1	PA, LDB-1 TYPE-1	PB, LDB-2 TYPE-1	PB, LDB-1 TYPE-1	PA, LDB-2 TYPE-1	PA, LDB-3 TYPE-4	CA, LDB-1 TYPE-1	CB, LDB-2 TYPE-2	CC, LDB-1 TYPE-2	CD, LDB-2 TYPE-2	EXT, LDB-6 TYPE-3	SPARE

BATTERY — 80 kVA UPS

BATTERY — 80 kVA UPS

1SET OF 60KVA UPS

(SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF 60KVA UPS UNDER THE S&T CONTRACTOR SCOPE

BASEMENT-VENTILATION PANEL-2
CONNECTED LOAD : 44.76KW

125A,TPN, 35kA, MCCB, 125/5A 15VA CL 1.0

125 AMPS TPN BUSBAR 'Cu' 35 kA FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
CONNECTED LOAD IN kW	5.6	5.6	5.6	5.6	5.6	5.6	5.6	-	-	-
SWITCHGEAR RATING	63A	63A	63A	63A	63A	63A	63A	63A	63A	63A
SWITCHGEAR TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	EX.FAN-1	EX.FAN-2	EX.FAN-3	EX.FAN-4	EX.FAN-5	EX.FAN-6	EX.FAN-7	EX.FAN-8	SPARE	SPARE

AIR CONDITIONING DISTRIBUTION PANEL
FROM ACPP
63A TPN MCB

R: 240V, 1Ø, 2 WIRE, 100A 'Cu' BUS — 63A DP MCB
Y: 240V, 1Ø, 2 WIRE, 100A 'Cu' BUS — 63A DP MCB
B: 240V, 1Ø, 2 WIRE, 100A 'Cu' BUS — 63A DP MCB

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14
MCB RATING IN AMPS	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A
CABLE SIZE IN SQ. MM XLPE Cu/	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LOAD IN WATT	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CIRCUIT NO.	FCU	FCU	FCU	FCU	FCU	FCU	FCU	FCU	-	-	-	-	-	-

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14
	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FCU	FCU	FCU	FCU	FCU	FCU	FCU	FCU	-	-	-	-	-	-

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14
	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FCU	FCU	FCU	FCU	FCU	FCU	FCU	FCU	-	-	-	-	-	-

UPS PANEL
CONNECTED LOAD : 72.9KW

250A,TPN, 25kA, MCCB, 250/5A 15VA CL 1.0

250 AMPS TPN BUSBAR 'Cu' 25 kA FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25
CONNECTED LOAD IN kW	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.5	2.0	0.4	0.4	0.4	0.4	0.4	0.4	1.0	2.0	-	-	15	15	15	
SWITCHGEAR RATING	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	25A	63A	63A	63A	
SWITCHGEAR TYPE	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	DP MCB	TP MCB	TP MCB	TP MCB	
FEEDER DESCRIPTION	BA, LDB-1 TYPE-1	BA, LDB-2 TYPE-1	PA, LDB-1 TYPE-1	PB, LDB-2 TYPE-1	PB, LDB-1 TYPE-1	PC, LDB-3 TYPE-1	CA, LDB-1 TYPE-2	CB, LDB-2 TYPE-2	CC, LDB-1 TYPE-2	CD, LDB-2 TYPE-2	PACP/SR	ELEVA-1	ELEVA-2	ESCA-1	ESCA-2	ESCA-3	ESCA-4	ESCA-5	ESCA-6	DFMD	X-RAY MACHINE	SPARE	SPARE	PSD-1	PSD-2	PSD-3

BASEMENT-VENTILATION PANEL-1
CONNECTED LOAD : 44.76KW

125A,TPN, 35kA, MCCB, 125/5A 15VA CL 1.0

125 AMPS TPN BUSBAR 'Cu' 35 kA FOR 1 SEC.

FEEDER NUMBER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
CONNECTED LOAD IN kW	5.6	5.6	5.6	5.6	5.6	5.6	5.6	-	-	-
SWITCHGEAR RATING	63A	63A	63A	63A	63A	63A	63A	63A	63A	63A
SWITCHGEAR TYPE	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB	TPN MCCB
FEEDER DESCRIPTION	EX.FAN-1	EX.FAN-2	EX.FAN-3	EX.FAN-4	EX.FAN-5	EX.FAN-6	EX.FAN-7	EX.FAN-8	SPARE	SPARE

NOTE :–DETAILS –A – SUPPLY & INSTALLATION OF TRANSFORMER SCOPE OF POWER SUPPLY CONTRACTOR

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R2	11-12-2017			TECHNICAL DETAILS UPDATED
R1	24-08-2017			TECHNICAL DETAILS UPDATED

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: GENERAL PANEL DRAWING

DRAWING TITLE: MAIN SCHEMATIC DIAGRAM FOR AAREY STATION

SCALE: NTS

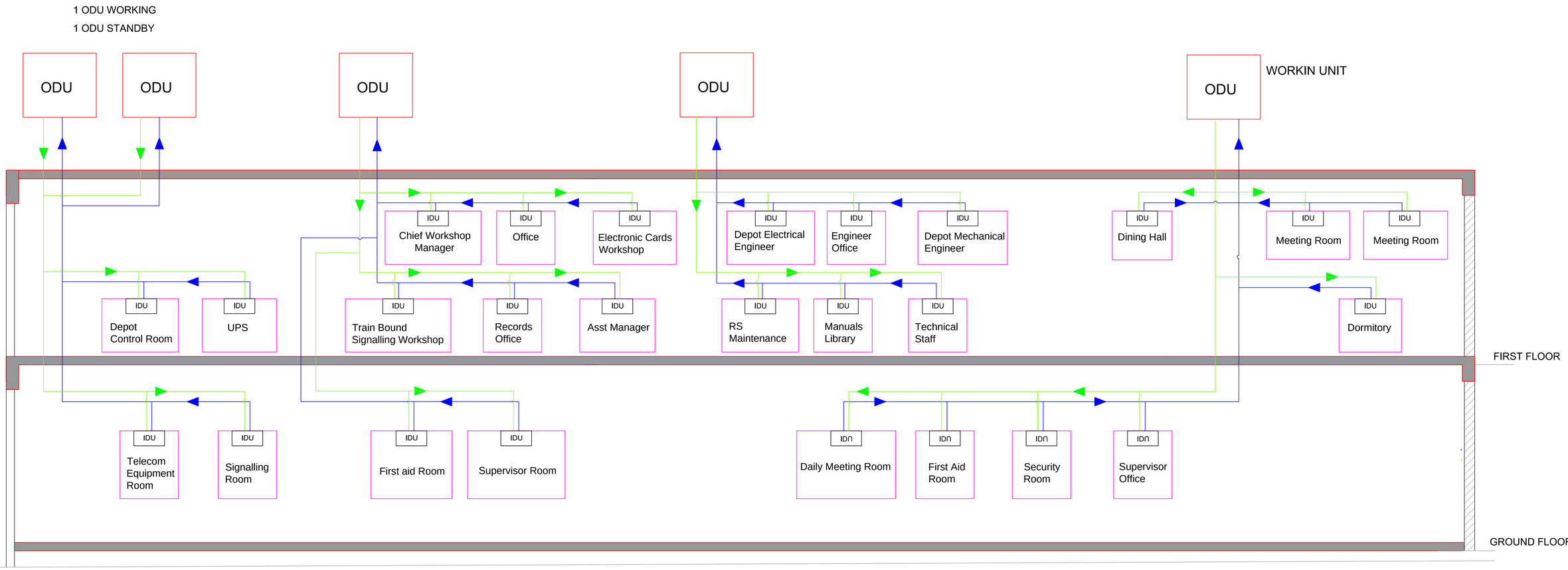
DRAWING NO: MM3-GC-DEL-GD-8-D09-1005

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

11-12-2017

Attachment No.12 To Addendum No. 5

TYPICAL VRF SCHEMATIC DRAWING FOR WORKSHOP BUILDING



NOTE: 1) IDU/ODU BASED ON CURRENT ARCHITECTURE PLAN

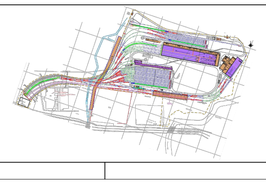
2) ACTUAL QTY. OF IDU/ODU SHALL BE ACCORDING TO FINAL ARCHITECTURE PLAN IF ANY ISSUED LATER.

Ref. Dwg. - MML3-CBS/MMRC/IC/DEP/AR/1001- DWG Status - P
MML3-CBS/MMRC/IC/DEP/AR/1002- DWG Status - P
MML3-CBS/MMRC/IC/DEP/AR/1003- DWG Status - P
MML3-CBS/MMRC/IC/DEP/AR/1004- DWG Status - P
Dwg Received as on 31 Oct 2017

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			AS PER REVISED ARCHITECT DRAWING

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN



E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC -2017

TITLE: VAC GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL VRF SCHEMATIC FOR WORKSHOP BUILDING

SCALE: NTS

DRAWING NO: MM3-GC-DVA-GD-08-D24-0001

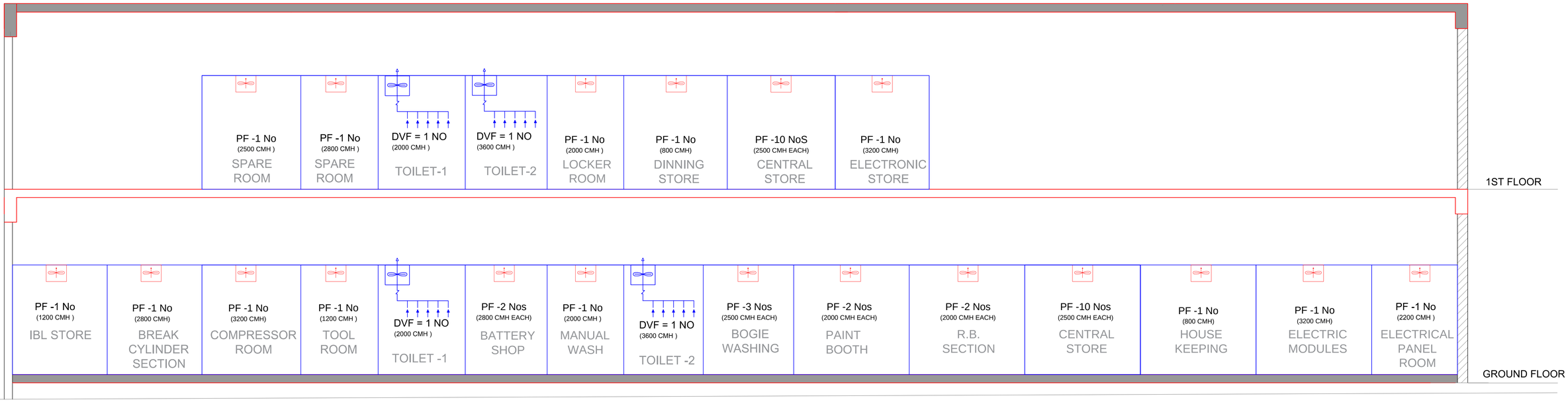
REV : R1

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D C B A

Attachment No.12 To Addendum No. 5

TYPICAL VENTILATION SCHEMATIC DRAWING FOR WORKSHOP BUILDING



Ref. Dwg. - MML3-CBS/MMRC/IC/DEP/AR/1001- DWG Status - P
MML3-CBS/MMRC/IC/DEP/AR/1002- DWG Status - P
MML3-CBS/MMRC/IC/DEP/AR/1003- DWG Status - P
MML3-CBS/MMRC/IC/DEP/AR/1004- DWG Status - P
Dwg Received as on 31 Oct 2017

LEGENDS:

SYMBOL	DESCRIPTION
	Wall Mounted PROPELLER FAN
	DUCTABLE AXIAL FAN

NOTE:
DVF = DUCTABLE VENTILATION FAN
PF = PROPELLER FAN

NOTE : FRESH AIR COMING FROM FRESH AIR LOUVERS

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R0	11-12-17			AS PER REVISED ARCHITECT DRAWING

MMRC

GENERAL CONSULTANCY SERVICES
FOR MUMBAI METRO RAIL PROJECT,LINE No. 3
COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC - 2017

TITLE: VAC GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL VENTILATION SCHEMATIC FOR WORKSHOP BUILDING

SCALE: NTS

DRAWING NO: MM3-GC-DVA-GD-08-D24-0028

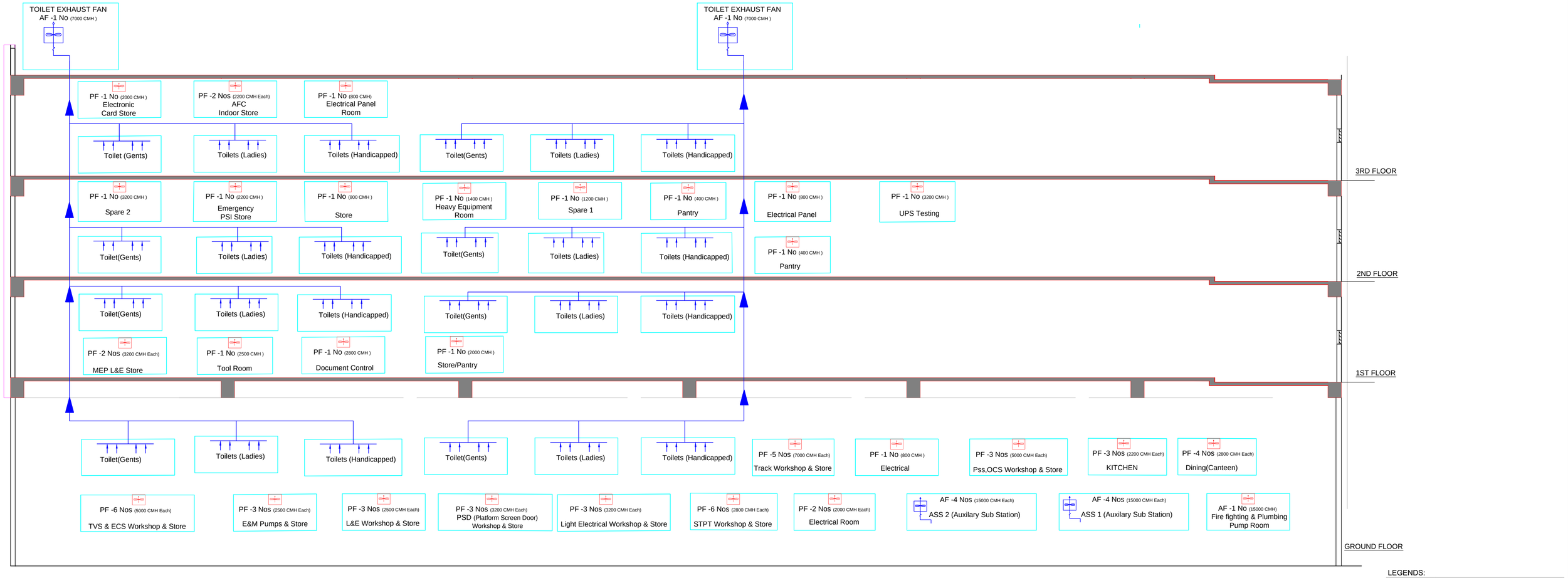
REV: R0

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

F E D C B A

Attachment No.12 to Addendum No.5

TYPICAL VENTILATION SCHEMATIC DIAGRAM FOR OCC BUILDING



NOTE : 1) FRESH AIR COMING FROM FRESH AIR LOUVERS.
2) FOR QTY OF VENTILATION FANS PLEASE REFER BOQ.

Ref. Dwg. - Dwg Received as on 31 Oct 2017

LEGENDS:

SYMBOL	DESCRIPTION
	PROPELLER FAN (Ventilation Fan)
	AXIAL FAN (Ventilation Fan)

NOTE:

PF = PROPELLER FAN
AF = AXIAL FAN

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R0	11-12-17			AS PER REVISED ARCHITECT DRAWING

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: VAC GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL VENTILATION SCHEMATIC FOR OCC BUILDING

SCALE: NTS

DRAWING NO: MM3-GC-DVA-GD-08-D24-0029

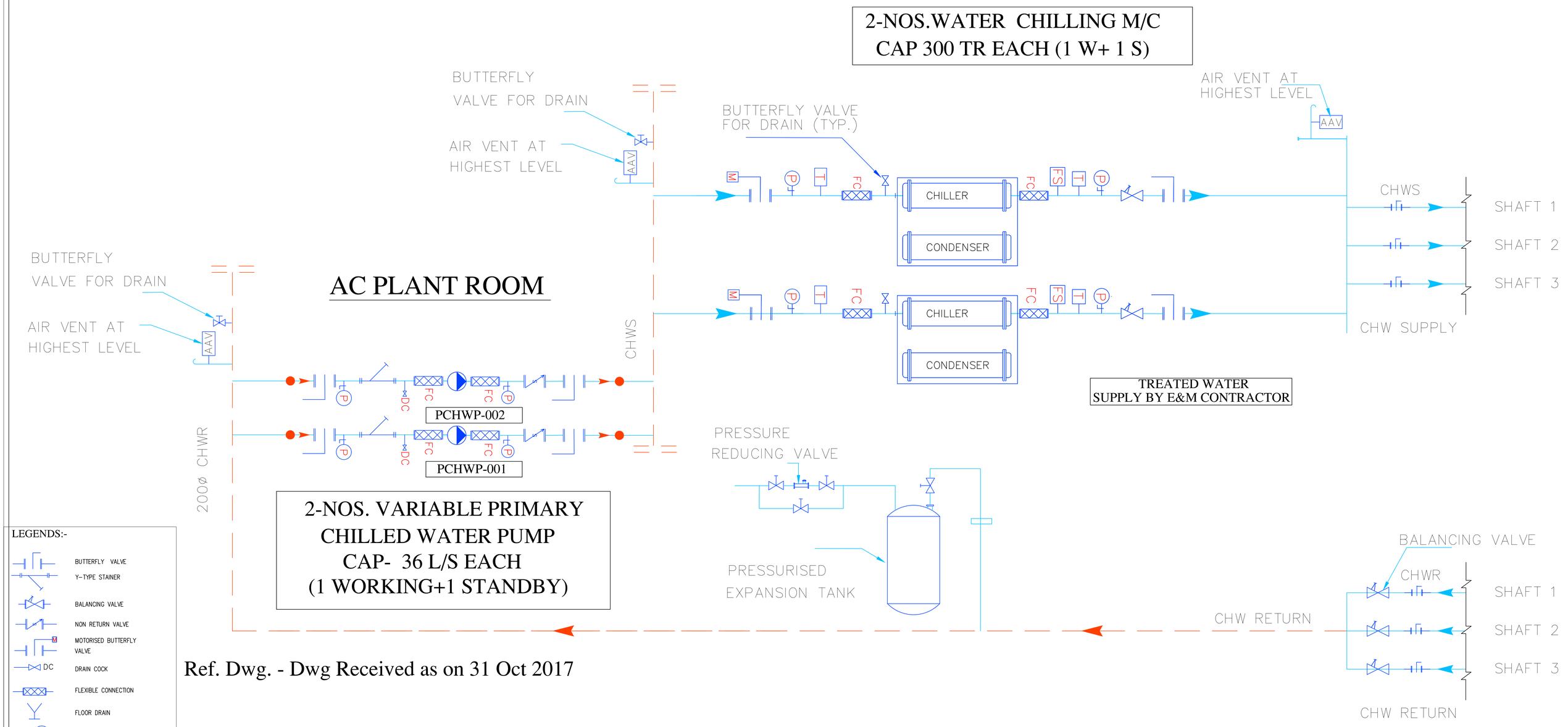
maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

11-12-2017

F E D C B A

Attachment No.12 To Addendum No.5

TYPICAL CHILLED WATER SCHEMATIC DRAWING FOR OCC BUILDING



Ref. Dwg. - Dwg Received as on 31 Oct 2017

LEGENDS:-

- BUTTERFLY VALVE
- Y-TYPE STAINER
- BALANCING VALVE
- NON RETURN VALVE
- MOTORISED BUTTERFLY VALVE
- DC — DRAIN COCK
- FLEXIBLE CONNECTION
- FLOOR DRAIN
- P — PRESSURE GAUGE
- THERMOMETER
- FS — FLOW SWITCH (DPS)
- AAV — AUTOMATIC AIR VENT
- GATE VALVE
- NEEDLE VALVE

ABBREVIATIONS:-

CH	CHILLING UNIT
CWP	CONDENSER WATER PUMP
NB	NOMINAL BORE

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R0	11-12-17			AS PER REVISED ARCHITECT DRAWING

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC -2017

TITLE: VAC GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL CHILLED WATER SCHEMATIC FOR OCC BUILDING (Sheet 1 of 2)

SCALE: NTS

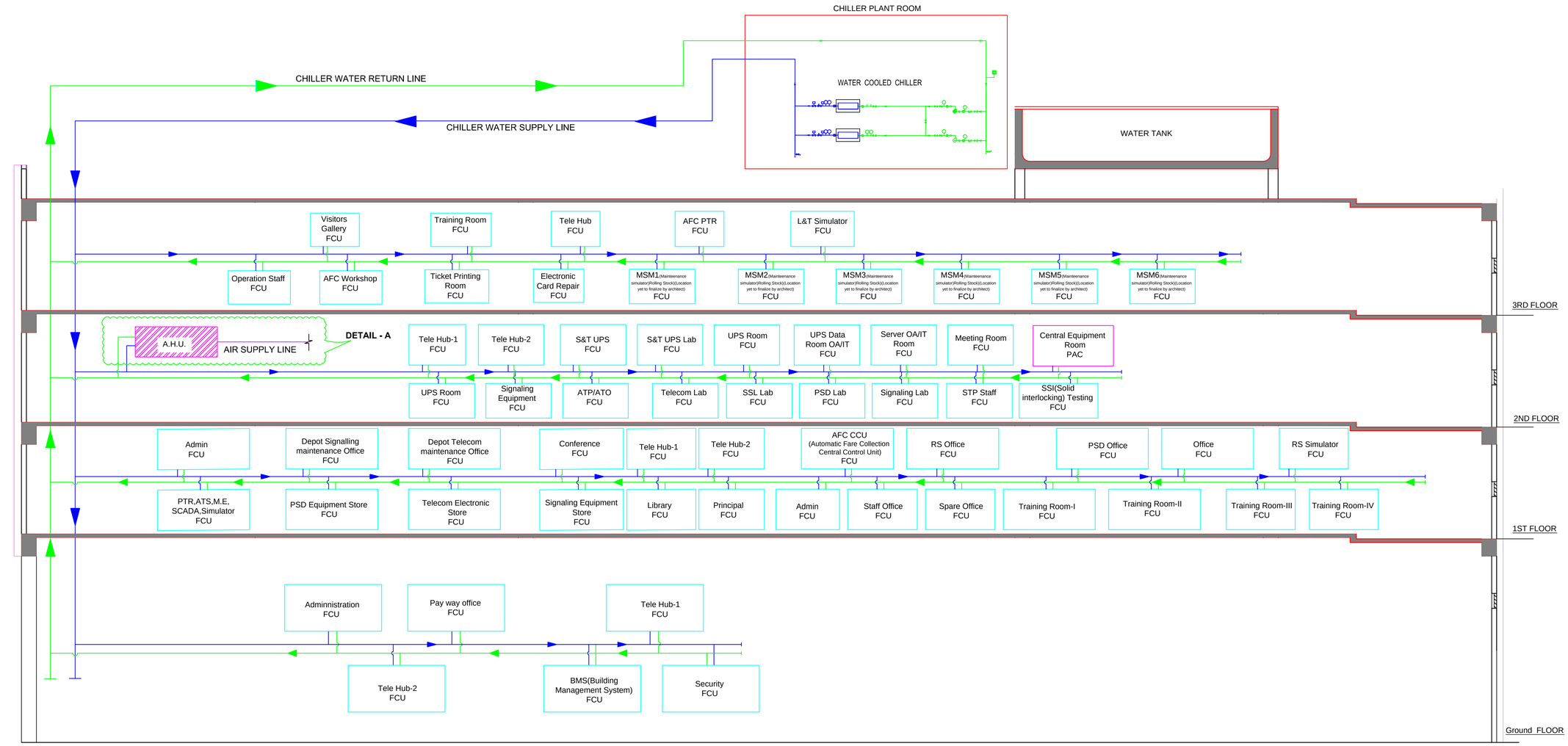
DRAWING NO: MM3-GC-DVA-GD-08-D24-0030 R0

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D C B A

Attachment No.12 to Addendum No.5

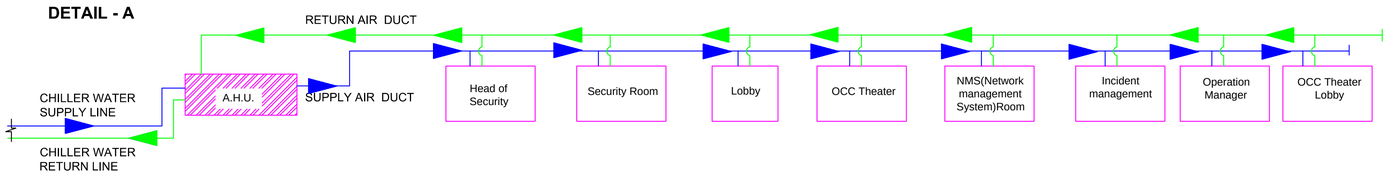
TYPICAL CHILLED WATER SCHEMATIC DRAWING FOR OCC BUILDING



ABBREVIATIONS

FCU - FAN COIL UNIT
PAC - PRECISION AIR CONDITIONER
AHU - AIR HANDLING UNIT

DETAIL - A



NOTE : 1) QTY OF AIR CONDITION EQUIPMENT AS PER BOQ.

