

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)**

2025/Proj./MPMRCL/D2/30/121

New Delhi, dated 30.05.2025

Managing Director,
Madhya Pradesh Metro Rail Corporation Ltd.,
2nd Floor, Smart City Dev. Corporation Building,
Kalibadi Road, BHEL, Sector-A, Berkheda,
Bhopal-462022.

Sub: In-principle approval for 750 V DC Third Rail Traction Power Supply and SCADA System (Annexure D2) for Priority section of Corridor-1 of Bhopal Metro Project of MPMRCL i.e. from Subhash Nagar Station buffer end to AIIMS Station buffer end- (Up Line Ch.: 26.987 km to Ch.: 20.025 km and DN Line Ch.: 20.025 km to 26.987km) including 01 depot at Subhash Nagar

Ref: Annexure D-2 and related certificates & documents submitted by MPMRCL on RDSO's online portal dated 26.04.2025, 06.04.2025, 18.11.2024, 22.08.2024, 08.05.2024 & 07.11.2023

Madhya Pradesh Metro Rail Corporation Ltd (MPMRCL)'s request for In-principle approval for 750 V DC Third Rail Traction Power Supply and SCADA System (Annexure D2 – copy enclosed) for Priority section of Corridor-1 of Bhopal Metro Project of MPMRCL i.e. from Subhash Nagar Station buffer end to AIIMS Station buffer end - (Up Line Ch.: 26.987 km to Ch.: 20.025 km and DN Line Ch.: 20.025 km to 26.987km) including 01 depot at Subhash Nagar has been examined in Board's office in consultation with RDSO and approval of the competent authority is hereby conveyed subject to submission of following reports for priority section as per undertakings of MPMRCL:-

1. Submission of FAT report, Site acceptance test certificate with onsite software level functionality tests reports, integration test report of SCADA in June 2025.
2. Submission of commissioning report & compliance report of Emergency Trip System to NFPA 130 in June 2025.
3. Submission of commissioning report for stray current monitoring & mitigation system (SCMS) as per para 10 of IEC 62128 by the end of December 2027.
4. Submission of EMC/EMI validation report for power supply installation by December 2027
5. Bhopal Metro will monitor the performance of following items installed in Bhopal metro rail project up to two years from the date of commencement of commercial operation, for provenness:
 - a. Power Cables : 95 sq. mm, Cu, XLPE
 - b. DC Power Cable: 400 sq. mm, Cu, DC Positive and Negative Cable
 - c. Rectifier Traction Transformer: 2850 KVA
 - d. Auxiliary Transformer (Dry Type): 200 kVA, 500kVA, 2000 kVA
 - e. Lightening arrestor: 120 kV
 - f. Main Auxiliary Power Transformer: 40MVA/50MVA
 - g. Optical Fiber Cable
 - h. 110V/50A and 110V/100A Battery Charger
 - i. 4 kVA UPS



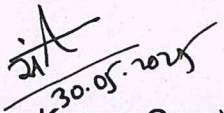
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6. The following measures are suggested for implementation --

- a. Instead of standby DG set Battery storage power backup should be explored for emergency load.
- b. Relay setting should be verified by independent agency.
- c. MPMRCL should ensure compliance of Cyber security guidelines issued by National Critical Information Infrastructure Protection Centre (NCIIPC) in liaison with the concerned ministry.

Any dilution in the Stipulation/Compliances as submitted and detailed in Annexure-'D2' suo moto by MPMRCL shall automatically invalidate the technical clearance.

Encl: as above


(Dr. Sanjeev Kumar Garg)
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Copy to:

- (i) **Executive Director/UTHS**, RDSO, Manak Nagar, Lucknow w.r.t letter No. UTHS/DMRC/DMRC/P01/072021 dated 02.04.2025
- (ii) **OSD/UT & Ex-Officio Joint Secretary**, Ministry of Housing & Urban Affairs (MoHUA), Nirman Bhavan, New Delhi-110011
- (iii) **ED/EEM**, Railway Board


