



METRO CUBE

A MUMBAI METRO RAIL CORPORATION NEWSLETTER

MD SPEAKS

Ms. Ashwini Bhide, IAS

I am extremely happy to announce that METRO CUBE completed 3 years of effective Project Information Outreach to the readers and stake holders. During last 3 years, Metro CUBE has emerged as authentic source of information presented in most lucid and simple language to benefit the readers and stakeholders. From the humble first edition in October 2016, the articles, technical information, presentation of project developments and activities has remarkably improved to evolve as most awaited publication by project patrons. Aided by the project implementation progress, METRO CUBE has become a platform for expression of Team Metro for their knowledge and skills, showcasing overall project performance.

Team MMRC is happy to declare that the project has now crossed 50% progress while overcoming almost all major hurdles and consistently marching towards completion. To be more specific; the tunneling has crossed 70% in length (38 km out of 56 km) and breakthrough (21 out of 32) as well. With more than 16,000 workforce from highly qualified Engineers to unskilled workers working on the field Team Metro-3 represents one of the largest cohesive team (with diverse backgrounds and skills) working in India. As multiple systems contracts are awarded, the team strength will further grow and will be working at different locations throughout India.

Continued on Page 3

ANNIVERSARY I S S U E

Content

MD Speaks	1
Communication Based Train Control	2
Communication Based Train Control MD Speaks	3
Aqua Line - Mumbai Metro Line 3 Safety and Security in Train	4-5
Emergency Evacuation Motion Safety	6
Traction Power Supply System Salient Features of Rolling Stock	7
Systems Contracts	8



Communication Based Train Control

Metro-3 is expected to have intensive utilization with ridership of over 12 Lakh in the first year of commissioning. Hence, Metro-3 is being equipped with latest state of the art signaling and train control system – Communication Based Train Control System (CBTC). It is an automatic train signaling system which is operated by telecommunication between the train and track equipment for the traffic management and infrastructure control. Primary features of CBTC system are as follows:

- i) High-resolution train location determination, independent of track circuits
- ii) Fixed beacons for refining train location information
- iii) Secondary detection system for safety during degraded mode of operation
- iv) Continuous, high capacity, bidirectional train-to-wayside data communication
- v) Train-borne & wayside processors performing vital functions
- vi) Conforming to International IEEE (institute of Electrical & Electronics) and EN standards (European Standards)