2) FCU SHALL BE PROVIDED AS PER FINAL APPROVED LAYOUT.

Ref. Dwg. - Dwg Received as on 31 Oct 2017

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R0	11-12-17			AS PER REVISED ARCHITECT DRAWING

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: VAC GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL CHILLED WATER SCHEMATIC FOR OCC BUILDING (SH 2 OF 2)

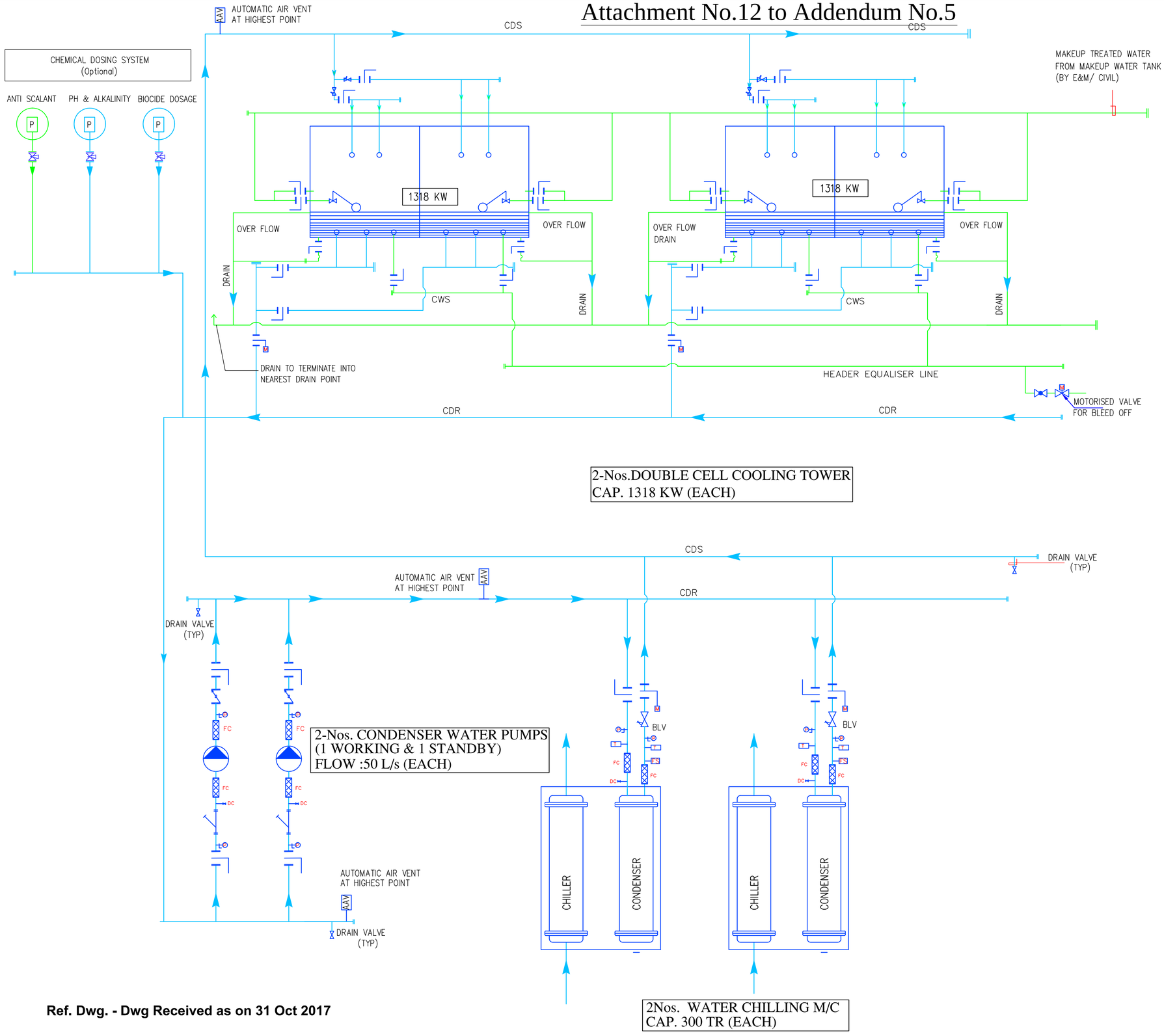
SCALE: NTS

DRAWING NO: MM3-GC-DVA-GD-08-D24-0031

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D C B A

Attachment No.12 to Addendum No.5



Ref. Dwg. - Dwg Received as on 31 Oct 2017

LEGENDS:-

- CONDENSER WATER FLOW PIPE LINE
- CONDENSER WATER RETURN PIPE LINE
- BUTTERFLY VALVE
- Y-TYPE STAINER
- BALANCING VALVE
- NON RETURN VALVE
- MOTORISED BUTTERFLY VALVE
- DC DRAIN COCK
- FLEXIBLE CONNECTION
- FLOOR DRAIN
- P PRESSURE GAUGE
- THERMOMETER
- FS FLOW SWITCH (DPS)
- AAV AUTOMATIC AIR VENT
- GATE VALVE
- NEEDLE VALVE

ABBREVIATIONS:-

CH	CHILLING UNIT
CWP	CONDENSER WATER PUMP
NB	NOMINAL BORE
CWF	CONDENSER WATER FLOW
CWR	CONDENSER WATER RETURN
CT	COOLING TOWER

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R0	11-12-17			AS PER REVISED ARCHITECT DRAWING

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		
11-12-2017		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: VAC GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL CONDENSER WATER SCHEMATIC FOR OCC BUILDING

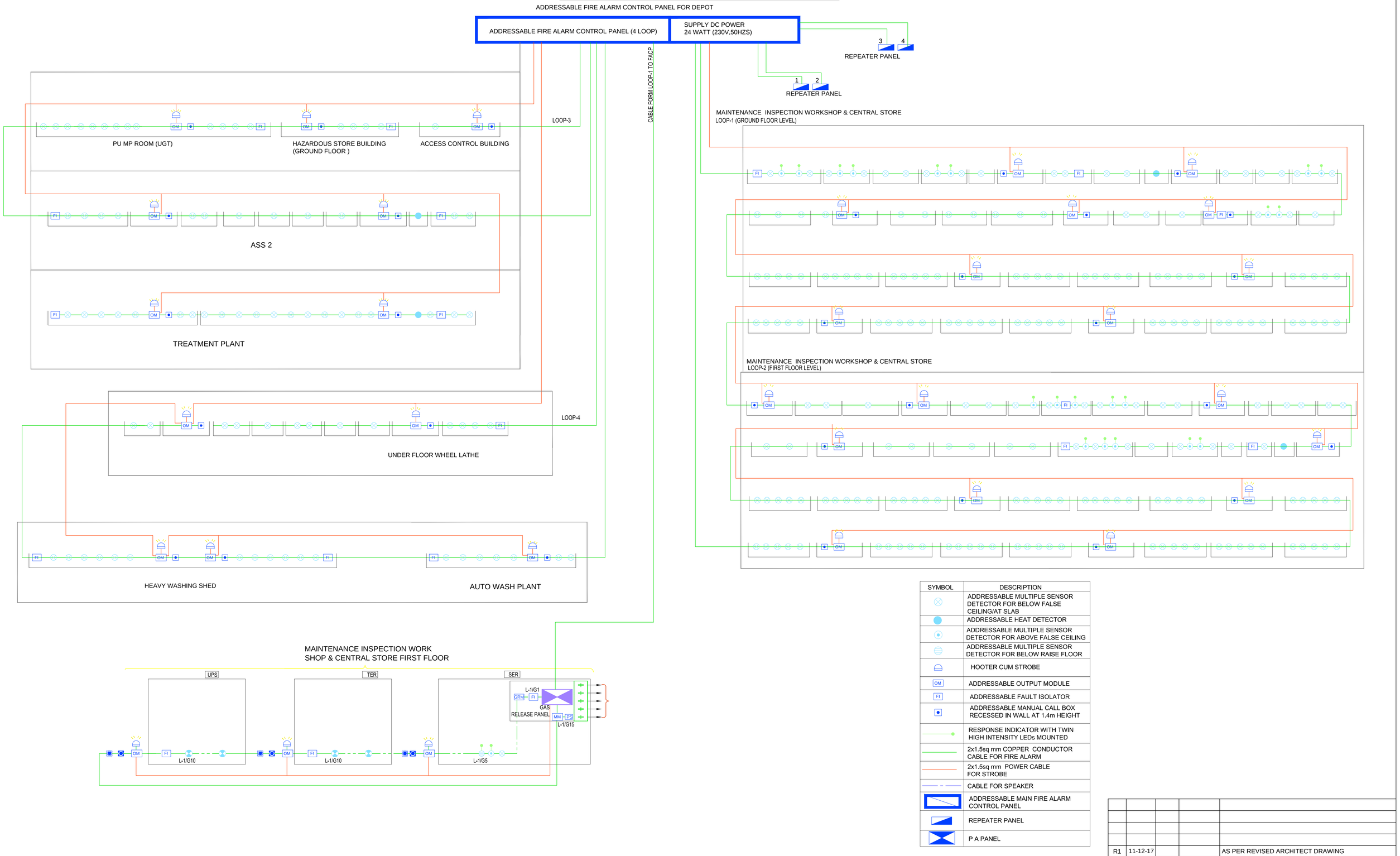
SCALE: NTS

DRAWING NO: MM3-GC-DVA-GD-08-D24-0032 R0

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D C B A

Attachment No.12 to Addendum No.5



SYMBOL	DESCRIPTION
	ADDRESSABLE MULTIPLE SENSOR DETECTOR FOR BELOW FALSE CEILING/AT SLAB
	ADDRESSABLE HEAT DETECTOR
	ADDRESSABLE MULTIPLE SENSOR DETECTOR FOR ABOVE FALSE CEILING
	ADDRESSABLE MULTIPLE SENSOR DETECTOR FOR BELOW RAISE FLOOR
	HOOTER CUM STROBE
OM	ADDRESSABLE OUTPUT MODULE
FI	ADDRESSABLE FAULT ISOLATOR
	ADDRESSABLE MANUAL CALL BOX RECESSED IN WALL AT 1.4m HEIGHT
	RESPONSE INDICATOR WITH TWIN HIGH INTENSITY LEDs MOUNTED
	2x1.5sq mm COPPER CONDUCTOR CABLE FOR FIRE ALARM
	2x1.5sq mm POWER CABLE FOR STROBE
	CABLE FOR SPEAKER
	ADDRESSABLE MAIN FIRE ALARM CONTROL PANEL
	REPEATER PANEL
	P A PANEL

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			AS PER REVISED ARCHITECT DRAWING

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

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	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: FF GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL SINGLE LINE DIAGRAM FIRE ALARM SYSTEM DEPOT

SCALE: NTS

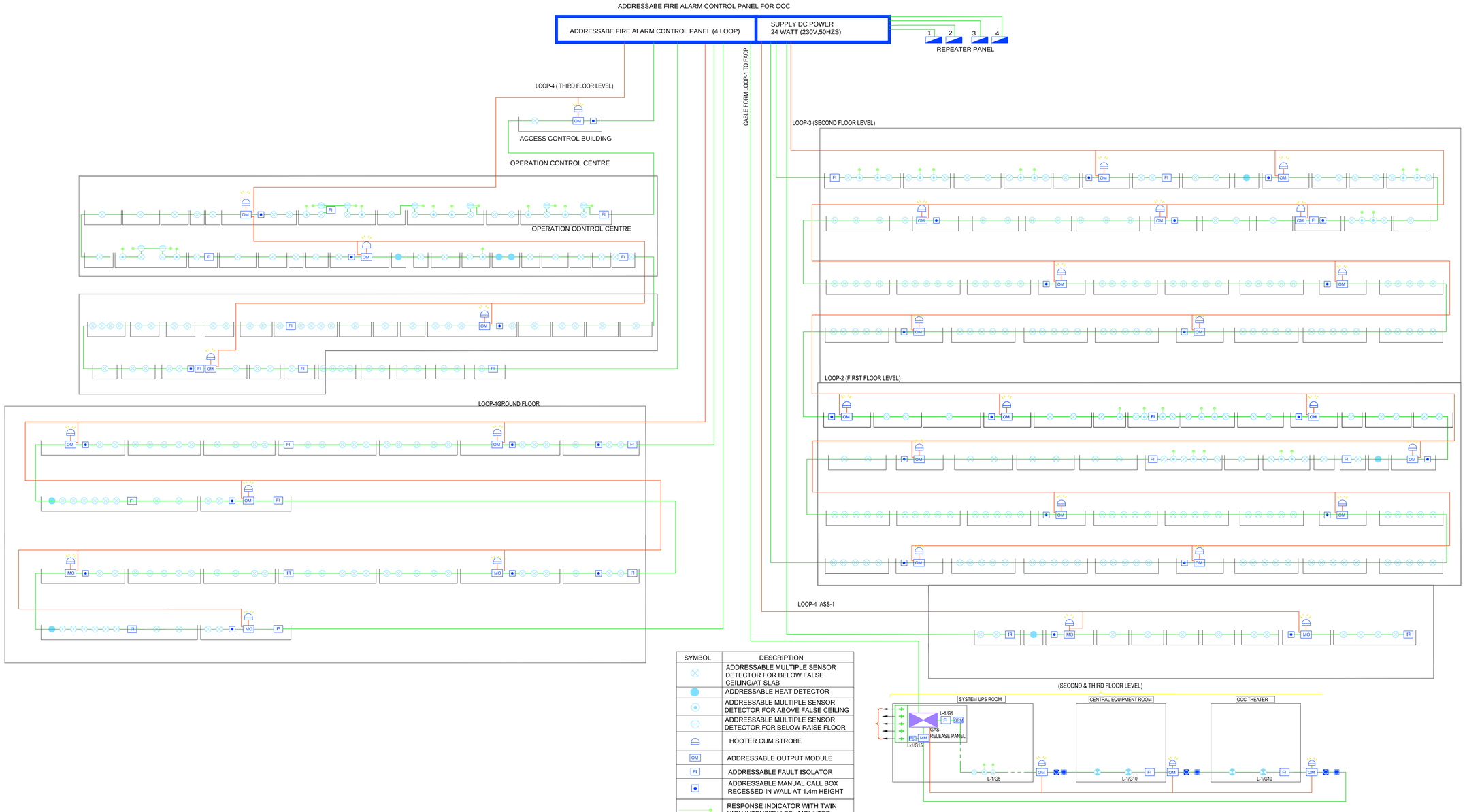
DRAWING NO: MM3-GC-DFF-GD-08-D10-0004

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

F E D C B A

Attachment No.12 to Addendum No.5

TYPICAL SINGLE LINE DIAGRAM FIRE ALARM SYSTEM OCC AND INFRASTRUCTURE BUILDING



SYMBOL	DESCRIPTION
	ADDRESSABLE MULTIPLE SENSOR DETECTOR FOR BELOW FALSE CEILING/AT SLAB
	ADDRESSABLE HEAT DETECTOR
	ADDRESSABLE MULTIPLE SENSOR DETECTOR FOR ABOVE FALSE CEILING
	ADDRESSABLE MULTIPLE SENSOR DETECTOR FOR BELOW RAISE FLOOR
	HOOTER CUM STROBE
OM	ADDRESSABLE OUTPUT MODULE
FI	ADDRESSABLE FAULT ISOLATOR
	ADDRESSABLE MANUAL CALL BOX RECESSED IN WALL AT 1.4m HEIGHT
	RESPONSE INDICATOR WITH TWIN HIGH INTENSITY LEDs MOUNTED
	2x1.5sq mm COPPER CONDUCTOR CABLE FOR FIRE ALARM
	2x1.5sq mm POWER CABLE FOR STROBE
	CABLE FOR SPEAKER
	ADDRESSABLE MAIN FIRE ALARM CONTROL PANEL
	REPEATER PANEL
	P A PANEL

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			AS PER REVISED ARCHITECT DRAWING

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: FF GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL SINGLE LINE DIAGRAM FIRE ALARM SYSTEM OCC

SCALE: NTS

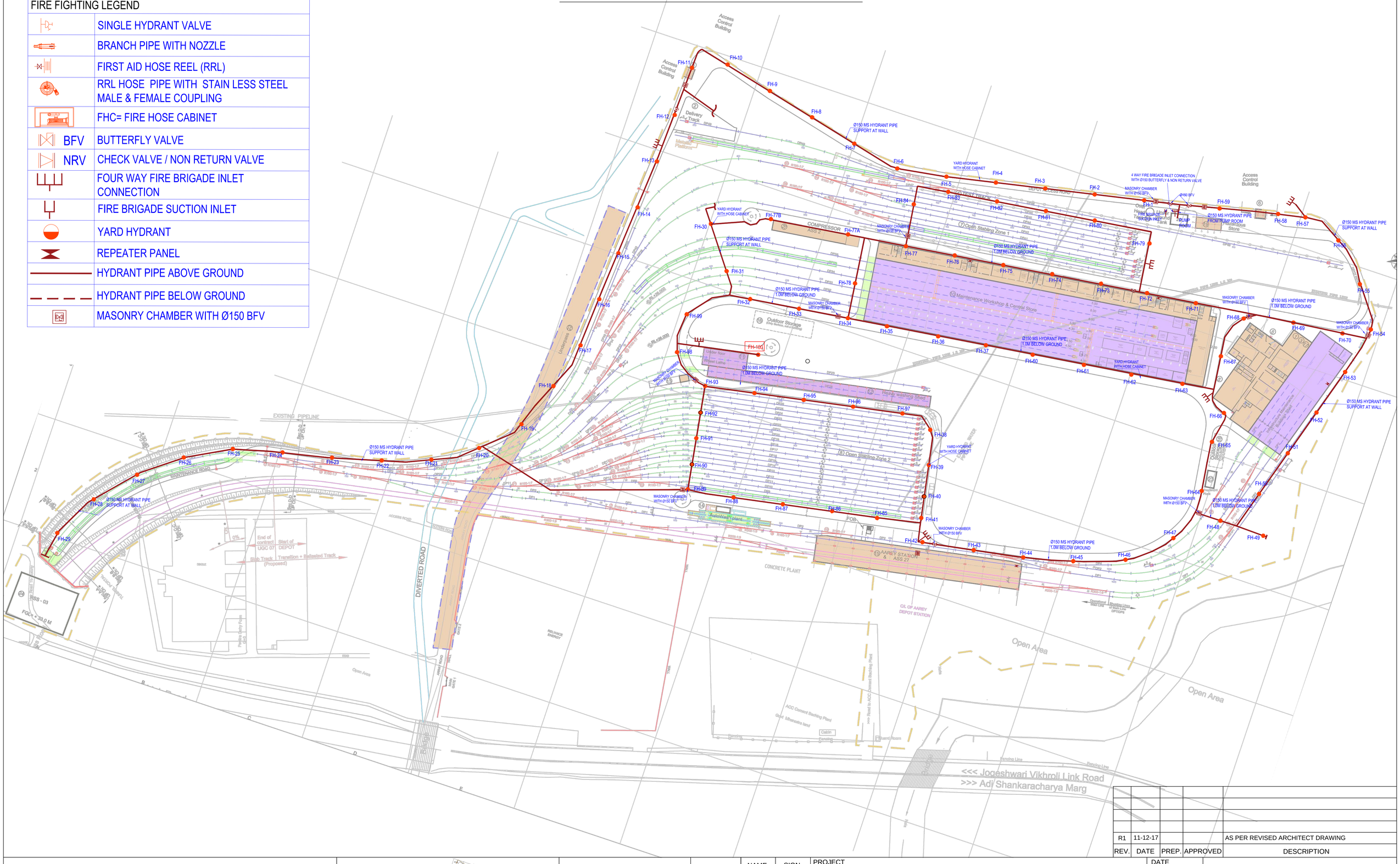
DRAWING NO: MM3-GC-DFF-GD-08-D10-0005

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

F | E | D | 11-12-2017 | C | B | A

Attachment No.12 to Addendum No.5

FIRE FIGHTING LEGEND	
	SINGLE HYDRANT VALVE
	BRANCH PIPE WITH NOZZLE
	FIRST AID HOSE REEL (RRL)
	RRL HOSE PIPE WITH STAIN LESS STEEL MALE & FEMALE COUPLING
	FHC= FIRE HOSE CABINET
BFV	BUTTERFLY VALVE
NRV	CHECK VALVE / NON RETURN VALVE
	FOUR WAY FIRE BRIGADE INLET CONNECTION
	FIRE BRIGADE SUCTION INLET
	YARD HYDRANT
	REPEATER PANEL
	HYDRANT PIPE ABOVE GROUND
	HYDRANT PIPE BELOW GROUND
	MASONRY CHAMBER WITH Ø150 BFV



REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			AS PER REVISED ARCHITECT DRAWING

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

PROJECT	MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ
DATE	DEC-2017
TITLE	FF GENERAL ARRANGEMENT DRAWING
DRAWING TITLE	FIRE SUPPRESSION SYSTEM
SCALE	NTS
DRAWING NO	MM3-GC-DFF-GD-08-D10-0001