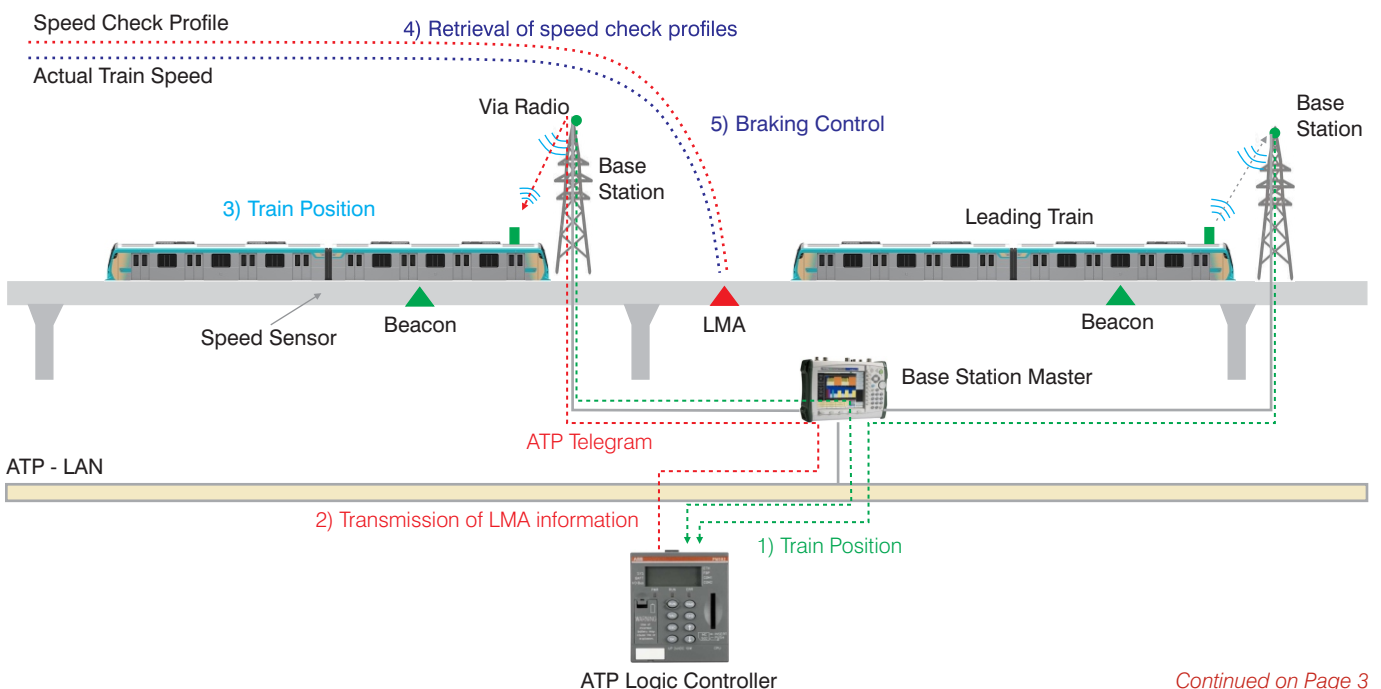
Functionalities provided by CBTC comprise of the following:

- 1) Automatic Train Control (ATC): On-board and wayside train control system to define movement of authority, speed control and maintain safe distance between trains. ATC consists of Automatic Train Protection (ATP) and Automatic Train Operation (ATO) functionalities.
- 2) Computer Based Interlocking (CBI): CBI ensures proper setting of points en route and clearance of signals dependent on Interlocking logic in fail-safe manner. It interfaces with ATC system for correct route setting, signal status and opening & closing of platform screen doors.
- 3) Automatic Train Supervision System (ATS): ATS System is the overall management system which undertakes all the functions of train operations, such as:
 - Monitoring and control of signaling equipment
 - Train identification and online timetable management

- Automatic route setting and automatic turn back
- Remote operation of signaling equipment at stations
- Passenger Information System Management, Rolling Stock and crew management, etc.

ATS interfaces with all other sub-systems of Metro for unified smooth operations.

- 4) Automatic Train Operation (ATO): ATO system manages automatic operation of train except closing of train doors and operation in the event of a disruption, which are handled by Train Operator. ATO enable smooth running of trains as per track, signalling and rolling stock characteristics.
- 5) Unattended Train Operation (UTO): UTO system manages all train operation related functions automatically without requirement of train operator.



Continued on Page 3

Communication Based Train Control

Continued from Page 2

Benefits of CBTC with Unattended Train Operation:

1. Reduced headway: More train services with the same infrastructure
2. Reduced track side equipment: Less maintenance requirement
3. Energy saving: Efficient coasting and regenerative braking commands to train
4. Greater flexibility in operation: By taking the human factor out of the driving equation, operators gain flexibility and can make better use of assets.
5. Increased service quality: Overall passengers perceive an increased quality of service, thanks to the enhanced reliability of trains and shorter waiting time at platforms.



Platform Screen Doors (PSD)

Platform Screen Doors (PSD): For ensuring safety of commuters full height Platform Screen Doors have been provided at 26 underground stations and half height Platform Edge Doors (PED) at Aarey which is at grade. Features of the PSD/PED system are as under:

- Prevents accidental falling of passengers and suicide attempts on track
- Aligned with the train doors to ensure smooth flow of commuters
- Reduces energy consumption of air-conditioning system at underground stations.
- Prevents air and noise pollution from incoming train at stations.
- Provision of emergency escape doors



Operations Control Centre (OCC)

Operations Control Centre: OCC of Metro-3 will be located at Aarey depot, and acts as the nerve center for entire Metro-3.