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

11-12-2017

F E D C B A

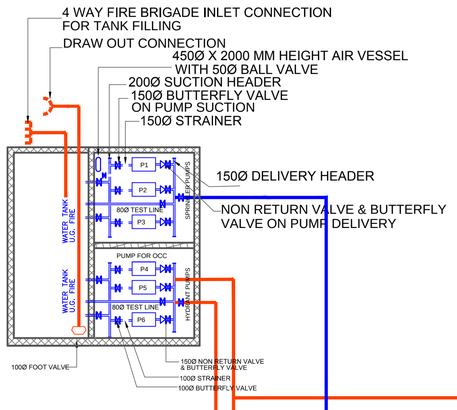
Attachment No.12 to Addendum No.5

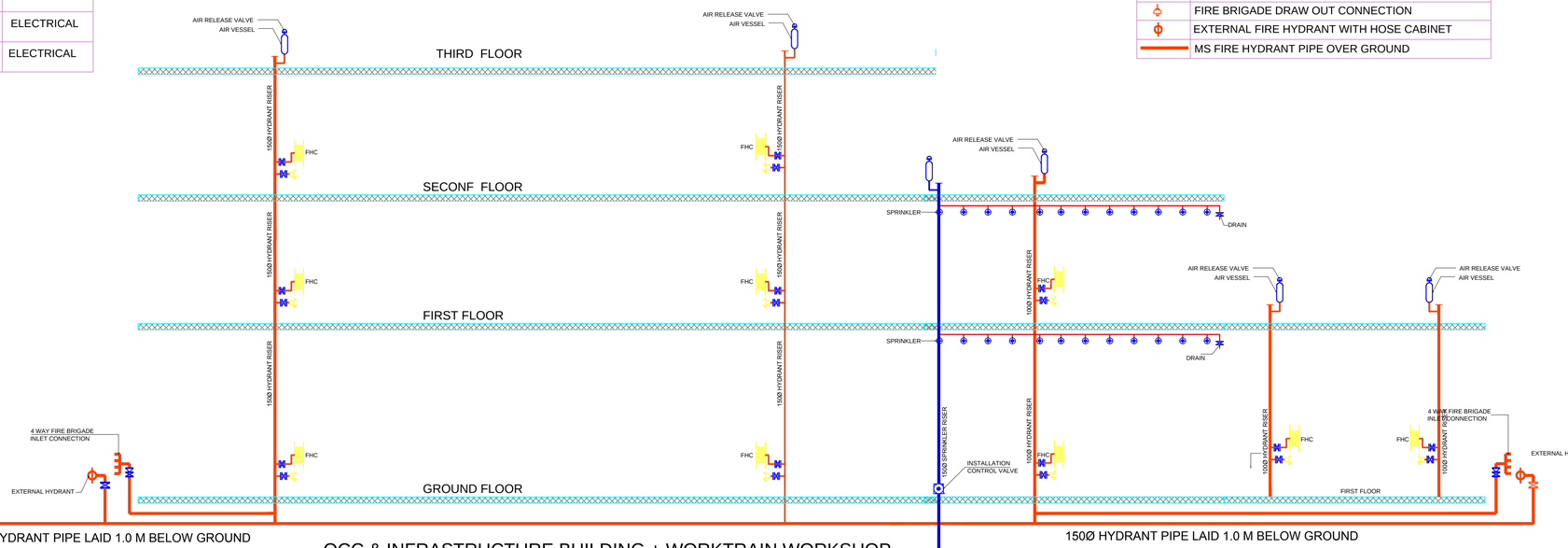
SCHEMATIC DIAGRAM FOR FIRE FIGHTING SYSTEM
SCALE : NTS

EQUIPMENT LIST					
TAG NO.	DESCRIPTION	CAPACITY	HEAD	QTY.	DESCRIPTION
P1	MAIN PUMP	2850 LPM	90 MTRS.	1 NO.	ELECTRICAL
P2	STANDBY PUMP	2850 LPM	90 MTRS.	1 NO.	ELECTRICAL
P3	JOCKEY PUMP (VERTICAL)	180 LPM	90 MTRS.	1 NO.	ELECTRICAL
P4	MAIN PUMP FOR OCC	2850 LPM	90 MTRS.	1 NO.	ELECTRICAL
P5	STANDBY PUMP FOR OCC	2850 LPM	90 MTRS.	1 NO.	ELECTRICAL
P5	JOCKEY PUMP FOR OCC	180 LPM	90 MTRS.	1 NO.	ELECTRICAL

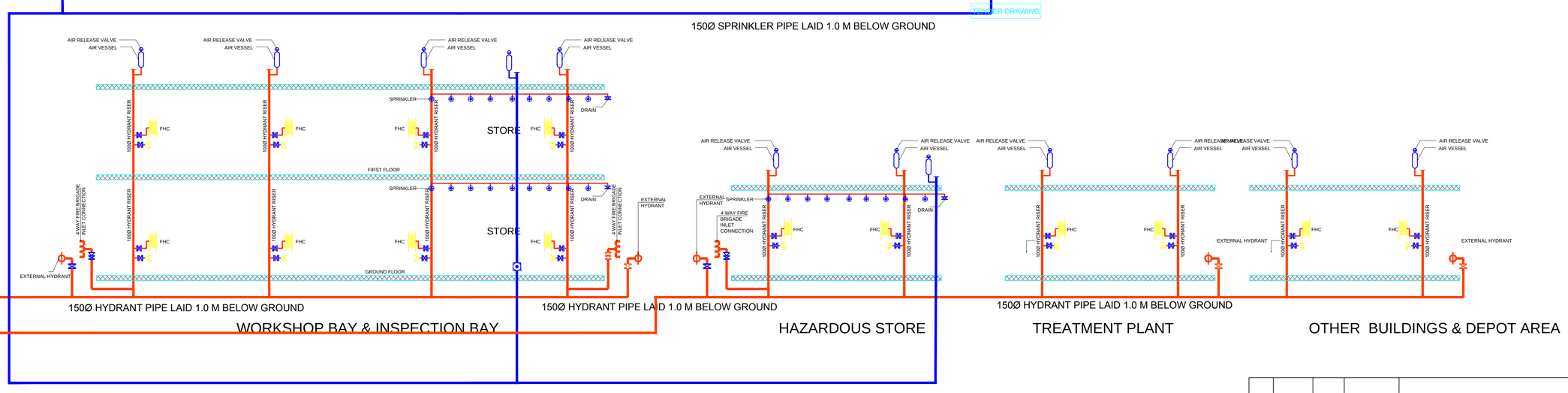
LEGEND

SYMBOL	DESCRIPTION
	FIRE PIPE RISER
	FIRST AID HOSE REEL WITH 36m X Ø20mm HOSE PIPE WITH 25mm DIA BALL VALVE
	STAINLESS STEEL OBLIQUE SINGLE LANDING VALVE TO IS:5290 WITH INSTANTANEOUS COUPLING
	NON-RETURN VALVE (NRV)
	BUTTERFLY VALVE (BFV)
	FOUR WAY FIRE BRIGADE INLET CONNECTION
	FIRE BRIGADE DRAW OUT CONNECTION
	EXTERNAL FIRE HYDRANT WITH HOSE CABINET
	MS FIRE HYDRANT PIPE OVER GROUND





OCC & INFRASTRUCTURE BUILDING + WORKTRAIN WORKSHOP



REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11.12.17			Layout scheme revised as per revised drawings

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: FF GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL FIRE SUPPRESSION SYSTEM FOR DEPOT

SCALE: NTS

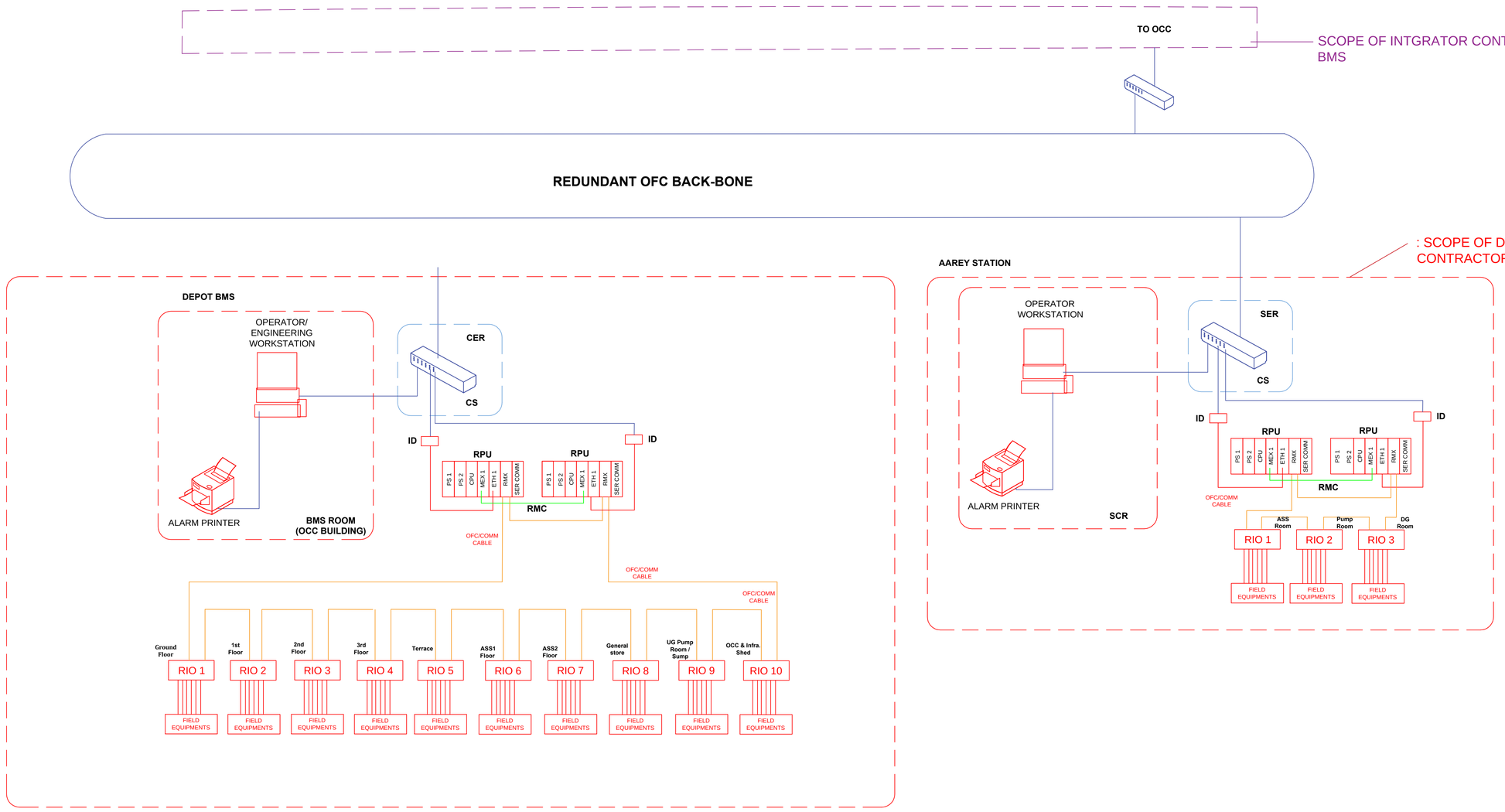
DRAWING NO: MM3-GC-DFF-GD-8-D10-0002

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D C B A

Attachment No. 12 To Addendum No. 5

BMS SYSTEM ARCHITECTURE



LEGENDS:

- : SCOPE OF DEPOT E & M CONTRACTOR FOR BMS
- : SCOPE OF S & T CONTRACTOR FOR BMS
- : SCOPE OF INTGRATOR CONTRACTOR FOR STATION BMS AND DEPOT BMS

RPU – REMOTE PROCESSING UNIT
OCC – OPERATION CONTROL CENTER
BCC – BACKUP CONTROL CENTER
DCC – DEPOT CONTROL CENTER
SCR – STATION CONTROL ROOM
BMS – BUILDING MANAGEMENT SYSTEM
LAN – LOCAL AREA NETWORK
FOC – FIBER OPTIC CABLE
SER – STATION EQUIPMENT ROOM
TER – TELECOM EQUIPMENT ROOM
CS – COMMUNICATION SWITCH
RMC – REDUNDANCY MESSAGE CHANNEL
RIO – REMOTE INPUT OUTPUT
ID – INTERFACE DEVICE

NOTE: -

- Station Data will be available at the Redundant Server at OCC BMS Room
- RPU is comprise of Power Supply, Interface Modules, Control/Communication Module and Remote Input/Output Modules
- Field Equipments are the monitoring & control equipments from LV/MV Distribution System, Lighting System, Fire Alarm and Fire fighting system, Lift & Escalator, DG, UPS, Water supply and drainage system etc
- OFC/Comm cable for Remote IO network is in BMS Vendor's scope

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R2	11-12-17			Revised room name
R1	24-08-17			Revised Drawing

GENERAL CONSULTANCY SERVICES
FOR MUMBAI METRO RAIL PROJECT,LINE No. 3
COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

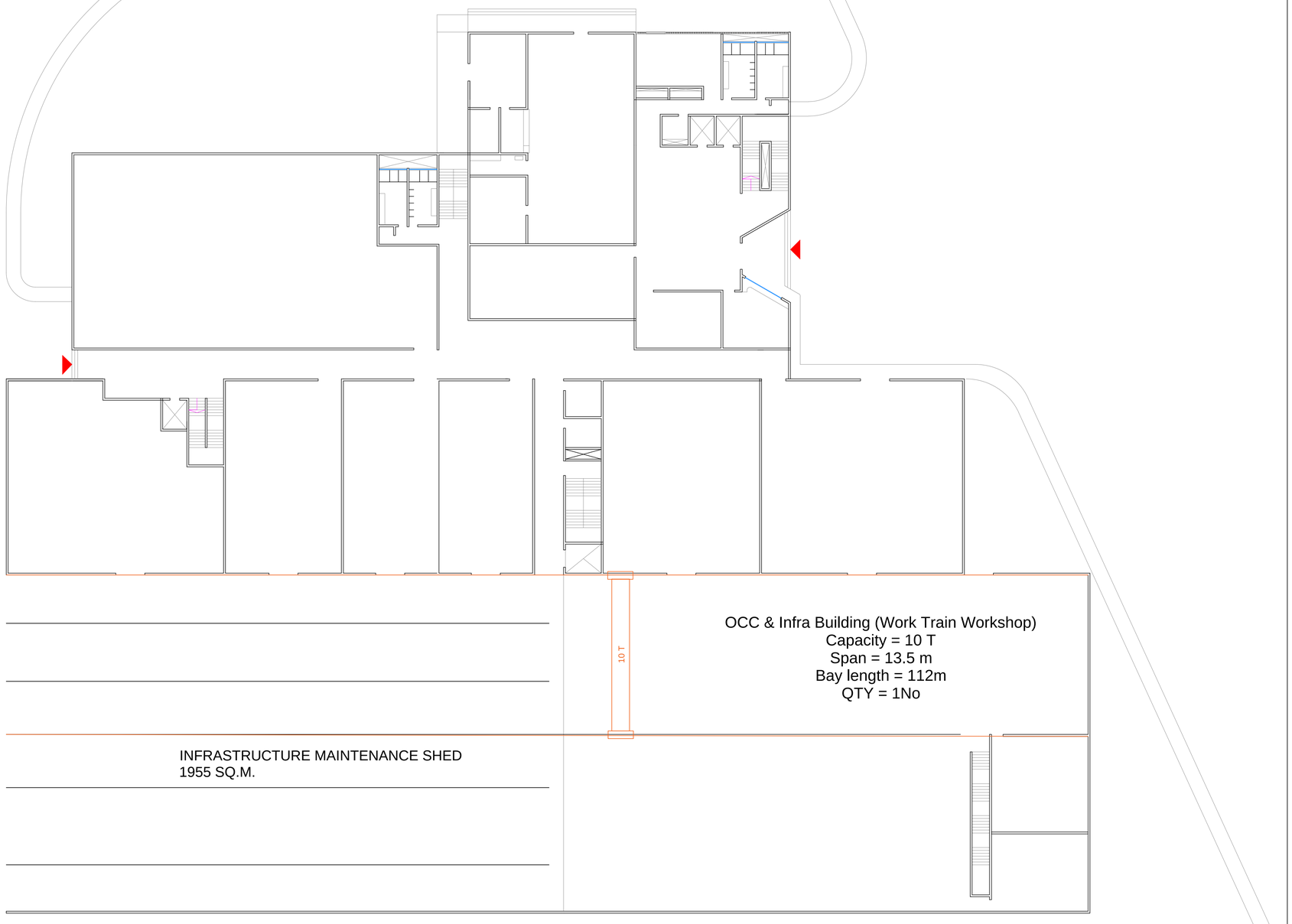
PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ
DATE: DEC-2017
TITLE: BMS GENERAL ARRANGEMENT DRAWING
DRAWING TITLE: TYPICAL BMS ARCHITECTURAL DRAWING
SCALE: NTS
DRAWING NO: MM3-GC-DBM-GD-08-D23-0001

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F | E | D | 11-DEC-2017 | C | B | A

Attachment No.12 To Addendum No.5

TYPICAL EOT SCOPE OF WORK DEM & CIVIL _OCC & INFRASTRUCTURE MAINTENANCE BUILDING (VEHICULAR & WORKTRAIN WORKSHOP)



NOTES:

1) ALL EOT Crane INSTALLATION TESTING & COMMISSIONING IS E&M SCOPE OF WORK.
2) ALL THE CIVIL STRUCTURE AND RELATED WORK IS CIVIL SCOPE OF WORK
3) FOR MORE DETAIL ABOUT SPAN LENGTH, WIDTHS, AND HEIGHT REFER CIVIL TENDER DRAWINGS OR COORDINATE WITH CIVIL

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			AS PER REVISED ARCHITECT DRAWING

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: EOT CRANE GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL EOT SCOPE OF WORK DEM & CIVIL

SCALE: NTS

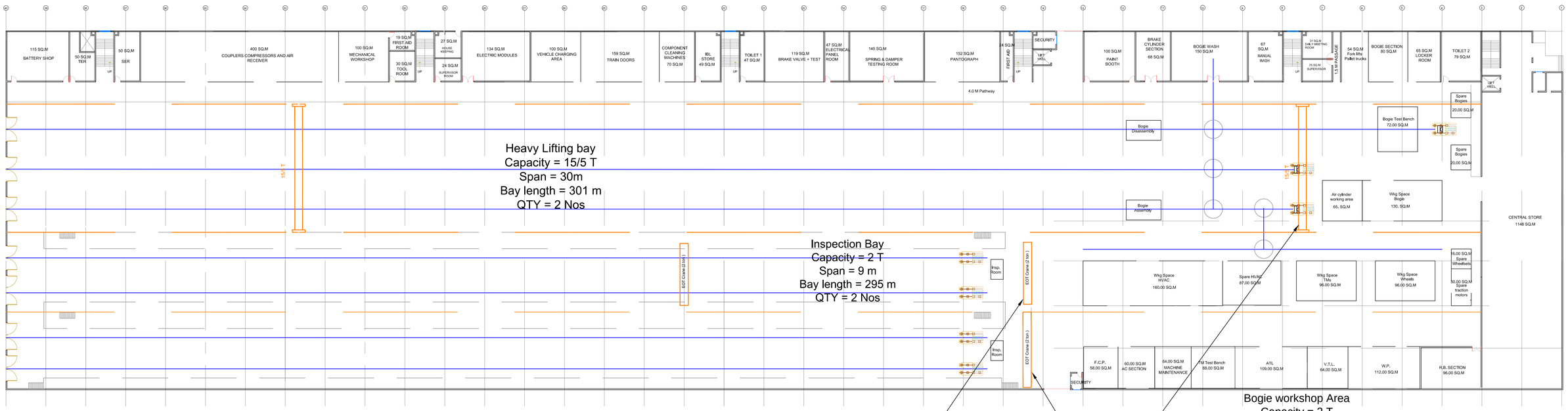
DRAWING NO: MM3-GC-DIM-GD-08-D07-0105

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D C B A

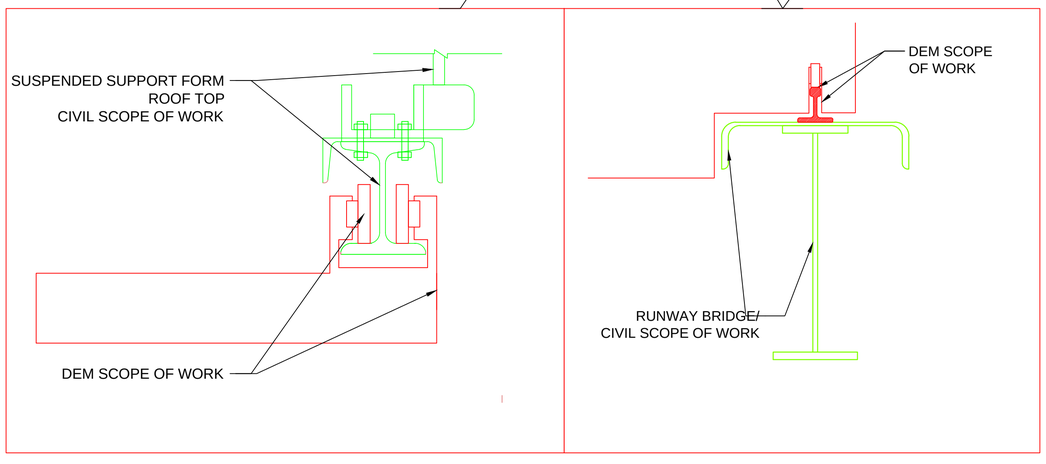
Attachment No. 12 To Addendum No.5

TYPICAL EOT SCOPE OF WORK DEM & CIVIL
(MAINTENANCE & INSPECTION WORKSHOP AND CENTRAL STORE)



GROUND FLOOR PLAN

GROUND FLOOR PLAN



NOTES:

1) ALL EOT Crane INSTALLATION TESTING & COMMISSIONING IS E&M SCOPE OF WORK.
2) ALL THE CIVIL STRUCTURE AND RELATED WORK IS CIVIL SCOPE OF WORK
3) FOR MORE DETAIL ABOUT SPAN LENGTH, WIDTHS, AND HEIGHT REFER CIVIL TENDER DRAWINGS OR COORDINATE WITH CIVIL

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11/12/17			MODIFIED AS PER ARCHITECTURAL CHANGE

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC 2017

TITLE: EOT CRANE GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: TYPICAL EOT SCOPE OF WORK DEM & CIVIL

SCALE: NTS

DRAWING NO: MM3-GC-DIM-GD-08-D07-0106

11-12-2017

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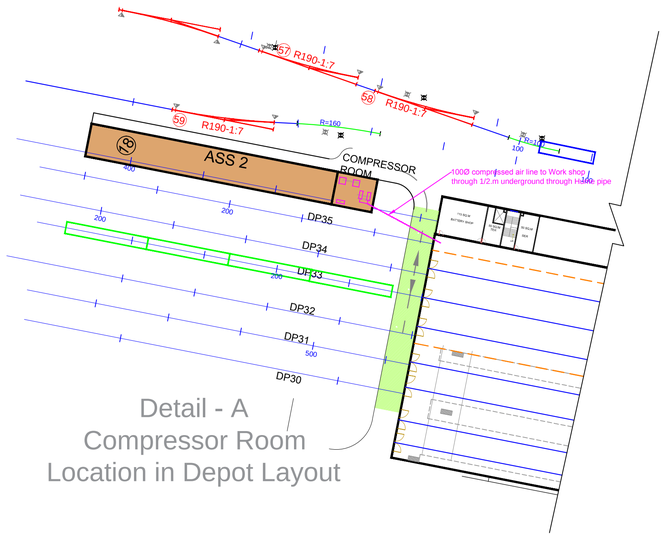
F E D C B A

Attachment No. 12 To Addendum No.5

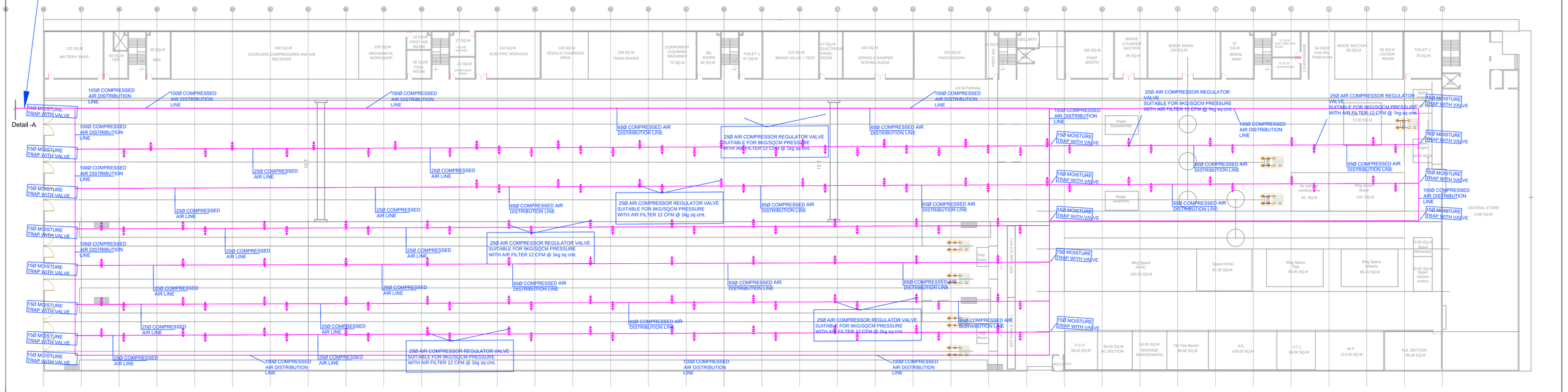
COMPRESSED AIR LINE FOR MAINTENANCE -INSPECTION WORKSHOP & CENTRAL STORE



LEGENDS

	COMPRESSOR
	RESERVIOR
	AIR COMPRESSOR REGULATOR VALVE
	COMPRESSOR AIR PIPING (25Ø , 65Ø , 100Ø)
	MOISTURE TRAP WITH VALVE

100Ø COMPRESSED AIR LINE
1/2 M UNDERGROUND THROUGH HUME PIPE
FROM COMPRESSOR ROOM



GROUND FLOOR PLAN

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11/12/2017			drawing revised as per revised depot layout
R0	08/08/2017			

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: COMPRESSED AIR GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: COMPRESSED AIR LINE FOR MAINTENANCE T INSPECTION WORKSHOP & CENTRAL STORE

SCALE: NTS

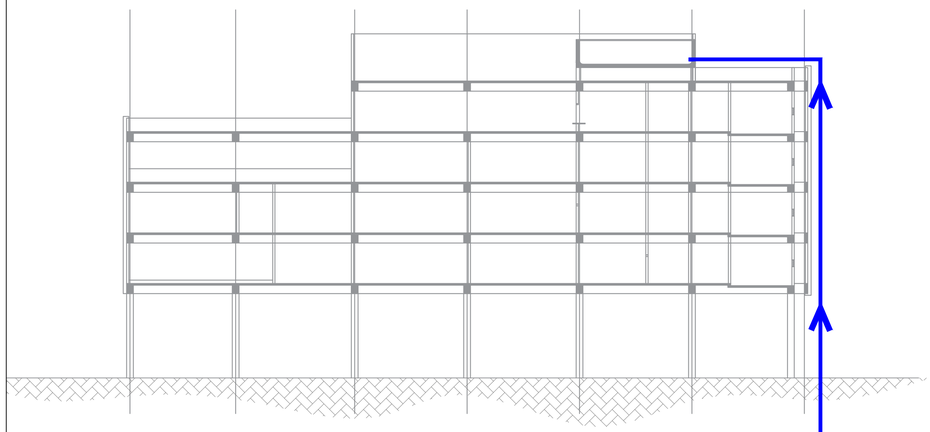
DRAWING NO: MM3-GC-DIM-GD-08-D07-0101

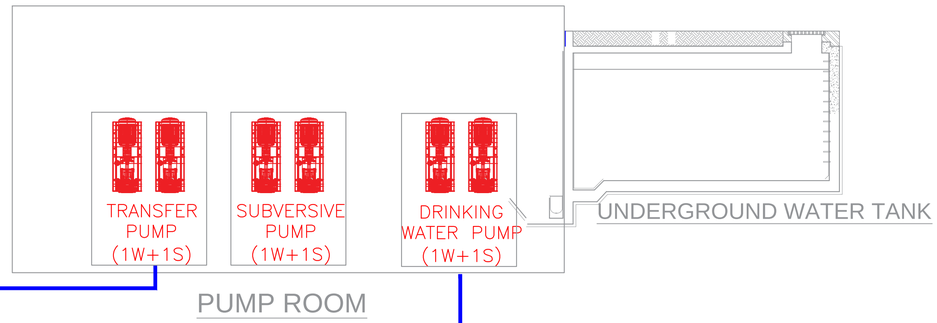
maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

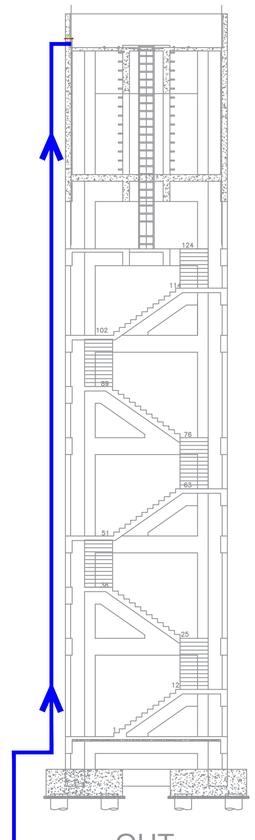
F E D C B A

Attachment No.12 to Addendum No.5

PLUMBING PUMP DEPOT
SCALE : NTS







NOTES:

1) ALL PUMPS INSTALLATION TESTING & COMMISSIONING IS E&M SCOPE OF WORK.
2) ALL THE PLUMBING AND RELATED PIPING IS CIVIL SCOPE OF WORK
3) FOR MORE DETAIL ABOUT WATER PIPING LAYOUT REFER CIVIL TENDER DRAWINGS
4) IN RED E&M SCOPE OF WORK
5) IN BLUE CIVIL SCOPE OF WORK

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			Technical detail updated

MMRC

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: PUMP GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: PLUMBING PUMP - AAREY DEPOT

SCALE: NTS

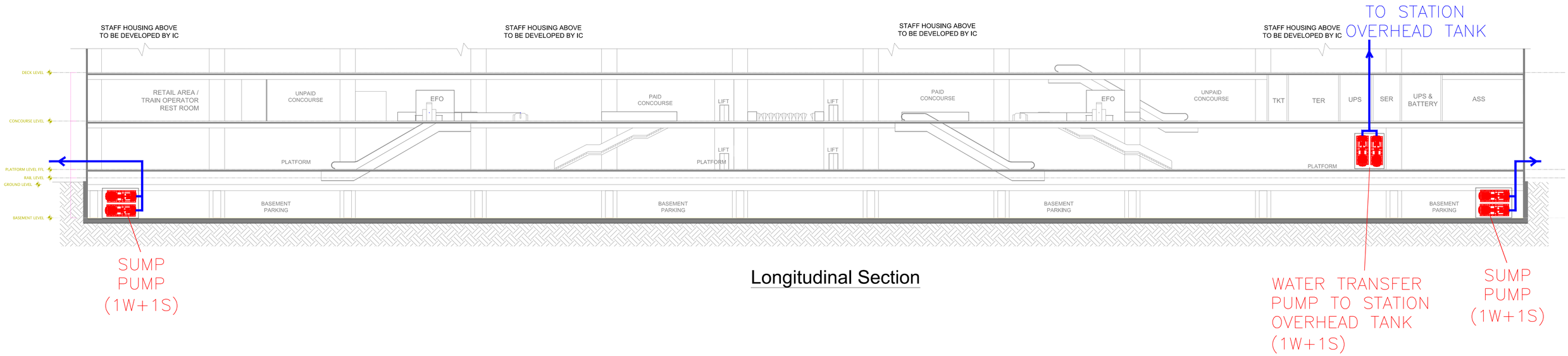
DRAWING NO: MM3-GC-DPL-GD-08-D11-0001

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

F E D C B A

Attachment No.12 to Addendum No.5

PLUMBING PUMP AAREY STATION
SCALE : NTS



Longitudinal Section

NOTES:

1) ALL PUMPS INSTALLATION TESTING & COMMISSIONING IS E&M SCOPE OF WORK.
2) ALL THE PLUMBING AND RELATED PIPING IS CIVIL SCOPE OF WORK
3) FOR MORE DETAIL ABOUT UTILITY PIPING LAYOUT REFER CIVIL TENDER DRAWINGS
4) IN RED E&M SCOPE OF WORK
5) IN BLUE CIVIL SCOPE OF WORK

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			Technical detail updated

GENERAL CONSULTANCY SERVICES
FOR MUMBAI METRO RAIL PROJECT,LINE No. 3
COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

11-12-2017

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: PUMP GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: PLUMBING PUMP AAREY STATION

SCALE: NTS

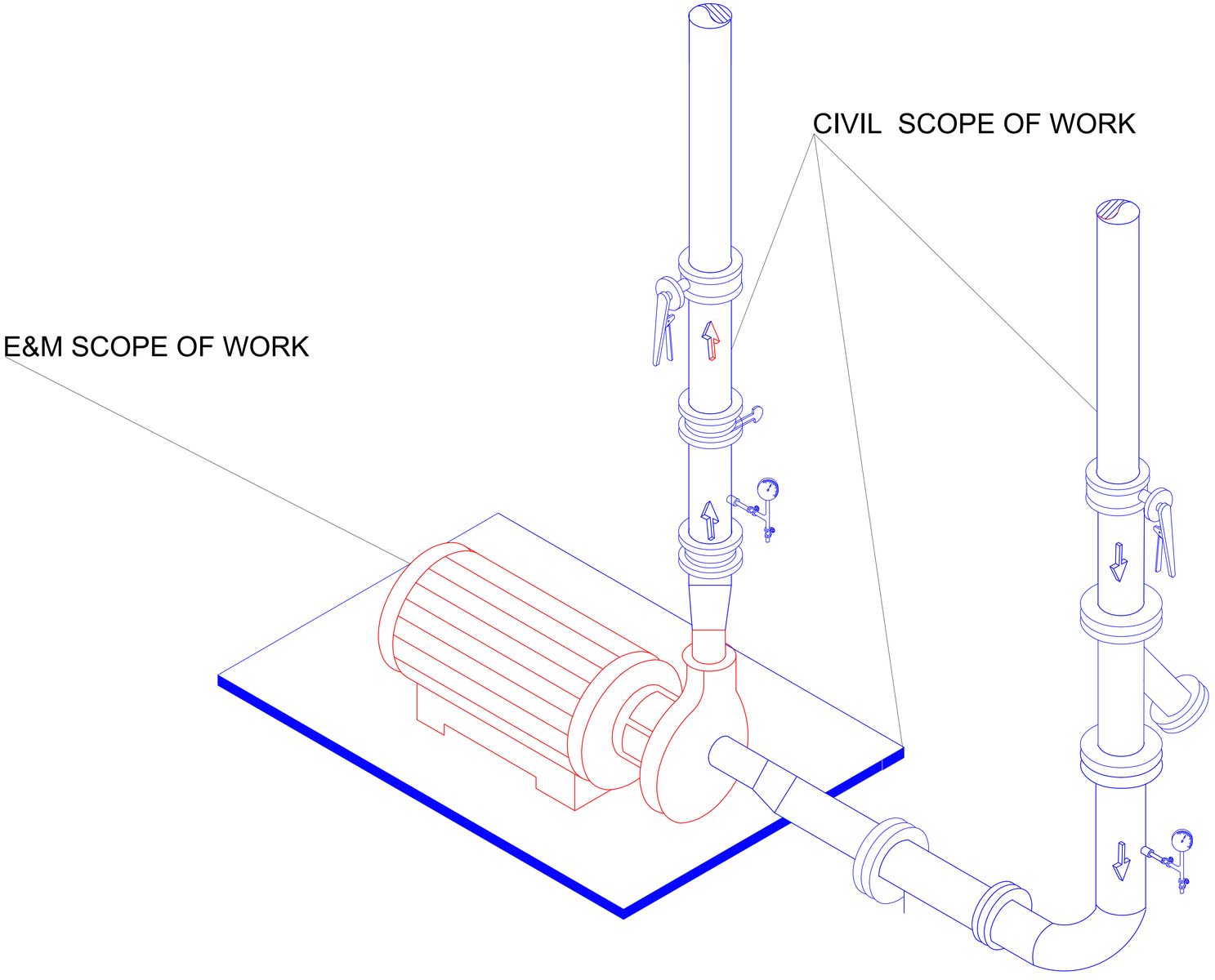
DRAWING NO: MM3-GC-DPL-GD-08-D11-0002

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

F E D C B A

Attachment No.12 to Addendum No.5

SCOPE OF WORK E&M / CIVIL
SCALE : NTS



NOTES:

1) ALL PUMPS INSTALLATION TESTING & COMMISSIONING IS E&M SCOPE OF WORK.
2) ALL THE PLUMBING AND RELATED PIPING IS CIVIL SCOPE OF WORK
3) FOR MORE DETAIL ABOUT UTILITY PIPING LAYOUT REFER CIVIL TENDER DRAWINGS
4) IN RED E&M SCOPE OF WORK
5) IN BLUE CIVIL SCOPE OF WORK

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	11-12-17			Technical detail updated

GENERAL CONSULTANCY SERVICES
FOR MUMBAI METRO RAIL PROJECT,LINE No. 3
COLABA- BANDRA-SEEPZ

KEY PLAN

E&M

FOR TENDER ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		
11-12-2017		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: DEC-2017

TITLE: PUMP GENERAL ARRANGEMENT DRAWING

DRAWING TITLE: SCOPE OF WORK E&M AND CIVIL PLUMBING WORK

SCALE: NTS

DRAWING NO: MM3-GC-DPL-GD-08-D11-0003

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

F E D C B A

Attachment No. 12 To Addendum No. 5

LEGENDS

- R190-1:7 (T/O no., Radius,Crossing Angle)
- Tangent Track (Depot)
- Curved Track (Depot)
- Track (Main Line)
- Begin/End of Curve in Turnout
- Fouling Point
- Aarey Station
- Old Land Boundary
- New Land Boundary
- Limit Between Mainline & Depot
- Buffer Stop
- Turntable
- Fence
- Special Track form
- DP1 Depot Track line no.
- 40 60 Chainags every 20 m.
- Shunting loc (L = 15 m approx)
- Train car (L = 22.6 m)
- Barrier
- Trackform to be defined by Depot Equipment

Sr.No.	Facility Of Aarey Depot	Footprint Area	Paved Area	Ballasted Area Unpaved
1	OCC, Administration Building	3001.264		
2	Delivery Track		555	
3	Depot Auxiliary Substation ASS 1	765.28		
4	Test Track	0		
5	Vehicular parking		1221.801	
6	Access Control Building	144		
7	Stabling Line Zone 1	0		
8	Stabling Line Zone 2	0		
9	Stabling Line Zone 3	0		
10	Maintance-Inspection Workshop & Central Store + Shed	15924.708		
11	Under Floor Wheel Lathe Shed	560		
12	Heavy Washing Shed	2003.234		
13	Depot Traction switching station SSP-05	216		
14	Auto Wash Plant	128.646	476	
15	Aarey Depot Station & ASS 27	4567.486	1000	
16	Outdoor Storage (Only Surface,not a building)		1170.001	
17	Infrastructure Maintenance Building + Shed	4390.182		
18	Depot Auxiliary Substation ASS 2	608		
19	Hazardous Store Building	230		
20	Under Ground Tank	149.91		
21	Over Head Tank	41.375		
22	Underpass	0		
23	Treatement Plant	120		
24	Receiving Sub Station RSS 3(Under System Contract)	2200		
25	Roads Paved		28715.781	
26	total	35050.085	33138.583	
27	Track Area Ballasted	0	0	85071.426

REV.	DATE	PREP.	APPROVED	DESCRIPTION
R1	24-11-17			REVISED AS PER ARCHITECT CIVIL LAYOUT

GENERAL CONSULTANCY SERVICES FOR MUMBAI METRO RAIL PROJECT,LINE No. 3 COLABA- BANDRA-SEEPZ

MMRC

KEY PLAN

FOR INFORMATION ONLY

	NAME	SIGN
DRAWN BY		
DESIGN BY		
CHECKED BY		
APPROVED BY		

PROJECT: MUMBAI METRO LINE 3 COLABA-BANDRA-SEEPZ

DATE: 24-11-2017

TITLE: DEPOT GENERAL ARRANGEMENT DRAWING

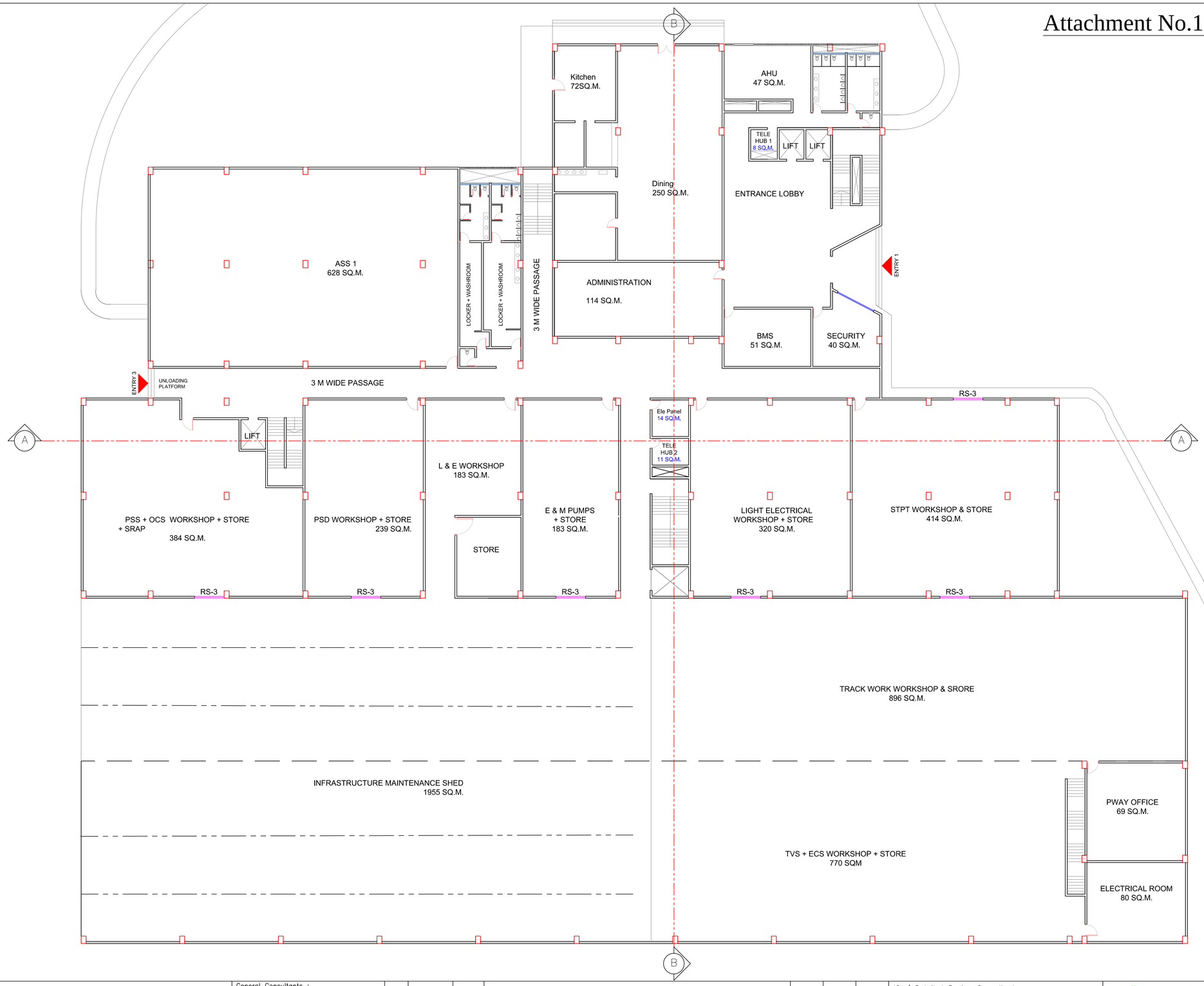
DRAWING TITLE: AAREY DEPOT LAYOUT

SCALE: 1:1000

DRAWING NO: MM3-GC-DTR-GD-8-D03-2001

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

11-DEC-2017



REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____
dated _____

A : Objection. A complete resubmission is required.
B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
3						
2						
1	DD.MM.YYYY	--	--	--	--	--

IC / Detailed Design Consultant :

PADECO Co., Ltd.
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THE Louis Berger Group, Inc., USA
Engineers • Planners • Scientists • Economists
1250 23rd St. NW
Washington, DC 20037,
USA.