- OCC theater shall be equipped with a Laser based video wall to provide panoramic display of complete line for live monitoring of track status, points, signals, train location and traction power control.
- Live video streaming of CCTV coverage from trains through on-board Video Transmission System.
- Individual workstations shall be provided to various operations' staff for close monitoring of all aspects of train operations.
- Backup Operations Control Center has been planned at different geographic location which shall take over operations in the event of a failure of main OCC, thereby having minimal impact on train operations.

MD Speaks

Continued from Page 1

Being anniversary issue, this 37th edition is focused on specific subject as a tradition. This edition of Metro Cube is therefore dedicated to Rolling Stock which is the essential and most awaited aspect of Metro System. Design of Metro Rail Car for Metro-3 is finalized keeping in view the latest technical standards ensuring passenger comfort, amenities, safety and security with an elegant look and ambiance. Conceptualized and designed with Aqua theme, this modern Rolling Stock will be designed and built as Driverless trains with an option of onboard driver controls. The details of all special features are presented in various articles.

On this 3rd anniversary of METRO CUBE, I take this opportunity to especially congratulate and appreciate the enthusiastic efforts of the METRO CUBE team who will continue to ensure publishing of the newsletter by bringing out new aspects, updates and developments of Mumbai Metro-3 for the consumption of ordinary citizens and stakeholders.



Aqua Line - Mumbai Metro Line 3 (Colaba-Bandra SEEPZS)

Colour Harmony - Aqua & Design Theme – Fluidic:

Mumbaikars, always on the move, turn to the Sea (Aqua) for peace, soothed by its waves and breeze. This inspires the idea of using a unique blend of comfort of sand (beige) and freshness of sea (arctic green), to provide a relaxing and refreshing travel experience.

Dynamic fluidism, a tribute to the energy flowing throughout the city of Mumbai, the city that never sleeps. Inspired by the vital flow of water and aspiring to offer a fast, efficient & sustainable mode of travel, to become the new lifeline for the Mumbaikars. Inspired by the dynamic flow and energy in Mumbai, the Aqua Line cuts through the belly of Mumbai.



Passenger Comfort

Designed for high passenger capacity: Spacious interiors, high ceiling, handles at 1.75 m height, adequate handholds for passenger comfort.

Seating Arrangement: Stainless steel longitudinal seats along with coach in passenger area. It is designed as anti-slip bucket type which provides additional comfort to the seated passenger during acceleration and braking.

Innovative High Capacity Handling Area: Higher standing area and space for people with luggage with twin grab poles in gangway area.

Dedicated and easily accessible wheelchair space in each coach: Thoughtful details like Intercom at lower height at wheelchair bay for seated passenger accessibility.

Luggage space: There will be space available for luggage below seats in passenger saloon area.



Dedicated and easily accessible wheelchair space in each coach

Safety and Security in Train

Safety and security features for train

- Front detrainment door system with clear width of 1120 mm and head room of 1900 mm so that two passengers at the same time can come out of door without supervision
- Provision for side evacuation during acute emergency.
- Smoke & heat detection system in the passenger areas of train
- The design and the materials used will conform to fire safety requirements of International Standards
- The total floor structure with effective fire barrier for a minimum of 30 minutes.

On board Communication System in Aqua Line

- Two-way communication between the Operations Control Centre and train, via train radio equipment.
- Emergency passenger announcements on the train by OCC via train radio system.
- Automatic voice announcement
- A passenger information system
- Passenger coach surveillance system using CCTV inside train.

On board Communication devices

Passenger Emergency Alarm (PEA)

Passenger Emergency Intercom allows a passenger to alert the Train Operator/OCC and set up the call with both parties in case of emergency. An Emergency Intercom System consisting of four emergency intercom units per coach, including microphones, speakers, one miniature camera and alarm buttons. Camera shall activate if someone presses the PEA button and capture & transmit the passenger's visuals to Operational Control Center.

Passenger Information Subsystem

Electronic Destination Display (EDD): The EDD shall be able to display the destinations, train number and special messages. There shall be two EDD in each train.

Electronic Information Display (EID):

- High resolution multi-color graphic display, suitable for the remote displaying of moving messages, in Marathi, Hindi and English, on board the train, in the passenger area.
- These displays for special messages/ advertisements (incl. video) etc. which shall be downloadable from one end of the coach/unit and/or from the cab.
- Provision for real time video streaming as well. There shall be 6 No. EID per coach.



Passenger Emergency Alarm



Electronic Destination Display



Electronic Information Display

Digital Route Map Display:

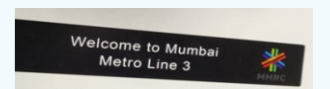
- 8 Nos. of Digital Route Map Display in one coach (at each Door)
- This will Display destination station, present station, approaching station, "time remaining" for reaching next stations, real time clock and door indications.
- Route-map of respective lines in different colors, point of interchange or any other important information, flashing of emergency messages, important train messages, scrolling of routes, adding/expunging of stations, selectable display of route.



- The station names shall be displayed in Hindi, Marathi & English

Internal Electronic Destination Display:

- Internal Electronic Destination Display shall display on both ends of coaches just above the gangway of the coach.
- The programmable display shall be capable of displaying the next station destination in Hindi, English & Marathi language along with other graphics



- **Passenger Coach Surveillance System:** It shall comprise of a CCTV network using surveillance cameras, routers and cables, monitors and other accessories. Total 4 Nos. CCTV will be in one coach. The data captured in CCTV can be retrieved to solve the serious incidents.