A-615/616, Kohinoor City,
Kurla (W), Mumbai 400070
India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : SC
Scale : 1:200 (A1)	Drawn : SP	Date : 13.12.2107

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

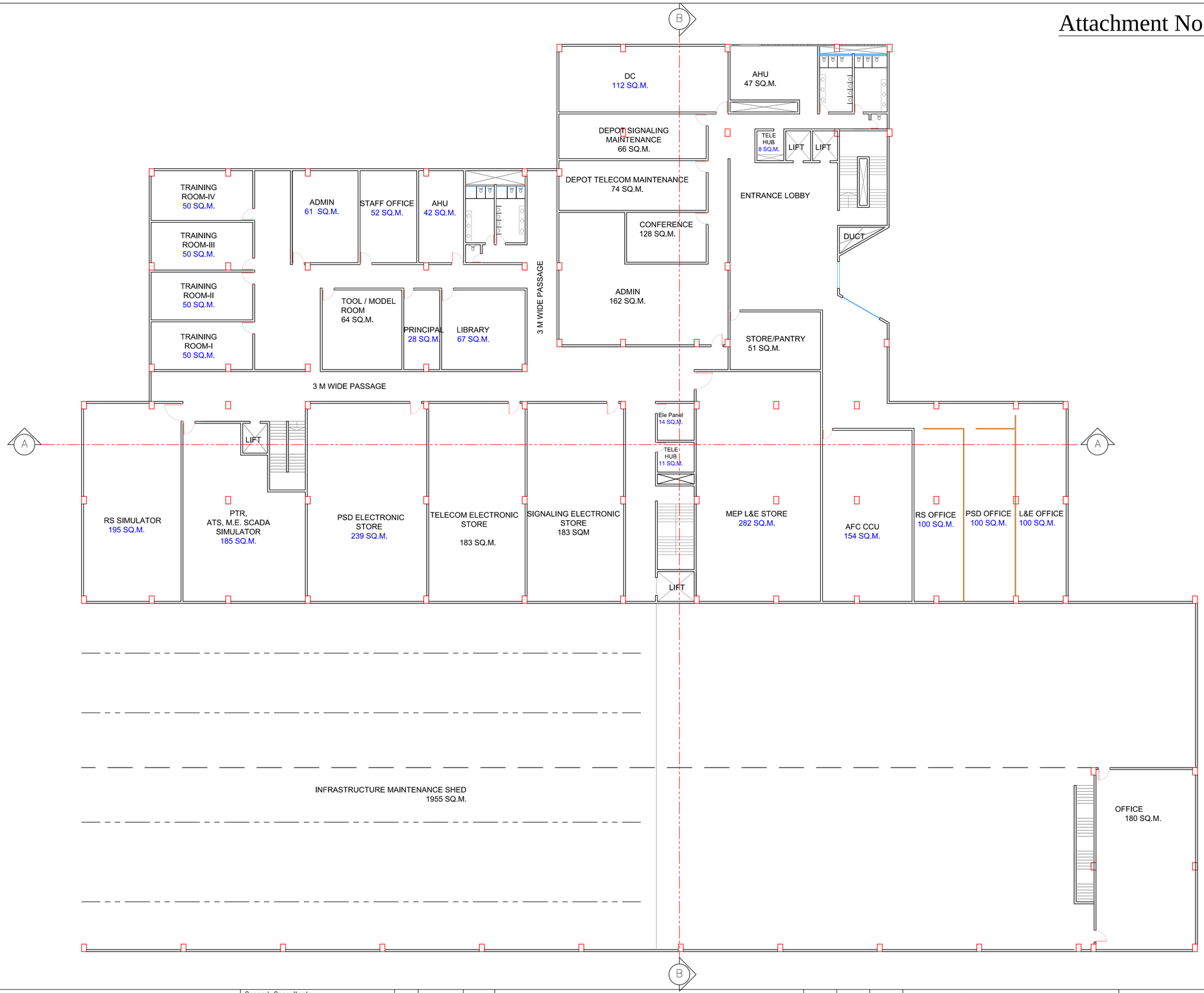
Drawing Title :

OCC and Infrastructure Building:
Ground Floor Plan

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/101	0	P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/101.dwg



REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

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Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
3						
2						
1	DD.MM.YYYY	--	--	--	--	--

IC / Detailed Design Consultant :

PADECO Co., Ltd.
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Fax: +91 124 4830373

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A-615/616, Kohinoor City,
Kurla (W), Mumbai 400098
India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : SC
Scale : 1:200 (A1)	Drawn : SP	Date : 13.12.2107

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :

OCC and Infrastructure Building: First Floor Plan

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/102	0	P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/102.dwg

Attachment No.12 to Addendum No.5

REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification :

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Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
3						
2						
1	DD.MM.YYYY	--	--	--	--	--

IC / Detailed Design Consultant :

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India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK | Checked : KT | Approved : SC

Scale : 1:200 (A1) | Drawn : SP | Date : 13.12.2107

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

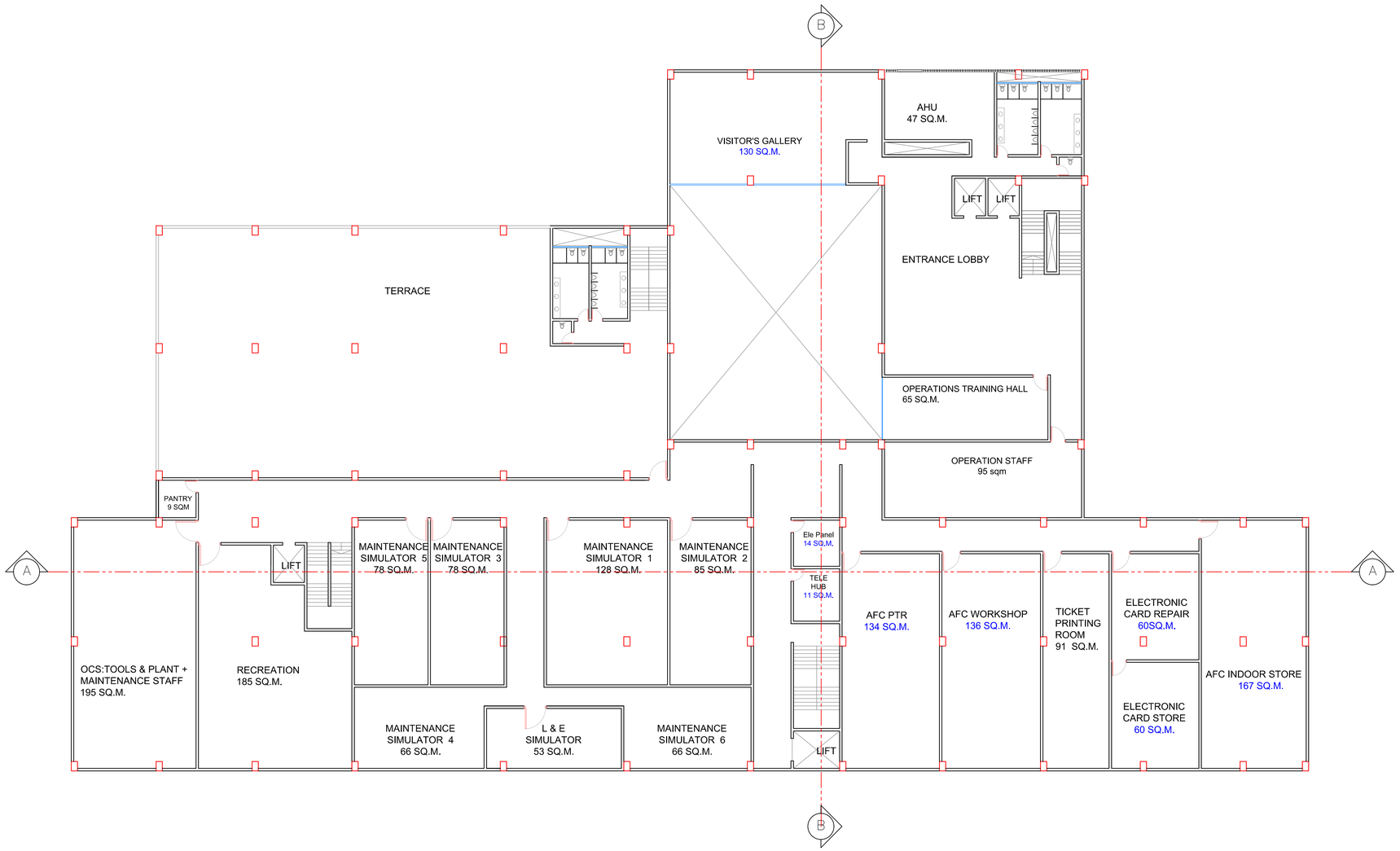
Drawing Title :

OCC and Infrastructure Building:
Second Floor Plan

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/103	0	P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/103.dwg



REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

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C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
3						
2						
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Kurla (W), Mumbai 400098
India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : SC
Scale : 1:200 (A1)	Drawn : SP	Date : 13.12.2107

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

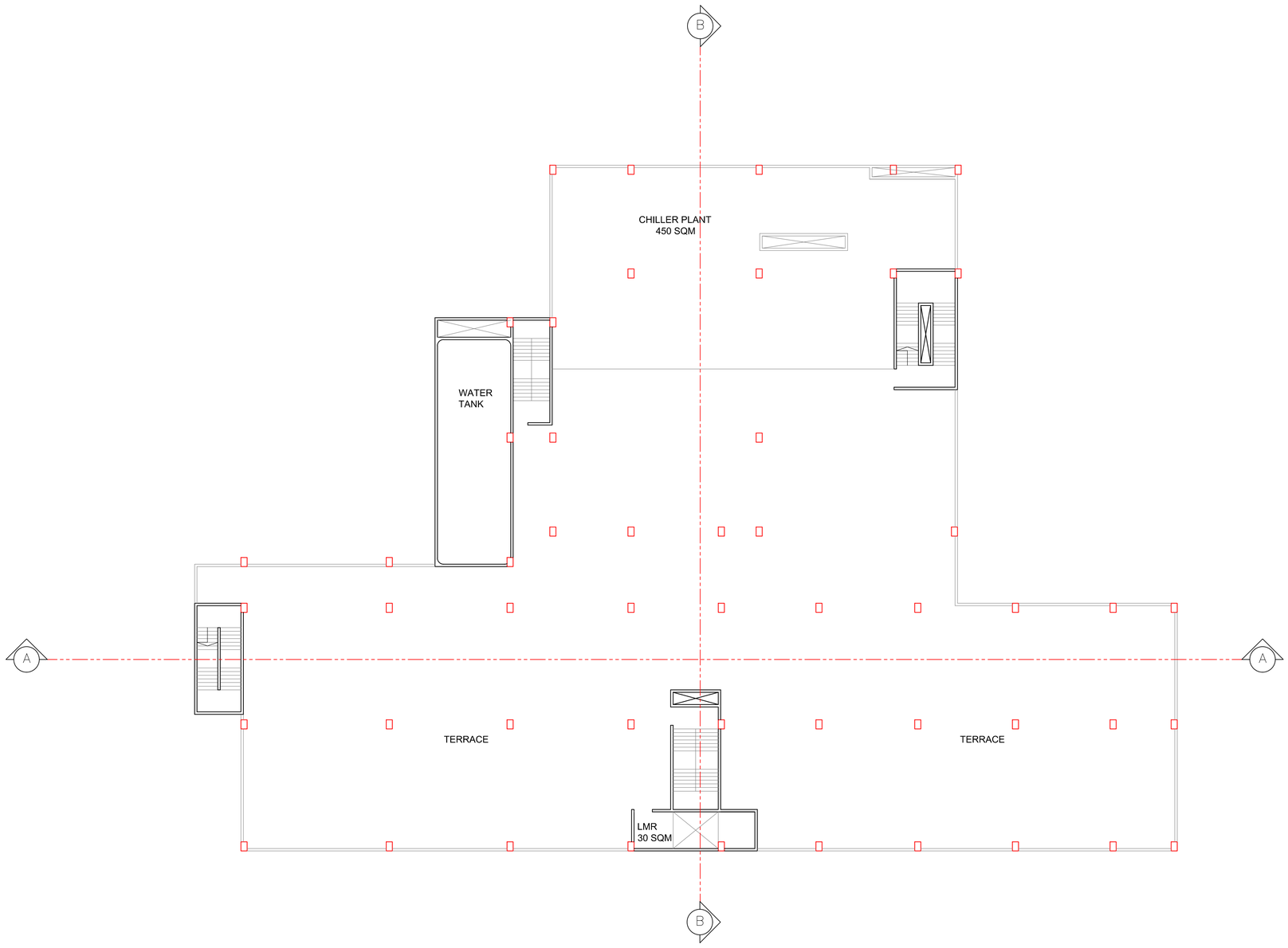
Drawing Title :

OCC and Infrastructure Building:
Third Floor Plan

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/104	0	P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/104.dwg



REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

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dated _____

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C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
3						
2						
1	DD.MM.YYYY	--	--	--	--	--

IC / Detailed Design Consultant :

PADECO Co., Ltd.
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Kurla (W), Mumbai 400098
India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : SC
Scale : 1:200 (A1)	Drawn : SP	Date : 13.12.2107

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

MMRC

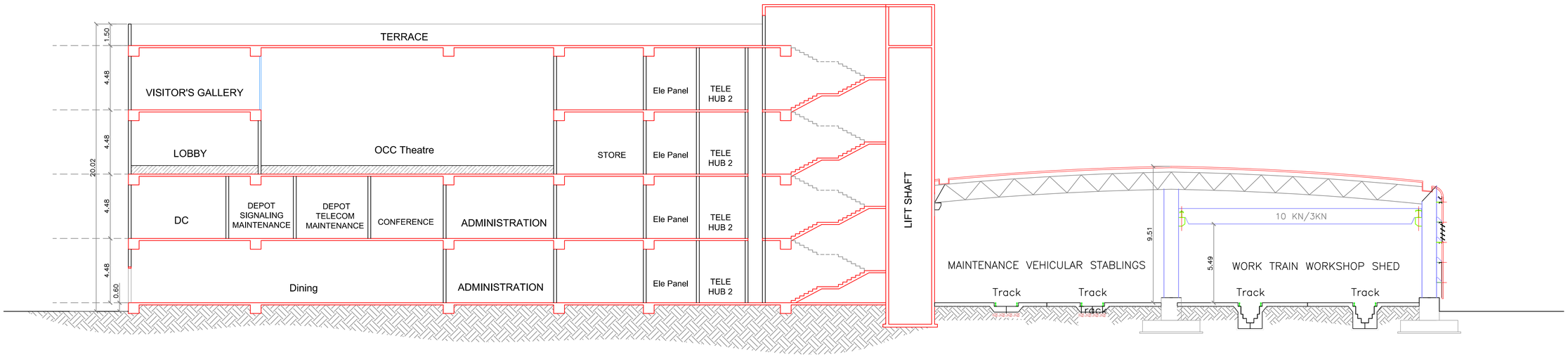
Drawing Title :

OCC and Infrastructure Building:
Terrace Level Plan

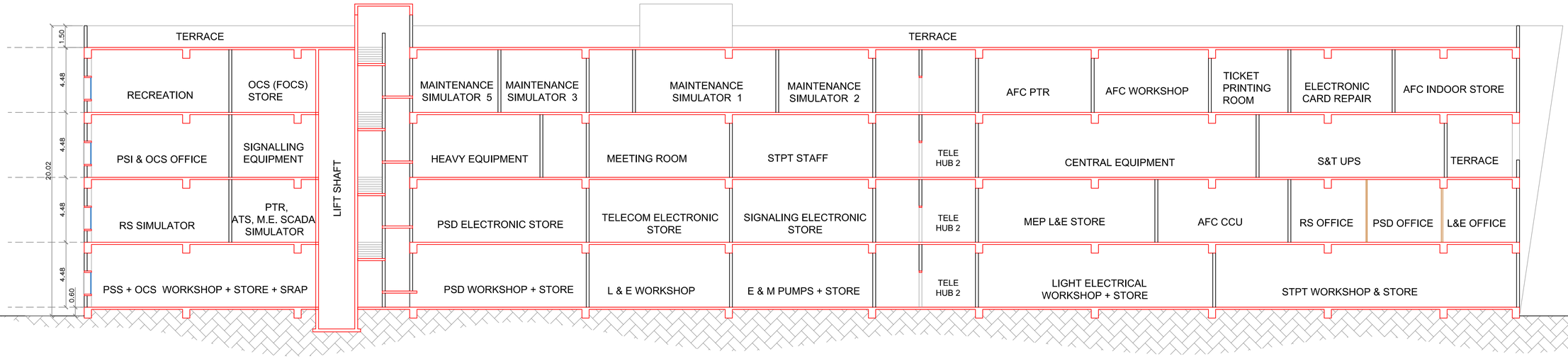
Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/105	0	P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/105.dwg



SECTION A-A



SECTION B-B

REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

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C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
3						
2						
1	DD.MM.YYYY	--	--	--	--	--

IC / Detailed Design Consultant :

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THE Louis Berger Group, Inc., USA Engineers * Planners * Scientists * Economists 1250 23rd St. NW Washington, DC 20037, USA. A-615/616, Kohinoor City, Kurla (W), Mumbai 400086 India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : SC
Scale : 1:200 (A1)	Drawn : SP	Date : 13.12.2107

MMRC

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block, Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :

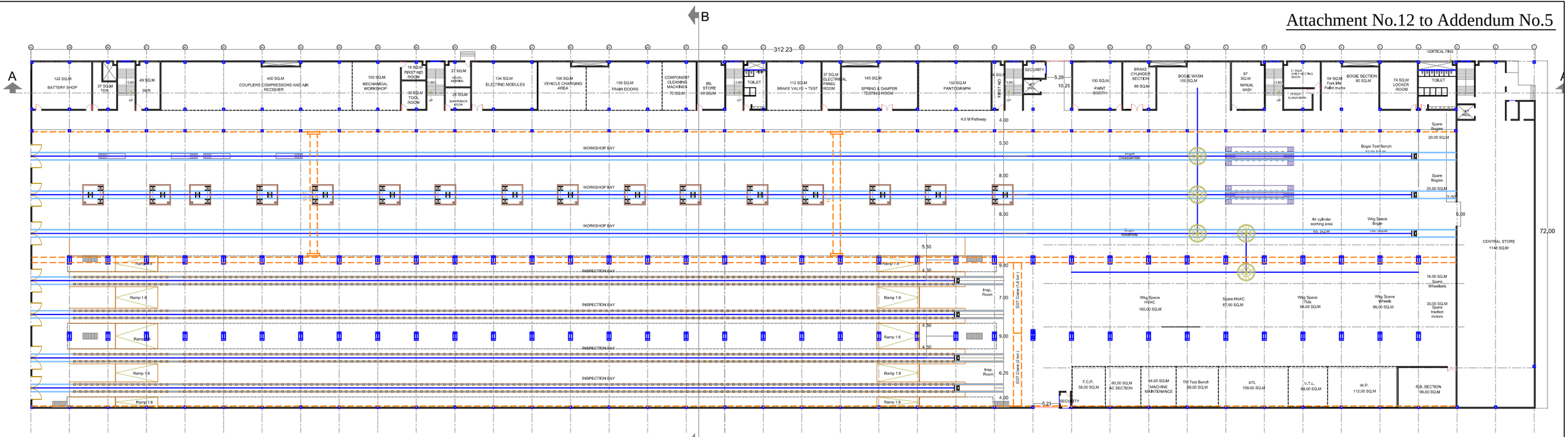
OCC and Infrastructure Building: Sections

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/106	0	P

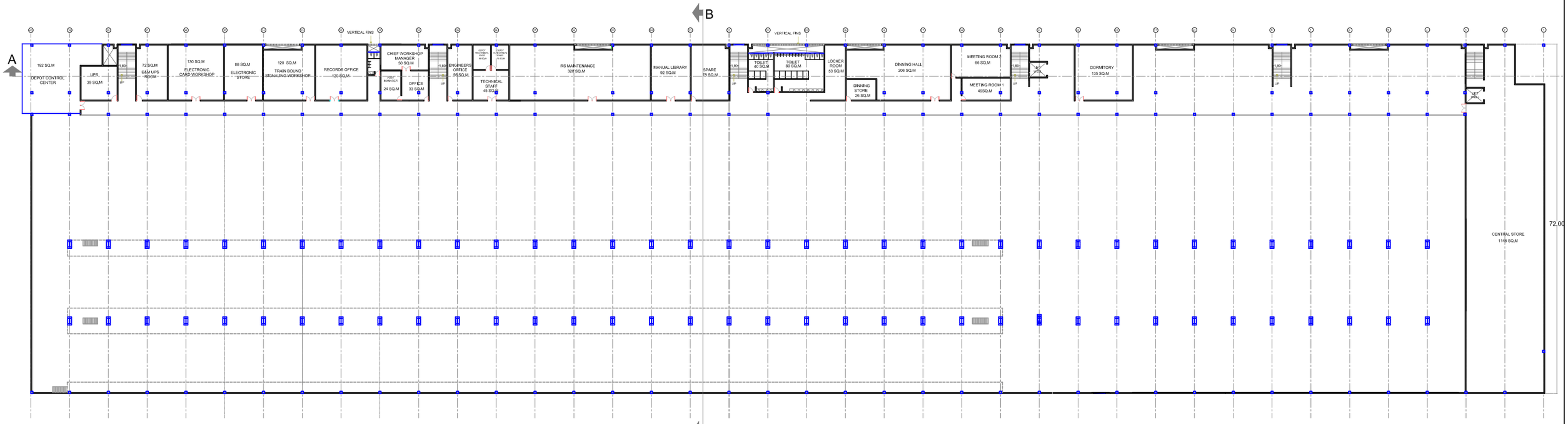
P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/106.dwg

Attachment No.12 to Addendum No.5



GROUND FLOOR PLAN



FIRST FLOOR PLAN

REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

A : Objection. A complete resubmission is required.
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C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
D						
C						
B						
A	DD.MM.YYYY	--		--	--	--

IC / Detailed Design Consultant :

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THE Louis Berger Group, INC., USA Engineers ▪ Planners ▪ Scientists ▪ Economists
1250 23rd St. NW Washington, DC 20037, USA.

A-415/416, Kohinoor City, Kurla (W), Mumbai 400070 India

Project Title :
Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : CL
Scale : AS SHOWN	Drawn : SP	Date : 23.10.2017

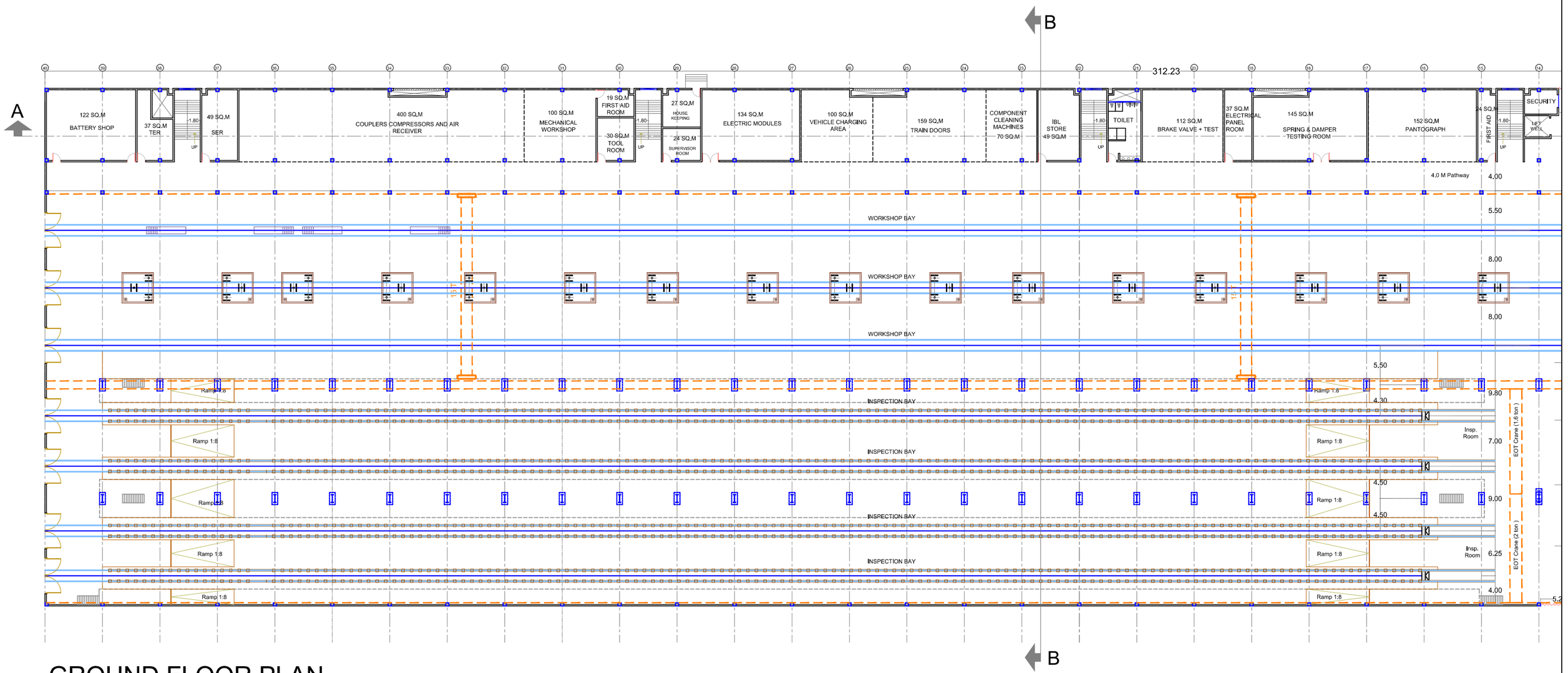
MUMBAI METRO RAIL CORPORATION LTD.
NaMTTRI Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :
MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING PLANS

Drawing No. : **MML3-CBS/MMRC/IC/DEP/AR/1001** | Rev. | DWG Status **P**

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3–CBS/MMRC/IC/DEP/AR/1001.dwg



GROUND FLOOR PLAN

REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification :

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Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
D						
C						
B						
A	DD.MM.YYYY	--		--	--	--

IC / Detailed Design Consultant :

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THE Louis Berger Group, INC., USA Engineers ▪ Planners ▪ Scientists ▪ Economists 1250 23rd St. NW Washington, DC 20037, USA.