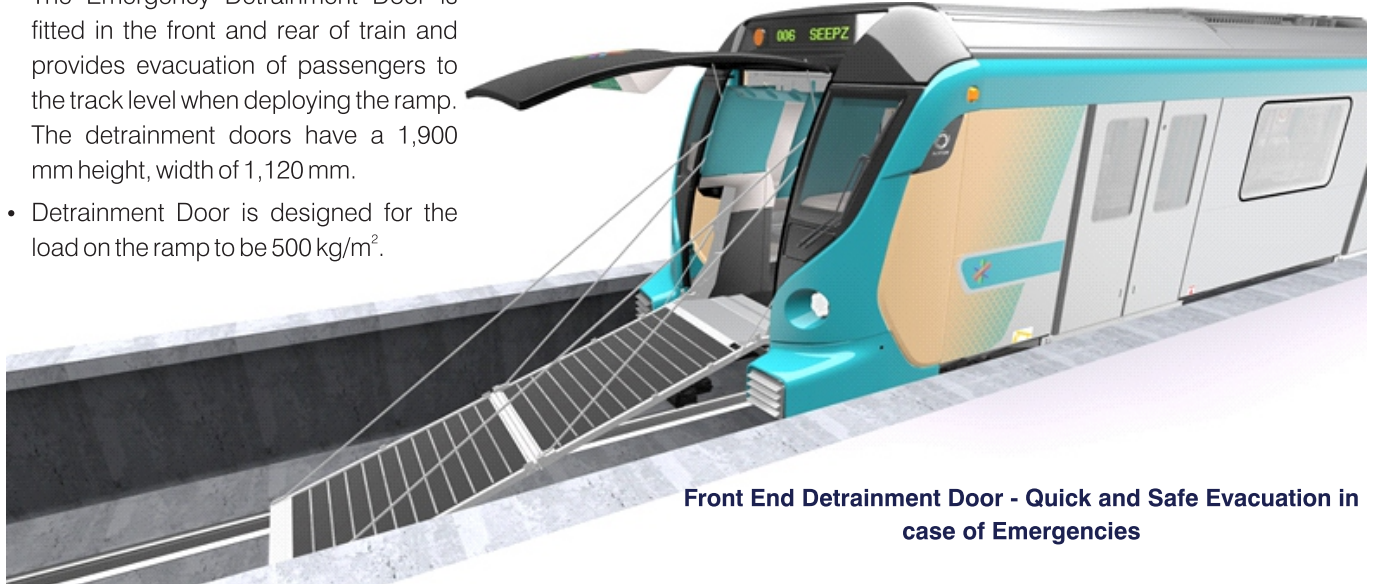


Emergency Evacuation

The Detrainment Doors for the Metro-3 project is centrally located on the front of both trailer coaches (front and rear of train)

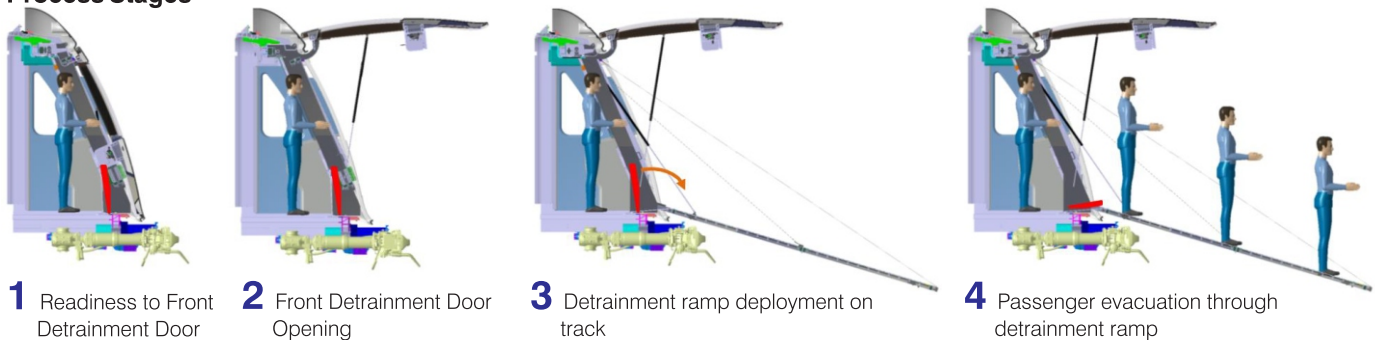
Detrainment Door's General Features:

- The Emergency Detrainment Door is fitted in the front and rear of train and provides evacuation of passengers to the track level when deploying the ramp. The detrainment doors have a 1,900 mm height, width of 1,120 mm.
- Detrainment Door is designed for the load on the ramp to be 500 kg/m².



Front End Detrainment Door - Quick and Safe Evacuation in case of Emergencies

Process Stages



Motion Safety

Motion Safety Diagnostic Features will include following devices: –

Obstruction Deflection Device: The Obstruction Deflection Device will be installed at both ends of the train to push away objects on track to avoid derailment.

Obstacle Detection Device: It shall detect obstacles in front of the train at the earliest. The detection of obstacle shall initiate the emergency brake. It is mounted on leading bogies of end coach.

Deraillment Detection Device: It shall monitor all running axles, and when activated, it shall apply the emergency brake. Detection of deraillment shall be reported to the Control Center. It is fitted in all leading axles of intermediate coaches of train.

Track Condition Monitoring System: This system is to identify the track conditions such as rail fractures, running edge defects, rail head surface defects, corrosion, missing fasteners, etc. through a suitably designed Digital Line Scan Camera (s) with automatic real time detection and warning up to 95 kmph of train speed. It is mounted on both ends of leading coaches of the train.

Hot Wheel Detection: Hot wheel detectors are designed to monitor axle, wheel, brake

temperatures and to indicate any overheating which could lead to derailments and transmits this data to the Operational Control Center/ Train Control and Management System. It is track side device and proposed location for this device is prior to the end station towards Depot.

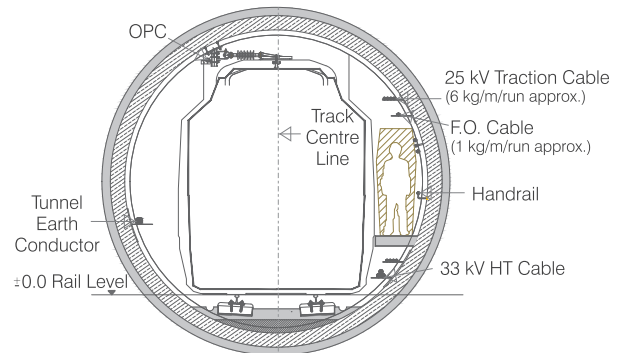
Wheel Flat Detection: Wheel defects are detected early before affecting other components or accelerating the progression of wheel cracks. Some independent studies have shown that the wheel impacts are an important factor in the initiation of wheel shattered rim defects. It is track side device and proposed location for this device is prior to the end station towards Depot.

Traction Power Supply System

Overhead Catenary System (OCS): OCS is a system of overhead wires used to supply electricity to a train vehicle that is equipped with a pantograph. The three main types of overhead catenary electric traction systems that exist are as follows:

- 1) **Flexible OCS (FOCS):** This type of system is mainly used on at-grade and elevated lines where there is no restriction on overhead clearance requirements. It is planned for at grade section including on stabling lines.
- 2) **Rigid Overhead Catenary System (ROCS):** This type of system is mainly used in underground lines where there is restriction on clearance requirements due to tunnels. Hence, in order to accommodate the required electrical clearances as per the standard, Rigid OCS has been adopted for traction supply in the underground section.
- 3) **Retractable OCS:** Mainly used in inspection lines of depots, where release of space is needed above the train to make all the necessary major maintenance activities with the use of gantry/EoT crane etc. Retractable OCS permits to freely let in and get out trains and locomotives in metro maintenance depots and workshops without any interruption and additional hauling systems.

In Metro-3, 25 kV, single phase, 50 Hz AC has been adopted for the traction system.



Schematic bore tunnel with ROCS arrangement

Advantages of Rigid Catenary System in comparison with the traditional Flexible Catenary System

- i. Less tunnel clearance requirements, less construction cost
- ii. More capability of current carrying
- iii. No risk of breaking-off, more security
- iv. Easy operation and maintenance

Salient Features of Rolling Stock

- Train configuration for Metro-3 is of 8 coaches having 75% of motorisation with regeneration braking. During braking traction, motor works as a generator and energy is fed back to the overhead equipment. With this system, about 30% of electric energy is saved, braking efficiency improves and wear & tear of brake equipment also reduces.
- Width of train is 3200 mm which supports to increase total passenger carrying capacity of train.
- Design speed of train is 95 kmph and operational speed is 85 kmph which helps to reduce total travel time for commuters by means of faster transport option.
- Axle load is 17 tons per axle and passenger capacity of train (8 cars) is approx. 2400 passengers (6 persons/m² in standing position and seated).
- Supply voltage is 25 kV AC, single phase 50 Hz, overhead catenary.
- Car body material is of stainless steel having good corrosive resistance properties which will help to sustain metro coach throughout life of 35 years in Mumbai climate condition.
- Air Conditioning (AC) is roof mounted, VAC with Variable Voltage Variable Frequency (VVVF) scheme. With this arrangement, 4-5% electric energy is saved.
- CO₂ and humidity automatic control system is inbuilt with air conditioning to provide better passenger comfort in all type of climate conditions.
- Smart LED lighting system with automatic light control feature reduces energy consumption and improves overall efficiency.
- Total 8 number of doors in one coach (4 on each side of coach) admeasuring 1900 mm × 1400 mm, provide comfort for commuters during boarding and deboarding in peak hour operation.
- Ethernet Based Train Control and Management System (TCMS) adopted to ensure error free and highspeed data transmission. Overall, it will improve reliability in train operation.
- Communication Based Train Control (CBTC) system is planned for train control signalling system to achieve designed headway of 90 seconds and operational headway of 120 seconds.
- To provide faster and comfortable ride for commuters, maximum acceleration of train is planned 1.2 m/s², maximum deceleration of 1.1 m/s² for service braking and 1.3 m/s² for emergency braking.