A-42/5/16, Kohinoor City, Kurla (W), Mumbai 400070 India

Project Title :
Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : CL
Scale : AS SHOWN	Drawn : SP	Date : 23.10.2017

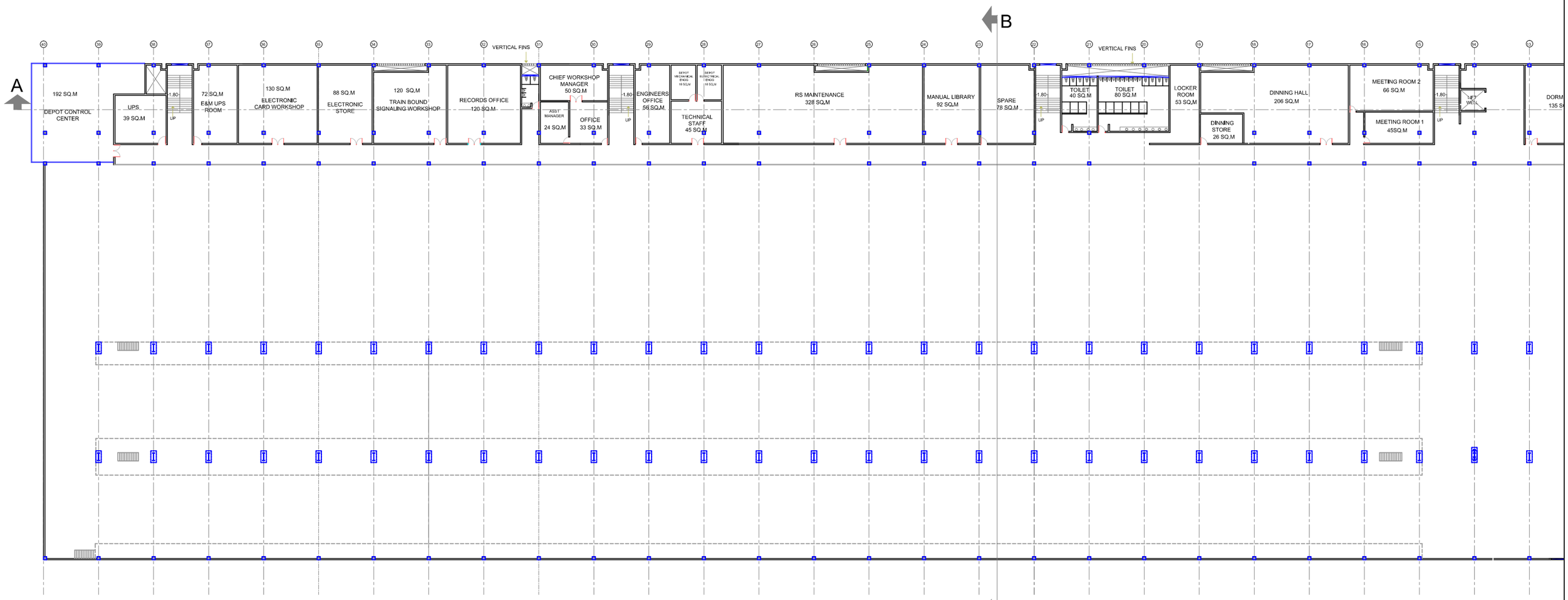
MUMBAI METRO RAIL CORPORATION LTD.
NaMTTRI Building, Plot No. R–13, 'E'– Block, Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :
MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING GROUND FLOOR PLAN 1/3

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/1002		P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3–CBS/MMRC/IC/DEP/AR/1002.dwg



FIRST FLOOR PLAN

REFERENCE DRAWINGS :-

X-REF FILES :-

NOTES :-

FOR INFORMATION ONLY

General Consultants : maple — MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

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C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
D						
C						
B						
A	DD.MM.YYYY	--		--	--	--

IC / Detailed Design Consultant :

PADECO Co., Ltd. Shin-Ossimon Bldg. 6-17-19 Shinbashi, Minato-ku Tokyo 105-0004 Japan Tel: +81-3-5733-0855 Fax: +81-3-5733-0856

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A-615/616, Kohinoor City, Kurla (W), Mumbai 400070 India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed :	Checked :	Approved :
AK	KT	CL
Scale : AS SHOWN	Drawn : SP	Date : 23.10.2017

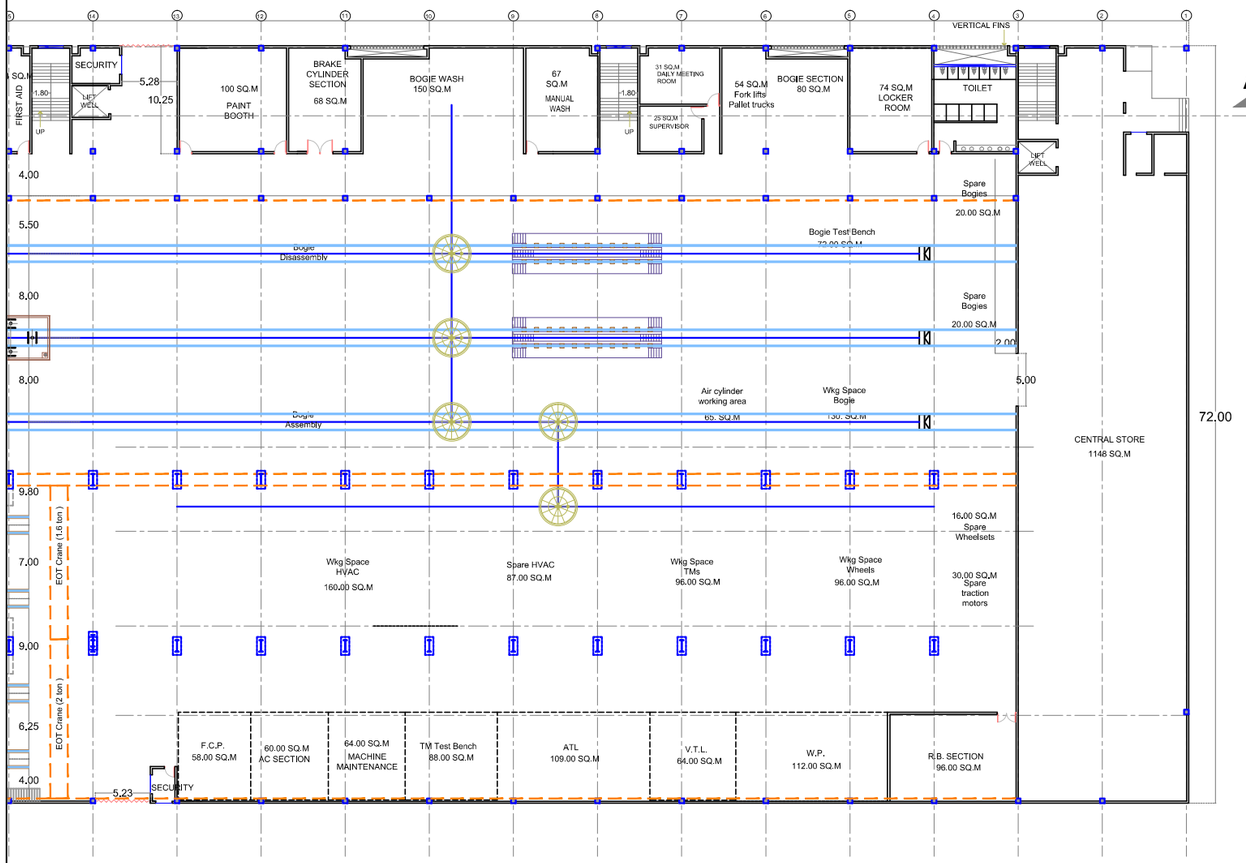
MUMBAI METRO RAIL CORPORATION LTD.
NaMTTRI Building, Plot No. R-13, 'E'- Block, Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title : MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING FIRST FLOOR PLAN 2/3

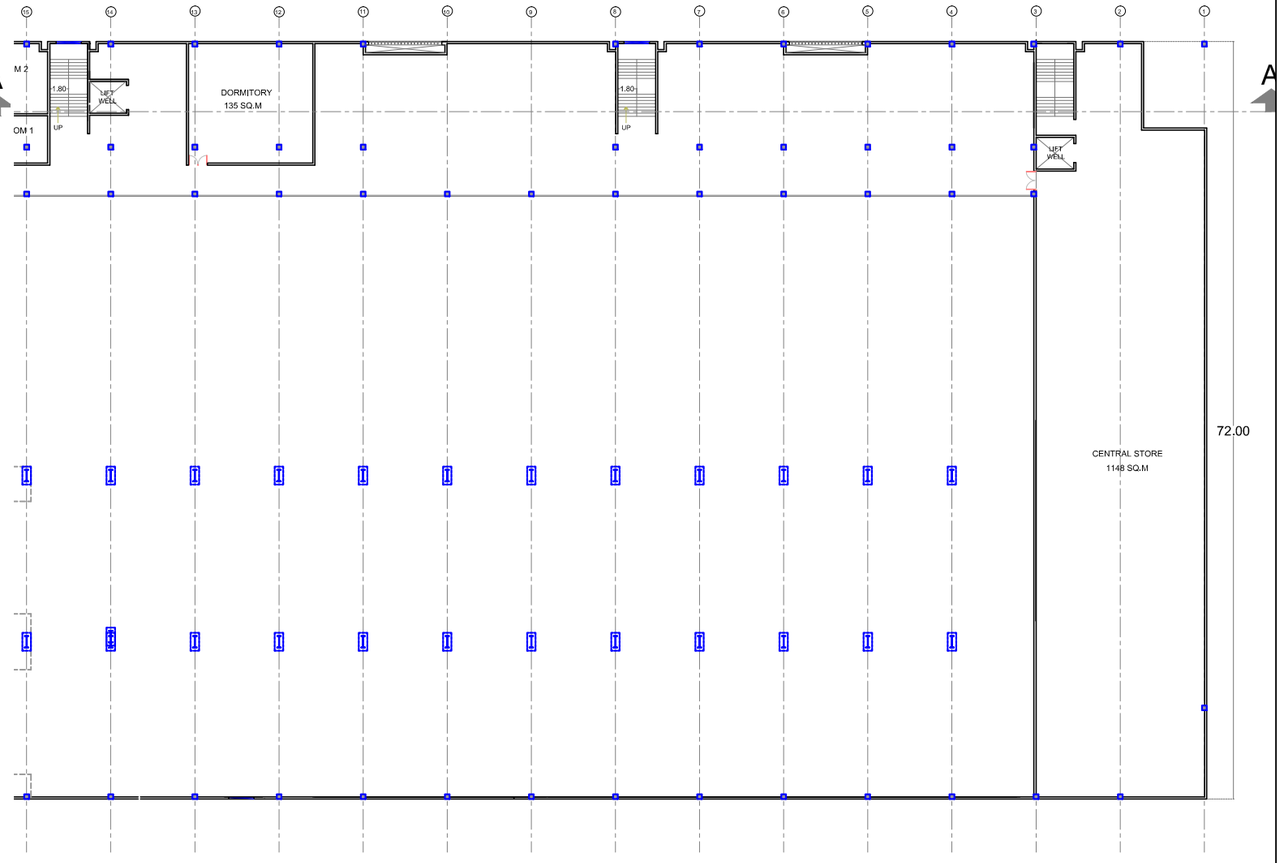
Drawing No. : **MML3-CBS/MMRC/IC/DEP/AR/1003** | Rev. | DWG Status **P**

P-Preliminary, D-Definitive, C-Construction Reference, W-Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/1003.dwg



GROUND FLOOR



FIRST FLOOR

REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

A : Objection. A complete resubmission is required.
B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
D						
C						
B						
A	DD.MM.YYYY	--		--	--	--

IC / Detailed Design Consultant :

PADECO Co., Ltd.
Shin-Onarimon Bldg.
6-17-19 Shimbashi,
Minato-ku
Tokyo 105-0004 Japan
Tel: +81-3-5733-0855
Fax: +81-3-5733-0856

9F, Infinity Tower C,
DLF Cyber City, DLF Phase – II,
Gurgaon – 122 002, Haryana – India
Tel : +91 124 4830100
Fax: +91 124 4830373

THE Louis Berger Group, INC., USA
Engineers ▪ Planners ▪ Scientists ▪ Economists
1250 23rd St. NW
Washington, DC 20037,
USA.

A-415/416, Kohinoor City,
Kurla (W), Mumbai 400070
India

Project Title :
Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed :	Checked :	Approved :
AK	KT	CL

Scale :	Drawn :	Date :
AS SHOWN	SP	23.10.2017

MUMBAI METRO RAIL CORPORATION LTD.
NaMTTRI Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

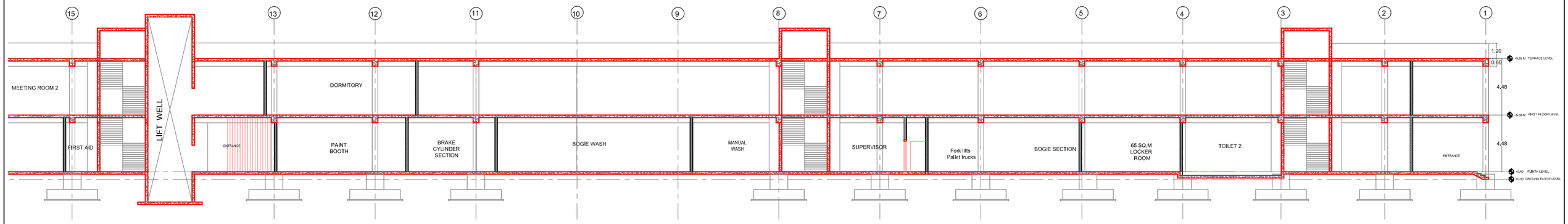
Drawing Title :
MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING BLOWN UP PLANS 3/3

Drawing No. : **MML3-CBS/MMRC/IC/DEP/AR/1004** | Rev. | DWG Status **P**

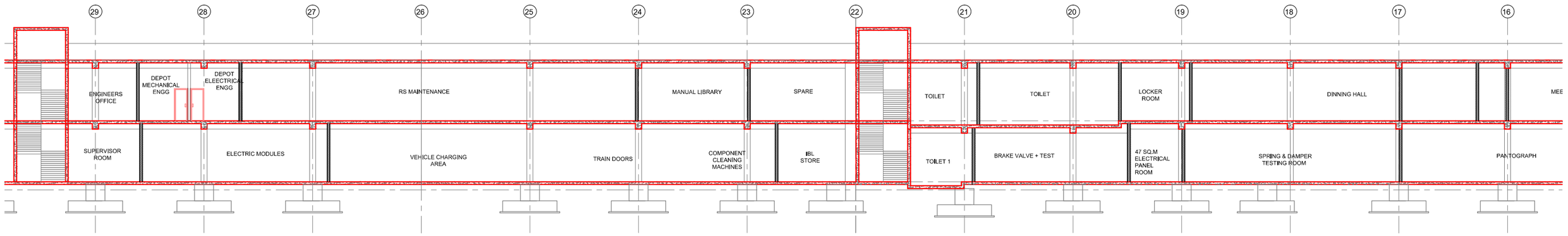
P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3–CBS/MMRC/IC/DEP/AR/1004.dwg

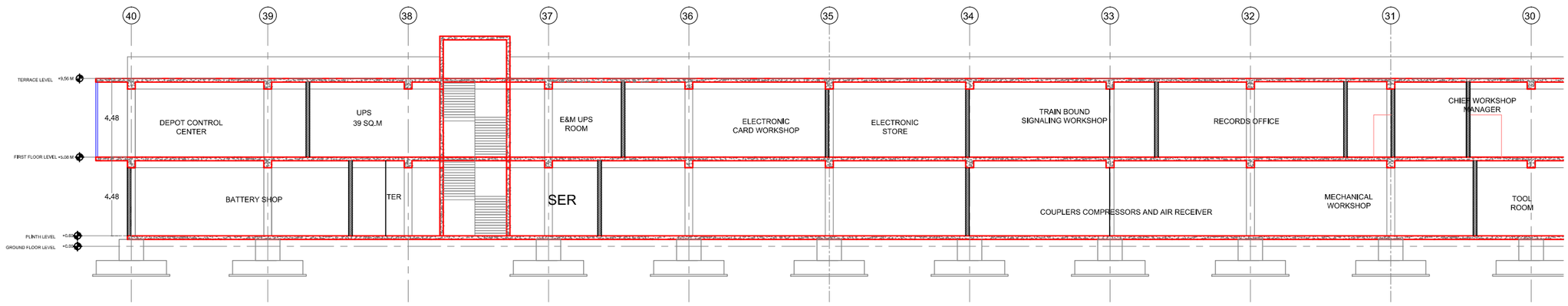
Attachment No.12 to Addendum No.5



SECTION A-A (GRID NO 1 TO 15)



SECTION A-A (GRID NO 15 TO 29)



SECTION A-A (GRID NO 29 TO 40)

REFERENCE DRAWINGS :-

X-REF FILES :-

NOTES :-

FOR INFORMATION ONLY

General Consultants :

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

A : Objection. A complete resubmission is required.
B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
D						
C						
B						
A	DD.MM.YYYY	--		--	--	--

IC / Detailed Design Consultant :

PADECO Co., Ltd. Shin-Onarimon Bldg. 6-17-19 Shimbashi, Minato-ku Tokyo 105-0004 Japan Tel: +81-3-5733-0855 Fax: +81-3-5733-0856

9/F, Infinity Tower C, DLF Cyber City, DLF Phase – II, Gurgaon – 122 002, Haryana – India Tel : +91 124 4630100 Fax: +91 124 4630373

THE Louis Berger Group, INC., USA Engineers • Planners • Scientists • Economists 1250 23rd St. NW Washington, DC 20037, USA.

A-42/5/10, Kohinoor City, Kurla (W), Mumbai 400070 India

Project Title :
Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : CL
Scale : NTS	Drawn : SP	Date : 21.11.2017

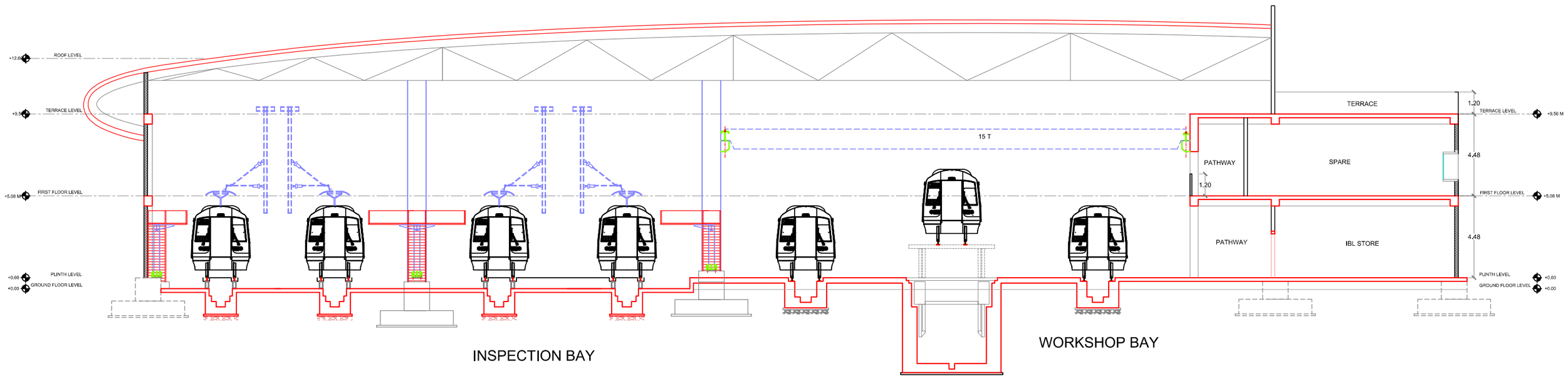
MUMBAI METRO RAIL CORPORATION LTD.
MMRC
NaMTTRI Building, Plot No. R–13, 'E'– Block, Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :
MAINTENANCE WORKSHOP & CENTRAL STORE BUILDING SECTION A-A

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/1006		P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3–CBS/MMRC/IC/DEP/AR/1006.dwg



SECTION B-B

REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

A : Objection. A complete resubmission is required.
B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
D						
C						
B						
A	DD.MM.YYYY	--		--	--	--

IC / Detailed Design Consultant :

PADECO Co., Ltd. Shin-Onarimon Bldg. 6-17-19 Shimbashi, Minato-ku Tokyo 105-0004 Japan Tel: +81-3-5733-0855 Fax: +81-3-5733-0856

AECOM 9/F, Infinity Tower C, DLF Cyber City, DLF Phase –II, Gurgaon – 122 002, Haryana – India Tel : +91 124 4630100 Fax: +91 124 4630373

THE Louis Berger Group, INC., USA Engineers • Planners • Scientists • Economists 1250 23rd St. NW Washington, DC 20037, USA. A-403/404, Kohinoor City, Kurla (W), Mumbai 400070 India

Project Title :
Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : CL
Scale : NTS	Drawn : SP	Date : 21.11.2017

MUMBAI METRO RAIL CORPORATION LTD.
NaMTTRI Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