Systems Contracts (Awarded as on 31/10/2019)

Sr. No.	Package	Description	Contractor	Date of Award
1	17	Rolling Stock (31 Trains of 8 cars each)	Consortium of Alstom Transport India Ltd & Alstom Transport S.A., France	17.07.2018
2	12	Signalling & Train Control, Platform Screen Doors and Telecom Systems		25.10.2018
3	11A	Traction System (25 kV Overhead Contact)		21.02.2018
4	11B	Power Supply System	Larsen & Toubro Limited, India	21.02.2018
5	15 (Ph-1)	Tunnel Ventilation & Environmental Control System(Aarey- BKC)	Shanghai Tunnel Engineering Co. Ltd (STEC), China.	15.02.2019
6	15 (P2L1)	Tunnel Ventilation & Environmental Control System (BKC-Mumbai Central)	Blue Star Limited, India	18.06.2019
7	15 (P2L2)	Tunnel Ventilation & Environmental Control System (Mumbai Central-Cuffe Parade)	Voltas Limited, India	27.08.2019
8	16B (L1)	Lifts (Aarey to Dadar, 13 Stns. & Depot)	JV of IFE, China & CRANEX, India.	11.02.2019
9	16B (L2)	Lifts (Siddhi Vinayak to Cuffe Parade, 14 Stns.)	Consortium of Yuanda, China & Royal, India	22.10.2018
10	16A (E1)	Escalators (Aarey to Dadar, 13 Stns.)		31.01.2019
11	16A (E2)	Escalators (Siddhi Vinayak to Cuffe Parade, 14Stns.)	Consortium of Johnson Lifts Pvt Ltd India & M/s SJEC Corporation, China.	09.10.2018
12	14	Automatic Fare Collection (AFC) System	Consortium of Kalindee, India & ASIS, Turkey.	15.01.2019
13	9-1	CNC Under Floor Wheel Lathe	HYT Engineering Company Pvt Ltd, India	20.09.2019
14	9-1	Battery Operated Shunter	JV of NITEQ, Netherlands - Renmakch, India	20.09.2019
15	10B	Track Works (Civil)	Larsen & Toubro Limited, India	28.05.2019
16	NJ-1	Depot (E&M) Works	Blue Star Limited, India	21.09.2018
17	NJ-2	Pylon Shifting Works	Consortium of Ravin & Ashtavinayaka, India	14.02.2018
18	NJ-3	Independent Safety Assessor (ISA)	Bureau Veritas Italia S.p.A., Italy.	13.09.2019

CONTRIBUTIONS

ARTICLES

Umashankar Rukmangada
Royal Correia
Kathiresan Ramesh

EXECUTIVE EDITOR

R. Ramana

EDITING & GRAPHICS

Pallavi Kulkarni
Zarqa Khan

Disclaimer: The information/contents of this Newsletter is not for legal purpose

Mumbai Metro Rail Corporation
NaMTTRI Building, Plot No. R-13 'E'-
Block, Bandra Kurla Complex, Bandra (E),
Mumbai 400051



Website Link

Connect With Us



@MumbaiMetro3



Mumbai Metro Rail Corporation, MMRC



@mumbaimetro3



@MumbaiMetro3

www.mmrc.com

www.mmrc.com/en/media-centre/gallery/photo-gallery

For Private Circulation Only