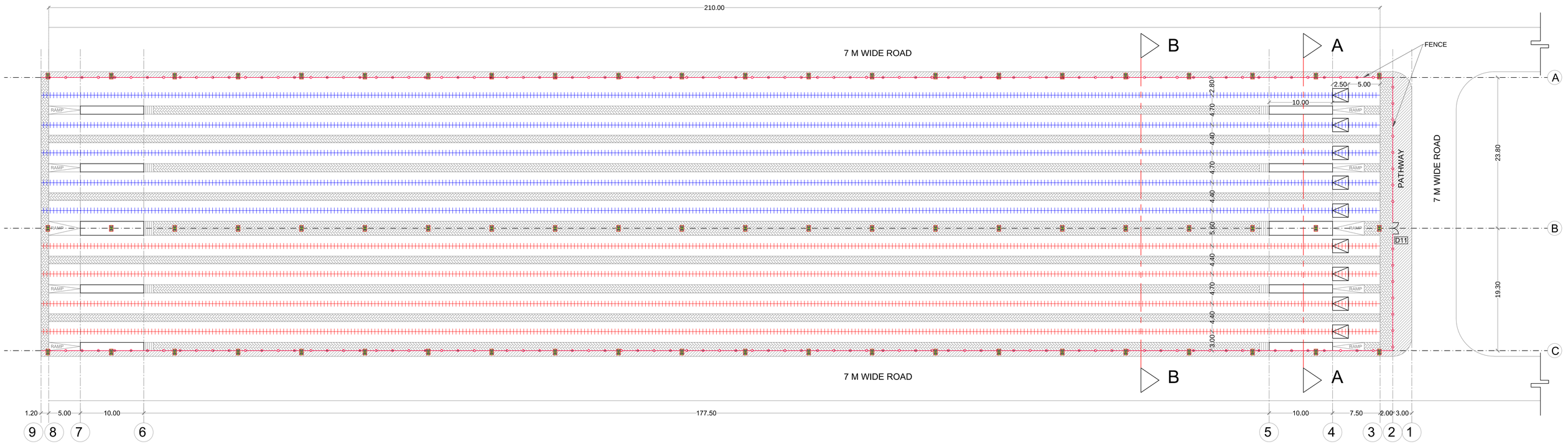
Drawing Title :
MAINTENANCE WORKSHOP &
CENTRAL STORE BUILDING
SECTION B-B

Drawing No. : **MML3-CBS/MMRC/IC/DEP/AR/1006** | Rev. | DWG Status **P**

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3–CBS/MMRC/IC/DEP/AR/1006.dwg

Attachment No.12 To Addendum No.5



REFERENCE DRAWINGS :-

X-REF FILES :-

NOTES :-

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

A : Objection. A complete resubmission is required.
B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
R1	13.12.2017	SP	SHEDS PROVIDED	AK	KT	VS

IC / Detailed Design Consultant :

PADECO Co., Ltd.
Shin-Onarimon Bldg. 6-17-19 Shinbashi, Minato-ku
Tokyo 105-0004 Japan
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Fax: +91 124 4830373

THE Louis Berger Group, Inc., USA
Engineers • Planners • Scientists • Economists
1250 23rd St. NW Washington, DC 20037, USA.
A-615/616, Kohinoor City, Kurla (W), Mumbai 400086 India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK | Checked : KT | Approved : SC

Scale : 1:300 (A1) | Drawn : SP | Date : 13.12.2017

MMRC

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R-13, 'E'- Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :

PROPOSED AAREY DEPOT

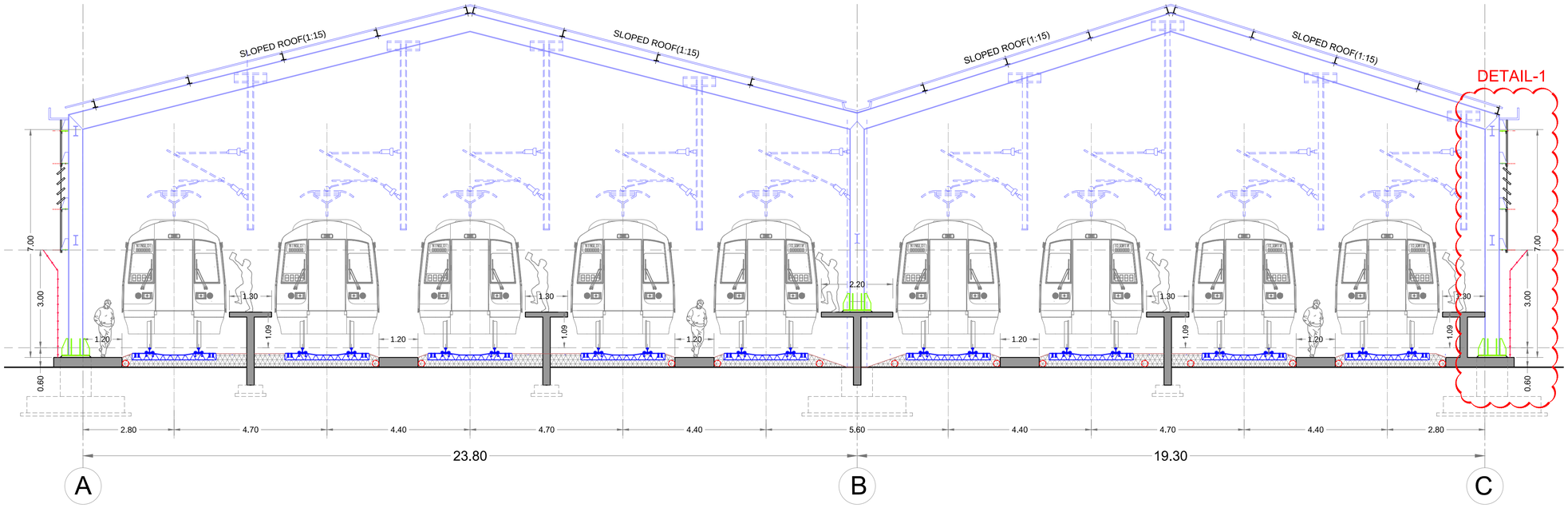
COVERED STABLING SHED 1
GROUND FLOOR PLAN

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/701	R1	P

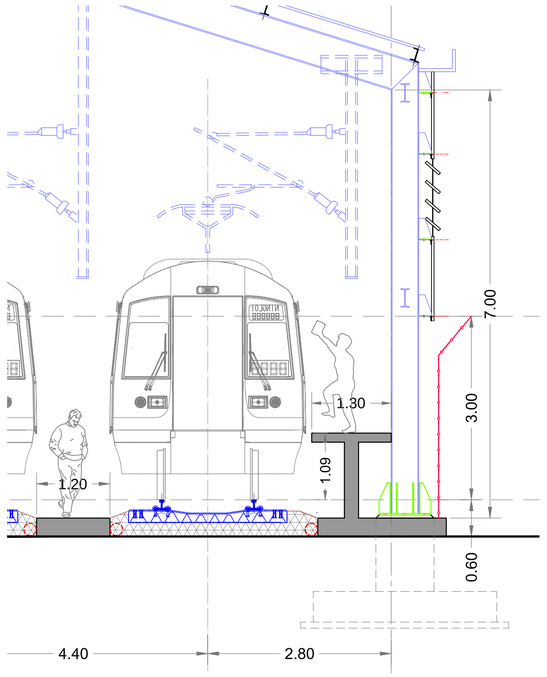
P-Preliminary, D-Definitive, C-Construction Reference, W-Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/701.DWG

Attachment No.12 To Addendum No.5

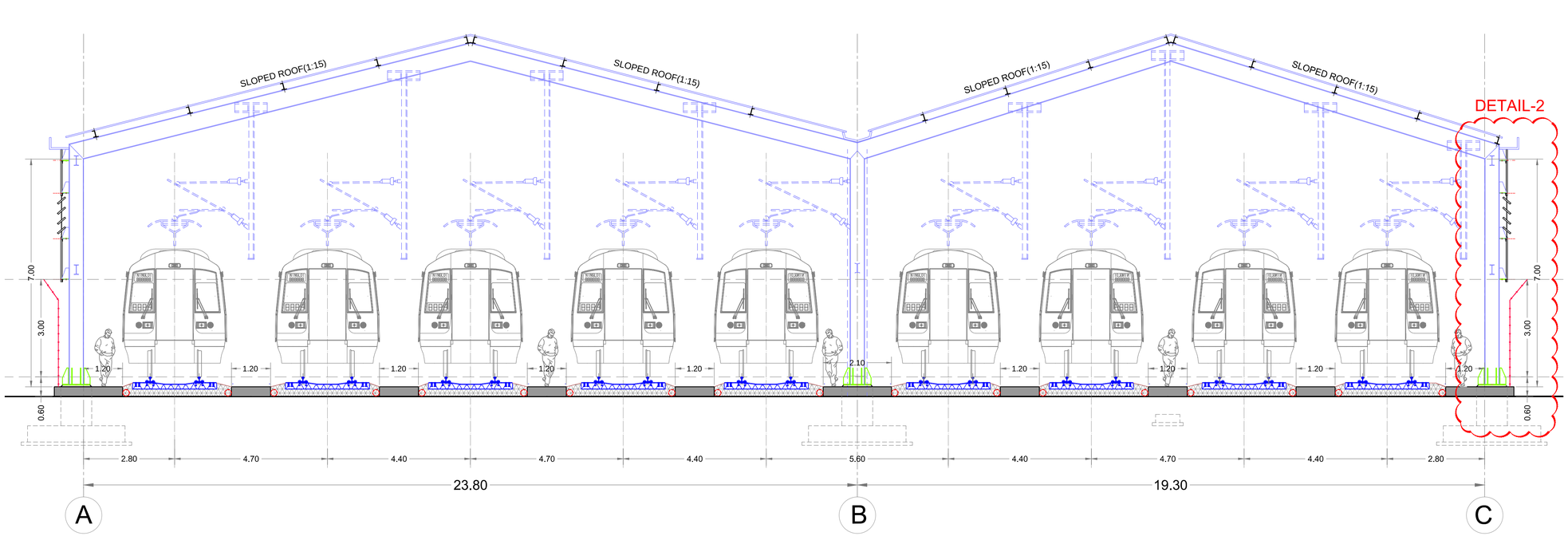


SECTION A-A

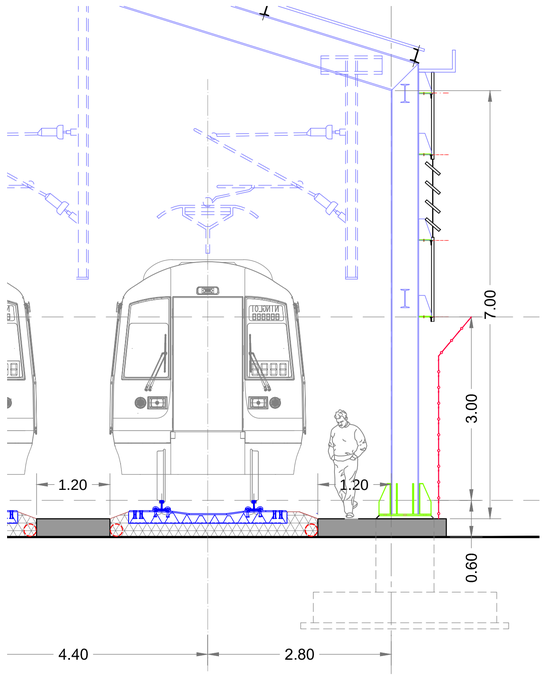


DETAIL-1

SCALE 1:50



SECTION B-B



DETAIL-2

SCALE 1:50

REFERENCE DRAWINGS :-

X-REF FILES :-

NOTES :-

FOR INFORMATION ONLY

General Consultants : maple — MUMBAI METRO LINE-3 GENERAL CONSULTANT

Notification : ☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

A : Objection. A complete resubmission is required.
B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
R1	13.12.2017	SP	SHEDS PROVIDED	AK	KT	VS

IC / Detailed Design Consultant :

PADECO Co., Ltd. Shin-Onarimon Bldg. 6-17-19 Shimbashi, Minato-ku Tokyo 105-0004 Japan Tel: +81-3-5733-0855 Fax: +81-3-5733-0856

AECOM 9/F, Infinity Tower C, DLF Cyber City, DLF Phase –II, Gurgaon – 122 002, Haryana – India Tel: +91 124 4830100 Fax: +91 124 4830373

THE Louis Berger Group, INC., USA Engineers • Planners • Scientists • Economists 1250 23rd St. NW Washington, DC 20037, USA. A-615/616, Kohinoor City, Kurla (W), Mumbai 400098 India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : SC
Scale : 1:75 (A1)	Drawn : SP	Date : 13.12.2017

MMRC

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :

PROPOSED AAREY DEPOT

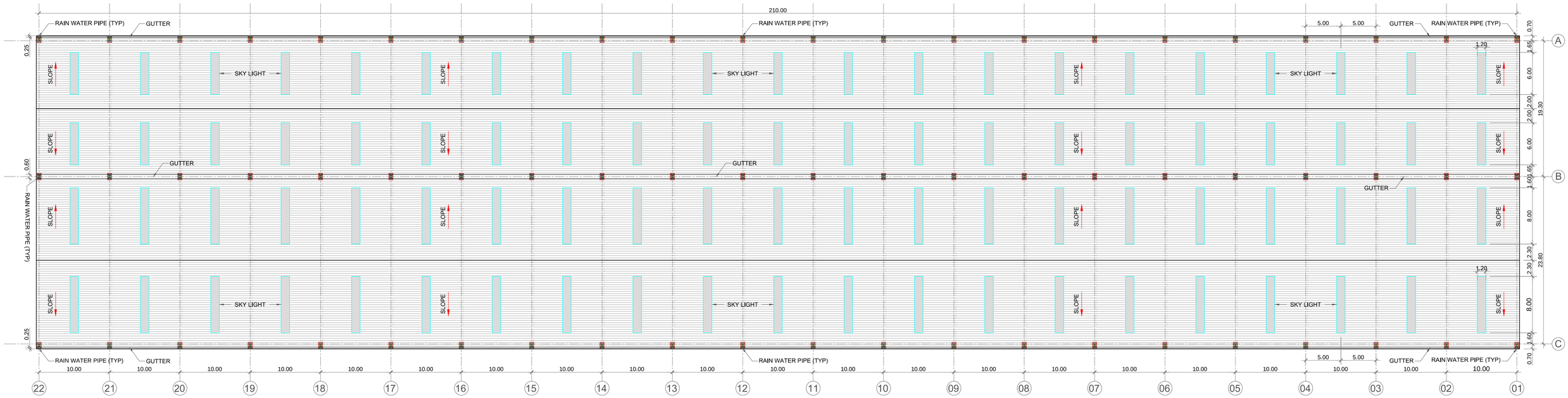
COVERED STABLING SHED 1
SECTION

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/702	R1	P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/702.DWG

Attachment No.12 To Addendum No.5



REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

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B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
R1	13.12.2017	SP	SHEDS PROVIDED	AK	KT	VS

IC / Detailed Design Consultant :

PADECO Co., Ltd.
Shin-Onarimon Bldg.
6-17-19 Shinbashi,
Minato-ku
Tokyo 105-0004 Japan
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AECOM
9/F, Infinity Tower C,
DLF Cyber City, DLF Phase –II,
Gurgaon – 122 002, Haryana – India
Tel : +91 124 4830100
Fax: +91 124 4830373

THE Louis Berger Group , Inc., USA
Engineers • Planners • Scientists • Economists
1250 23rd St. NW
Washington, DC 20037,
USA.
A-615/616, Kohinoor City,
Kurla (W), Mumbai 400086
India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK | Checked : KT | Approved : SC

Scale : 1:275 (A1) | Drawn : SP | Date : 13.12.2017

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :

PROPOSED AAREY DEPOT

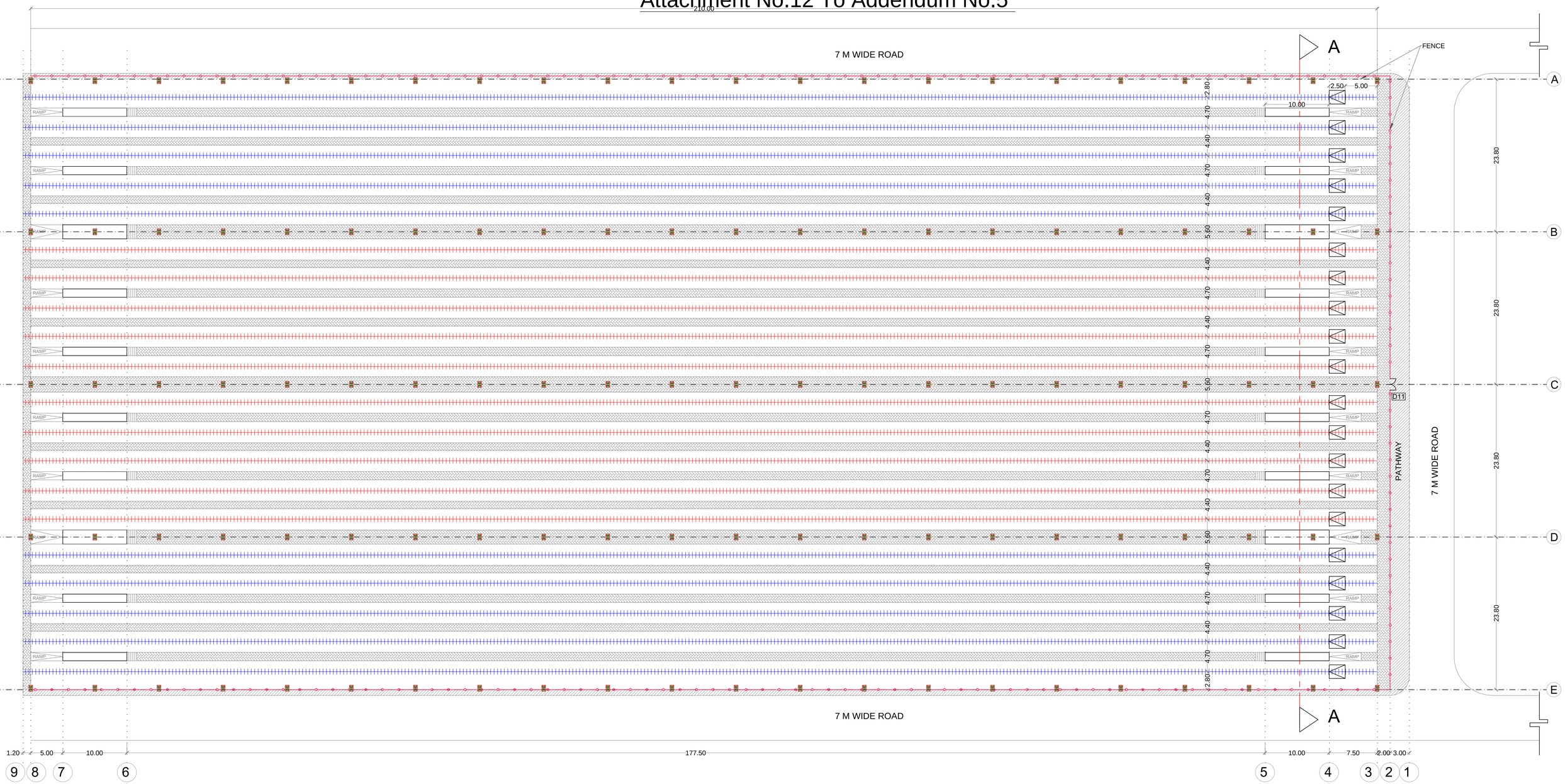
COVERED STABLING SHED 1
ROOF PLAN

Drawing No. : MML3-CBS/MMRC/IC/DEP/AR/703 | Rev. R1 | DWG Status P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/703.DWG

Attachment No.12 To Addendum No.5



REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

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C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
R1	13.12.2017	SP	SHEDS PROVIDED	AK	KT	VS

IC / Detailed Design Consultant :

PADECO Co., Ltd.
Shin-Onoimon Bldg.
6-17-19 Shinbashi,
Minato-ku
Tokyo 105-0004 Japan
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Fax: +81-3-5733-0856

AECOM
9/F, Infinity Tower C,
DLF Cyber City, DLF Phase –II,
Gurgaon – 122 002, Haryana – India
Tel : +91 124 4830100
Fax: +91 124 4830373

THE Louis Berger Group, Inc., USA
Engineers • Planners • Scientists • Economists
1250 23rd St. NW
Washington, DC 20037,
USA.
A-615/616, Kohinoor City,
Kurla (W), Mumbai 400086
India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK	Checked : KT	Approved : SC
Scale : 1:75 (A1)	Drawn : SP	Date : 13.12.2017

MMRC

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

Drawing Title :

PROPOSED AAREY DEPOT

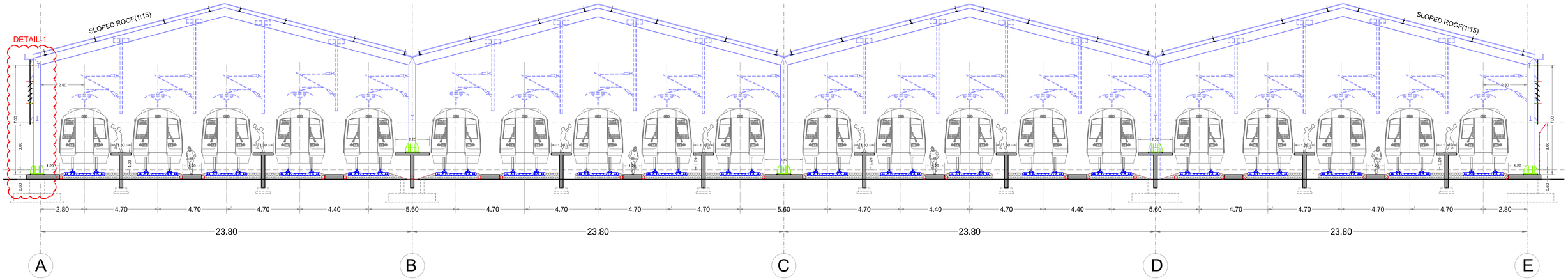
COVERED STABLING SHED 2
GROUND FLOOR PLAN

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/801	R1	P

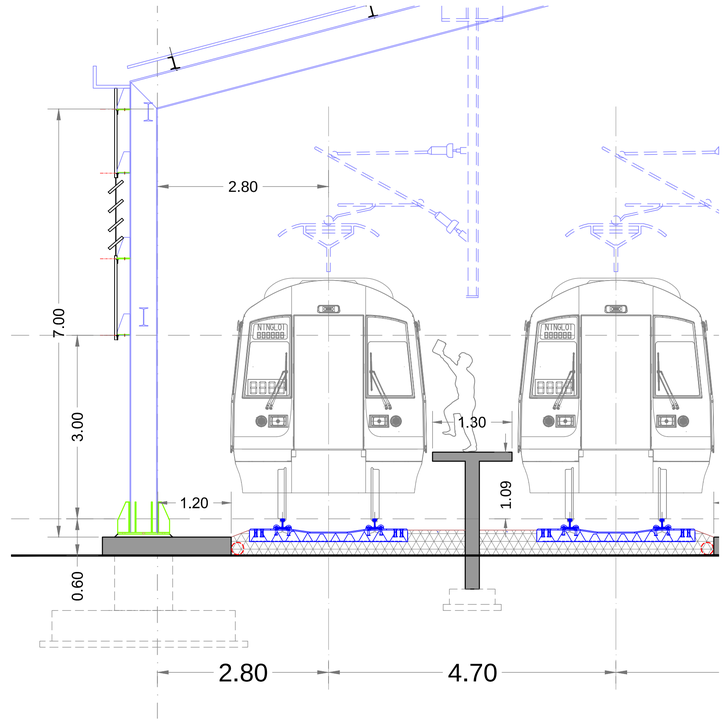
P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/801.DWG

Attachment No.12 To Addendum No.5



SECTION A-A



DETAIL-Y

SCALE1:50

REFERENCE DRAWINGS :-

X-REF FILES :-

NOTES :-

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

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B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
R1	13.12.2017	SP	SHEDS PROVIDED	AK	KT	VS

IC / Detailed Design Consultant :

PADECO Co., Ltd.
Shin-Onarimon Bldg.
6-17-19 Shimbashi,
Minato-ku
Tokyo 105-0004 Japan
Tel: +81-3-5733-0855
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AECOM
9/F, Infinity Tower C,
DLF Cyber City, DLF Phase –II,
Gurgaon – 122 002, Haryana – India
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THE Louis Berger Group , Inc., USA
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1250 23rd St. NW
Washington, DC 20037,
USA.

A-615/616, Kohinoor City,
Kurla (W), Mumbai 400086
India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK | Checked : KT | Approved : SC

Scale : 1:125 (A1) | Drawn : SP | Date : 13.12.2017

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R-13, 'E'- Block,
Bandra Kurla Complex, Bandra (East), Mumbai: 400051.

Drawing Title :

PROPOSED AAREY DEPOT

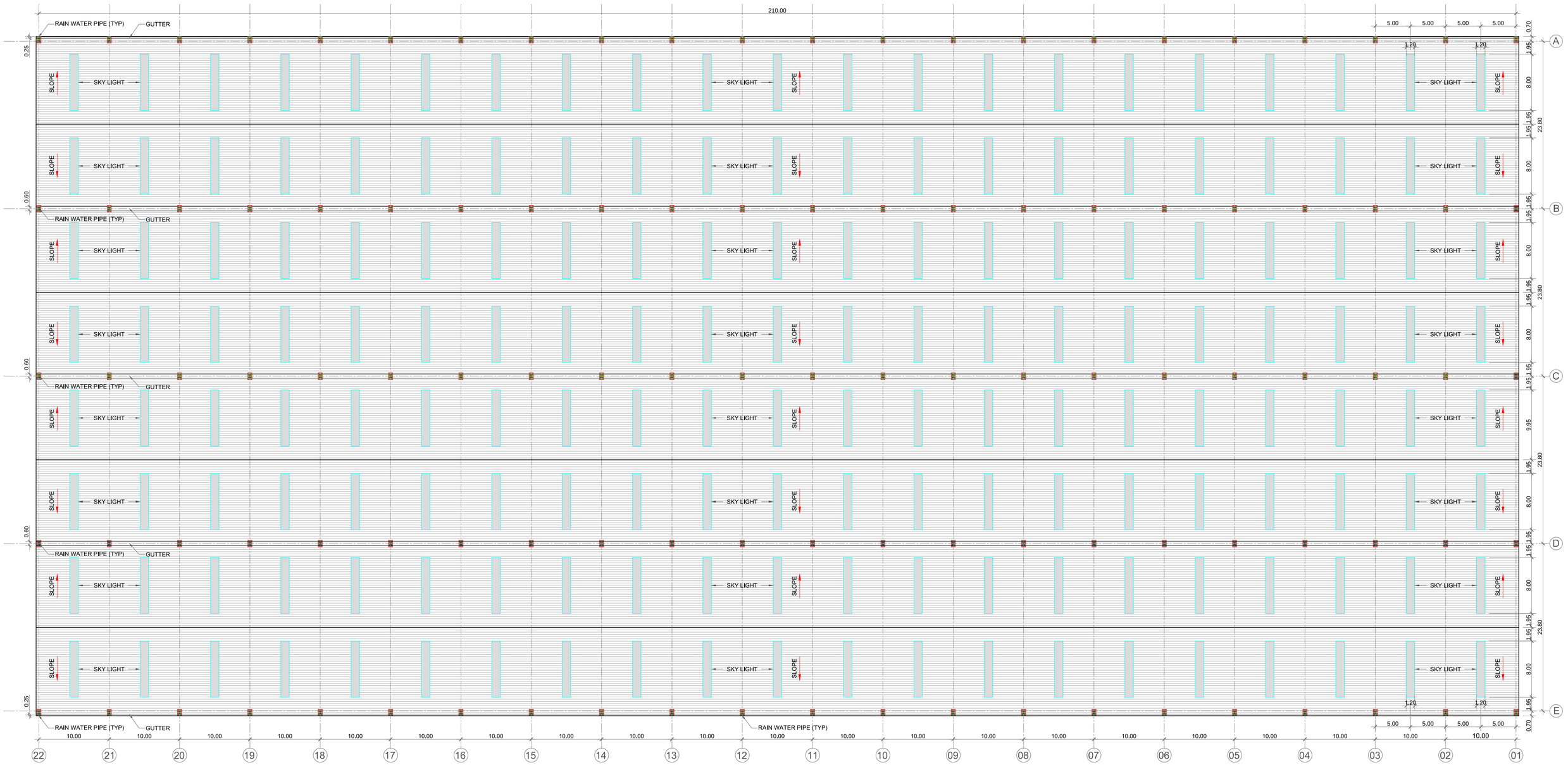
COVERED STABLING SHED 2
SECTION

Drawing No. : MML3-CBS/MMRC/IC/DEP/AR/802 | Rev. R1 | DWG Status P

P-Preliminary, D-Definitive, C-Construction Reference, W-Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/802.DWG

Attachment No.12 To Addendum No.5



REFERENCE DRAWINGS :–

X–REF FILES :–

NOTES :–

FOR INFORMATION ONLY

General Consultants :

maple
MUMBAI METRO LINE-3
GENERAL CONSULTANT

Notification :

☐ A ☐ B ☐ C

As noted in the DSR No. _____ dated _____

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B : No Objection with comments.
C : Notice of No objection.

Assessor	Discipline Leader	Engineer
--	--	--

Rev.	Date	Drawn	Description	Designed	Checked	Approved
R1	13.12.2017	SP	SHEDS PROVIDED	AK	KT	VS

IC / Detailed Design Consultant :

PADECO Co., Ltd.
Shin-Onarimon Bldg.
6-17-19 Shimbashi,
Minato-ku
Tokyo 105-0004 Japan
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Fax: +81-3-5733-0856

AECOM
9/F, Infinity Tower C,
DLF Cyber City, DLF Phase –II,
Gurgaon – 122 002, Haryana – India
Tel: +91 124 4830100
Fax: +91 124 4830373

THE Louis Berger Group, Inc., USA
Engineers • Planners • Scientists • Economists
1250 23rd St. NW
Washington, DC 20037,
USA.

A-615/616, Kohinoor City,
Kurla (W), Mumbai 400086
India

Project Title : Mumbai Metro Line – 3
Detailed Design Consultancy and Construction for Depot of Underground MML – 3

Designed : AK | Checked : KT | Approved : SC

Scale : 1:275(A1) | Drawn : SP | Date : 13.12.2017

MUMBAI METRO RAIL CORPORATION LTD.
Namttri Building, Plot No. R–13, 'E'– Block,
Bandra Kurla Complex, Bandra (East), Mumbai 400051.

MMRC

Drawing Title :

PROPOSED AAREY DEPOT

COVERED STABLING SHED 2
ROOF PLAN

Drawing No. :	Rev.	DWG Status
MML3-CBS/MMRC/IC/DEP/AR/803	R1	P

P–Preliminary, D–Definitive, C–Construction Reference, W–Working Drawing

CAD File Name : MML3-CBS/MMRC/IC/DEP/AR/803.DWG

APPENDIX-1 - REQUIREMENTS UNDER GENERAL CONDITIONS OF CONTRACT (GCC) (Revised)

Sr. N	DESCRIPTION	REF TO CLAUSE NO.	REQUIREMENT
i	Amount of Performance Security	Clause 4.2 of the GCC	10% of the Contract Price in types and proportions of Currencies in which the contract price is payable. In the event of variations during the execution of the contract which result in payments to the Contractor over and above the contract price, the Performance Security shall be suitably adjusted.
ii	Latest 'date for commencement' of the Works	Clause 8.1 of the GCC	Date given in LOA or Employer's Notice to Proceed
iii	'Time for completion' of the work from the date of commencement of the work	Clause 8.2 of the GCC	22 months (Including Monsoon Period)
iv	Liquidated Damages	Clause 8.5 of the GCC	Liquidated damages shall be levied @ 0.5% of Contract value for per week delay in achieving the key date targets as mentioned in appendix 2B of employers requirement: The maximum limit of Liquidated Damages shall be 10% of the total Contract Value.
v	'Defects Liability Period' for the whole of the Works	Clause 10 of the GCC	730 days after the date of issue of Taking-Over Certificate for the Whole of the Works.
vi	Amount of advance payment	Clause 11.2 of the GCC	As per clause No. 26 and 27 of SCC
vii	Amount of Professional Indemnity Insurance (PII).	Clause 15.1 and 15.5 of the GCC	AOA (Any One Accident) limit equal to 6% of the contract value against of BOQ in respect of 'design and construct' with AOY (Any One Year) limit of 2 incidents in a year. In the Professional Indemnity insurance Policy the deductible amount shall not be more than 5% of contract value AOA limit. PII Policy shall be obtained within four weeks from 'date of commencement' and shall be valid for two years after date of issue of 'Performance Certificate'. Wherever the contractor submits policy for shorter period / annual renewable policy, the same shall be renewed before its expiry date. In such situation, the performance guarantee (5% of contract value) shall be retained till required validity period. The contractor's submission of such shorter period / renewable policy shall be construed as their irrevocable consent for retention of the performance guarantee.

viii	Insurance cover for Contractor's All Risk and other requirements as specified in the GCC	Clause 15 of the GCC	100% of the Total Contract Price.
ix	Amount of Third Party Insurance	Clause 15 and 15.3 of the	INR 0.50 Million for any one incident, with no. of incidents unlimited.
x	Period in which all insurances have to be submitted	Clause 15.5 of the GCC	Within 4 weeks from the "date of commencement of work"
xi	Contract Key Dates	Clause 8.5 of the GCC	Refer Appendix 1A of FOT
xii	(a) Contractor's Name and Address	GCC clause 18.1	(Tenderer to Complete)
xii	(b) Employer's Name and Address	GCC clause 18.2	Mumbai Metro Rail Corporation Ltd. NaMTTRI Building, R-13, E Block, Bandra Kurla Complex, Bandra (E) , Mumbai 400 051
xiii	(a) Name of Entity	GCC clause 1.10	
xiii	(b) Address of Entity	GCC clause 1.10	
xiii	(c) Email-id	GCC clause 1.10	
xiii	(d) Contact no/Mobile no	GCC clause 1.10	
xiii	(e) Name of Authorized Person with Designation	GCC clause 1.10	
xiii	(f) GSTN no	GCC clause 1.10	
xiii	(g) Tender no and date	GCC clause 1.10	

Date:

Place: Stamp & Signature of Authorized Signatory

APPENDIX 13 - FINANCIAL DATA (FINANCIAL STANDING) (Revised)

Applicant's Legal Name: [insert full name]

Date:

Group Member's legal name: [insert full name]

Page _____ of _____ pages

Each Applicant or member of a JV must fill in this form

S.N.	Description	Financial Data for Latest Last 5 Years (Indian Rupees)				
	FY	2012-13	2013-14	2014-15	2015-16	2016-17
1.	Total Assets					
2.	Current Assets					
3.	Total External Liabilities					
4.	Current Liabilities (inclusive of provisions if any)					
5.	Annual Profits Before Taxes					
6.	Annual Profits After Taxes					
7.	Net Worth = 1 – 3					
8.	Working Capital = 2 - 4					
9.	Return on Equity					
10	Annual turnover					

NOTE:-

The financial data submitted shall be certified by the Chartered Accounted with his stamp and signature. In case audited balance sheet of last financial year is not made available by the bidder, he has to submit an affidavit certifying that 'the balance sheet has actually not been audited so far'. In such a case the financial data of previous '4' audited financial years will be taken into consideration for evaluation. If audited balance sheet of any other year than the last year is not submitted, the tender will be considered as non- responsive.

Attach copies of the audited balance sheets, including all related notes, income statements for the last five audited financial years, as indicated above, complying with the following conditions.

(i) Separate Performa shall be used for each member in case of JV / Consortium.

(ii) All such documents reflect the financial data of the Applicant or member in case of JV / Consortium, and not sister or Parent Company.

(iii) Historic financial statements shall be audited by Statutory Auditor of the Company under their seal & stamp and shall be strictly based on Audited Annual Financial results of the relevant period(s). No statements for partial periods will be accepted.

(iv) Historic financial statements must be complete, including all notes to the financial statements.

(v) Applicants whose financial year closure falls in months other than March, may submit all relevant data for the last 5 years i.e. 2013, 2014, 2015, 2016 and 2017

(vi) Return on Equity = Net Income / Shareholders Equity.

Return on Equity = Net Income is for the full fiscal year (before dividends paid to common stock holders but after dividends to preferred stock).

Shareholders equity does not include preferred shares.

(vii) The above Annexure shall be duly certified by Chartered Accountant / Company Auditor under his signature & stamp.

APPENDIX 14 - FINANCIAL DATA (WORKDONE) (Revised)

(MAXIMUM VALUE OF CONSTRUCTION WORKS DONE DURING THE LAST FIVE FINANCIAL YEARS)

NAME OF THE TENDERER (CONSTITUENT MEMBER IN CASE OF JV/JVA):

S. No.	DESCRIPTION	Financial Data for Last 5 Audited Financial Years (updated as per Note 5 given below)				
		Year 2012-2013	Year 2013-2014	Year 2014-2015	Year 2015-2016	Year 2016-2017
1	2	3	4	5	6	7
	Total maximum value of Construction work done as per audited financial statements					

NOTE:

(i) Separate Performa shall be used for each member in case of JV / Consortium.

(ii) Attach attested copies of the Audited Financial Statements of the last five financial years as Annexure.

(iii) All such documents reflect the financial data of the tenderer or member in case of JV / JVA, and not that of sister or parent company.

(iv) The financial data in above prescribed format shall be certified by Chartered Accountant / Company Auditor under his signature & stamp.

(v) The above financial data will be updated to tender submission date price level assuming 5% inflation for Indian Rupees every year and 2% for foreign currency portions per year. For the purpose of evaluation all prices will be converted to Indian Rupees using the Exchange rate of foreign currency applicable 28 days before the submission date of tender.

Applicants, whose financial year closure falls in months other than march, may submit all relevant data for the last 5 years i.e. 2013, 2014, 2015, 2016 and 2017.

APPENDIX 15 – WORKS IN HAND

(During the period of 22 months w.e.f 31.12.2017) (Revised)

Applicant's Legal Name: [insert full name]

Date:

Group Member's legal name: [insert full name]

Page _____ of _____ pages

Name and brief particulars of contract (Clearly indicate the part of the work assigned to the applicant(s)	Name of client with telephone number and fax	Contract Value In Rupees Equivalent (Give only the value of work assigned to the applicant(s) (Assume inflation as given in NIT)	Value of balance work yet to be done in Rupee equivalent as on tender submission on date	Date of Completion as per Contract Agreement	Expected Completion Date	Delay if any, with reason	Value of work to be done during the period of 22 months w.e.f 31.12.2017

APPENDIX 1 – TECHNICAL PARAMETERES

A) (1) EOT CRANE 15T/5T – MAINTENANCE BAY

Parameter	Specifications
Location	Maintenance bay (Work Shop)
SWL	15 T/5T
Crane Span, m	30m (approx.). to be coordinated with civil drawings
Bay length	301 m
Location	Indoor
Over Load Test	125 %
Hook path for Hoist (clearance under hook)	7.50 m to 9.00 m (min Req).
Reeving	4/1
Ambient Temperature (Max Deg C)	45°C
Quantity	2 Nos. (2 NOs EOT Crane. in one common bay)
Class of duty	FEM: 2 m
Speeds:	
15T Hoist (Slow/Fast)	0.5 - 5.0 m/min. (2 Speed Inverter control)
5T Hoist (Slow/Fast)	0.5 - 12.5 m/min. (2 Speed Inverter control)
Cross Travel (Slow/Fast)	2.0 -20.0 m/min. (2 Speed Inverter control)
Long Travel (Slow/Fast)	4.0 - 40.0 m/min. (2 Speed Inverter control)
Motor Type	Z (Squirrel cage).
Motor Rating :-KW	All motor shall be of B class insulation
Main Hoist	14.50 KW.
Auxiliary Hoist	11.4 KW.
Cross Travel	2 X 0.55 KW.
Long Travel	2 x 2.1 KW.

Wheel base (LT)	4200 mm
Paint	Golden Yellow EPOXY RAL 1004
Brakes – Hoist, Cross Travel and Long travel	DC Disc Brake
Long Travel Power Supply	Power supply thru single shroud bus bar system suitable for 2Nos. of 15T/5T Cranes in a common bay.
Hoist & CT Power Supply	Festoon cables with KBK tracks / drag chain arrangement
Long Travel Rail Type	Rec. bar Size –60 x 50mm, material – St52 or equivalent, with Line contact between wheel and rail surface which significantly reduces wheel / rail wear
Operation	
Control	Independently movable mobile Push button pendant & RRC
Power Supply	3 AC, 415 V +5%-10% & 50 Hz ± 3%
Control voltage	110 V AC
Anti-collision device	Required for both the cranes in a common bay

A) (2) Deleted

B). EOT CRANE 2.0 T – INSPECTION BAY & BOGIE WORK SHOP AREA

Parameter	Specifications
Location	Inspection bay & Bogie Work Shop Area (Work Shop)
INSPECTION BAY	
SWL	2.0 T
Span, m (Inspection Bay)	15.80 m (approx.). to be coordinated with civil drawings
Bay length (Inspection Bay)	295 m
BOGIE WORKSHOP(BAY) AREA	
SWL	2.0 T
Span, m (Bogie Workshop Area)	14.50 m (approx.). to be coordinated with civil drawings
Bay length (Bogie Workshop Area)	96 m
Overhang, mm	450 mm each side
Location	Indoor
Over Load Test	125 %
Hook path for Hoist (clearance under hook)	+7.65 m above floor and -2.5 m below floor
Reeving	4/1
Ambient Temperature (Max Degrees C)	45°C
Quantity	2 nos. (at single inspection bay)
Class of duty	FEM: 2 m
Speeds	
Main Hoist (Slow/Fast)	0.5 - 12.5 m/min. (2 Speed Inverter control)
Cross Travel (Slow/Fast)	5.0 - 30.0 m/min. (2 Speed Inverter control)
Long Travel (Slow/Fast)	2.0 - 20.0 m/min. (2 Speed Inverter control)
Motor Type	Z (Squirrel cage).
Motor Rating :-KW	All motor shall be of B class insulation
Main Hoist	4.2 KW.
Cross Travel	2 X 0.37 KW.

Long Travel	2 x 0.37 KW.
Wheel base (LT)	2200 mm
Paint	Golden Yellow EPOXY RAL 1004
Brakes – Hoist, Cross Travel and Long travel	DC Disc Brake
Limit Switch	
Limit Switch -Main Hoist	4 Position Geared Limit Switch
Cross Travel	2 Stage limit switch
Long Travel	2 Stage limit switch
LT Power Supply	Power supply through single shroud bus bar system Suitable for 2No. Of 2T Crane in a single bay. (Inspection Bay) and 1No. of 2T Crane in a single bay (Bogie Workshop Area).
Hoist & CT Power Supply	Festoon cables with KBK tracks
Long Travel Rail Type	Not Applicable
Operation	
Control	Independently movable mobile Push button pendant & RRC
Power Supply	3□ AC, 415 V +5%-10% & 50 Hz ± 3%
Control voltage	110 V AC

C). EOT CRANE 10T – OCC & INFRA BUILDING (WORK TRAIN WORKSHOP)

Parameter	Specifications
Location	OCC & Infra Building {Work Train Workshop (Maintenance vehicle stabling)}
SWL	10T
Span, m	13.5m (approx.). to be coordinated with civil drawings
Bay length	112 m
Location	Indoor
Over Load Test	125 %
Hook path for Hoist (clearance under hook)	+5.25 m above floor and -1.6 m below floor
Reeving	4/1
Ambient Temperature (Max Degrees C)	45°C
Quantity	1No.
Class of duty	FEM: 2 m
Speeds	
Main Hoist (Slow/Fast)	0.5 - 12.5 m/min. (2 Speed Inverter control)
Cross Travel (Slow/Fast)	2.0 - 20.0 m/min. (2 Speed Inverter control)
Long Travel (Slow/Fast)	2.0 - 20.0 m/min. (2 Speed Inverter control)
Motor Type	Z (Squirrel cage).
Motor Rating :-KW	All motor shall be of B class insulation
Main Hoist	13 KW.
Cross Travel	2 X 0.55 KW.
Long Travel	2 x 2 KW.
Wheel base (LT)	4000 mm
Paint	Golden Yellow EPOXY RAL 1004

Brakes – Hoist, Cross Travel and Long travel	DC Disc Brake
Limit Switch	
Limit Switch -Main Hoist	4 Position Geared Limit Switch
Cross Travel	2 Stage limit switch
Long Travel	2 Stage limit switch
LT Power Supply	Power supply thru single shroud bus bar system Suitable for 1No. Of 10T Crane in a bay.
Hoist & CT Power Supply	Festoon cables with KBK tracks / drag chain arrangement
Long Travel Rail Type	Rec. bar Size –50 x 40mm, material – St52 or equivalent, with Line contact between wheel and rail surface which significantly reduces wheel / rail wear
Operation	
Control	Independently movable mobile Push button pendant & RRC
Power Supply	3□ AC, 415 V +5%-10% & 50 Hz ± 3%
Control voltage	110 V AC

D) EOT CRANE 5T – UNDER FLOOR WHEEL LATHE (UFWL)

Parameter	Specifications
Location	Under Floor Wheel Lathe (UFWL)
SWL	5 T
Span, m	7 m (approx.). to be coordinated with civil drawings
Bay length	40 m
Location	Indoor
Over Load Test	125 %
Hook path for Hoist (clearance under hook)	+5.25 m above floor and -2.5 m below floor
Reeving	4/1
Ambient Temperature (Max Degrees C)	45°C
Quantity	1No.
Class of duty	FEM: 2 m
Speeds	
Main Hoist (Slow/Fast)	0.5 - 12.5 m/min. (2 Speed Inverter control)
Cross Travel (Slow/Fast)	2.0 - 20.0 m/min. (2 Speed Inverter control)
Long Travel (Slow/Fast)	2.0 - 20.0 m/min. (2 Speed Inverter control)
Motor Type	Z (Squirrel cage).
Motor Rating :-KW	All motor shall be of B class insulation
Main Hoist	11.4 KW.
Cross Travel	2 x 0.25 KW.
Long Travel	2 x 0.55 KW.
Wheel base (LT)	2500 mm
Paint	Golden Yellow EPOXY RAL 1004

Brakes – Hoist, Cross Travel and Long travel	DC Disc Brake
Limit Switch	
Limit Switch -Main Hoist	4 Position Geared Limit Switch
Cross Travel	2 Stage limit switch
Long Travel	2 Stage limit switch
LT Power Supply	Power supply thru single shroud bus bar system Suitable for 1No. Of 5T Crane in a bay.
Hoist & CT Power Supply	Festoon cables with KBK tracks / drag chain arrangement
Long Travel Rail Type	Rec. bar Size –50 x 40mm, material – St52 or equivalent, with Line contact between wheel and rail surface which significantly reduces wheel / rail wear
Operation	
Control	Independently movable mobile Push button pendant & RRC
Power Supply	3□ AC, 415 V +5%-10% & 50 Hz ± 3%
Control voltage	110 V AC