Annexure-I

| 750 V DC Third Rail Traction Power Supply and SCADA System for Priority section of Corridor-I of Bhopal Metro Project of MPMRCL i.e. from Subhash Nagar Metro Station buffer end to AIIMS Station buffer end-(Up Line Ch.: 26.987 km to Ch.: 20.025 km and DN Line Ch.: 20.025 km to 26.987km) | | | |
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| S. N. | System | Features | Conforming Standards/Drawings |
| 1.0 | POWER SUPPLY: Incoming 132 kV | | |
| 1.1 | Receiving Substation (RSS) | 132 kV/33 kV AC | Drawing no BH-08-KGJV-OR-SBND(RSS)-DWG-PST-09102 |
| 1.2 | Earth Resistance at RSS | < 0.5 Ω | IEEE 80, IS 3043 |
| 2.0 | Power Transformer at RSS | 132 kV/33 kV RSS | IEC 60076 |
| | Capacity | 40/50 MVA (02 Nos) | |
| | Phase of Transformer | Three Phase | |
| | Vector Group | YNyn0+d | |
| | Number of Taps and On load Changing on HV side | 16 taps (+6 tap to -9 tap positions) +10% to -15% in step of 1.667% | |
| | Cooling Mode | ONAN/ONAF | |
| | Rated Power | 40/50 MVA | |
| | Temperature Rise above Ambient | Oil- 50 °C Winding- 55 °C | |
| | Overload Capacity | 10 % for 4 Hours 25 % for 2 Hours 50 % for 0.5 Hours 100 % for 0.16 Hours | |
| | Temperature Rise above ambient during occasional Overload | Oil- 65 °C Winding- 75 °C | |
| | Operating Voltage | 132kV/33kV | |
| | Type | Outdoor | |
| | Noise Level-Transformer | Not more than 70 db | |
| | Transformer Oil | Mineral Oil | IEC 60296:2012 |
| 3.0 | Traction Sub-Station (TSS) | 33 kV (AC)/ 0.585 kV-0.585 kV (AC)/ 750 V (DC) | Drawing no BH-08-KGJV-BPL-SYS--DWG-PST-00001 |
| 4.0 | Transformer – Rectifier unit | <ul style="list-style-type: none"> • Cast Coil Dry Type Transformer • Capacity: 2850 kVA (2 Nos) • One Primary & Two Secondary Winding • Vector Group: D (+ 7.5°) d0y11 and D (- 7.5°) d0y11 • Cooling Mode: AN • Overload Capacity: <ul style="list-style-type: none"> (a) 150 % for 2 Hours (b) 300 % for 1 minute • Tap Changer: +5% to -5% in step of 2.5% each (in 5 steps) (Off circuit Tap links) • Insulation Class: (HV/LV) : F/H • Type : Indoor | IS 2026-11, IEC 60076-11, EN 50329 Class VI. |




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| 5.0 | Auxiliary Sub-Station (ASS) | 33 kV/0.415 kV | Drawing no BH-08-KGJV-BPL-SYS--DWG-PST-00001 |
| 5.1 | Earth Resistance of ASS | <1.0 Ω | IS 3043, IEEE-80 |
| 6.0 | Auxiliary Transformer | <ul style="list-style-type: none"> • Cast Coil Dry Type Transformer • Capacity: 200 kVA, 500 kVA & 2000 kVA • 33 KV/0.415KV, 3 phase • Vector Group: Dyn11 • Cooling Mode: AN • Tap Changer: +5% to -5% @ 2.5% (Off circuit Tap links) • Insulation Class: (HV/LV): F/H • Type : Indoor | IS 2026-11, IEC 60076-11 |
| 7.0 | 750 V DC Traction System (Bottom Current Collection) | | |
| 7.1 | Conductor Rail (Third Rail) | Steel & Aluminium (Co-Extruded) | As per technical details submitted by MPMRCL for the priority section of corridor 1 of Bhopal Metro Rail Project. |
| 7.2 | Nominal Current at 45° C ambient | 4500 A DC | |
| 7.3 | Nominal Voltage | 750 V DC | |
| 7.4 | Designed voltage | 1000 V DC | |
| 7.5 | Transient Voltage | 3000 V DC | |
| 7.6 | Max. Electrical Resistance at 20° C | 6.35 micro ohm / meter | |
| 7.7 | Maximum Heat Rise at an Ambient Temp. of 45° C | 36 °C at an Ambient Temp. of 45° C | |
| 7.8 | Short Circuit Level | 100 kA for 150 ms | |
| 7.9 | Linear mass | 17.2 kg/mtr. | |
| 7.10 | Thickness | 6 mm | |
| 7.11 | Stainless Steel Strip | Chromium: 16.14 % | |
| 8.0 | Cables (DC & AC) | <ul style="list-style-type: none"> • 750 VDC Positive Cable • 400 sq.mm, 1C, XLPE, FR-LSH, Copper (Cu) cable • Voltage grade: 1.8/3 kV , DC Cable • Conductor: Plain annealed Copper Class 5. • Outer Sheath : FRLSH PVC Type, ST-2 Sheathed, ATR UV Resistance • Colour - Red • Rated continuous current: In ground 539 A @ 30°C In Air 754 A @ 40°C • Short Circuit current @ 250°C: 57.20 kA for 1 second | IEC-60502-1, IEC-60332-1, IEC-60332-3, IEC-60228 |
| | | <ul style="list-style-type: none"> • 750 VDC Negative Cable • 400 sq.mm, 1C, XLPE, FR-LSH, Copper (Cu) cable • Voltage grade: 0.6/1 kV , DC Cable • Conductor: Plain annealed Copper Class 5 • Outer Sheath : FRLSH PVC Type, ST-2 Sheathed, ATR UV Resistance • Colour - Black | IEC-60502-1, IEC-60332-1, 3 IEC-60228. |




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| | | <ul style="list-style-type: none">Rated continuous current: In ground 544 A @ 30°C In Air 753 A @ 40°CShort Circuit current @ 250°C: 57.20 kA for 1 second | |
| | | <ul style="list-style-type: none">33 kV AC Power cable (Cu):240 sq.mm, Single Core, XLPE, 33 kV FRLS, Annalaed plain copper Power CableConductor screen material – Extruded semiconducting compound.Non-Metallic Insulation Screen material – Extruded Semi-conducting Compound (Bonded Type)Metallic Screen Material: Copper wire screen followed by open Helix copper tapeOuter Sheath- Extruded FRLSH PVC ST-2, Black colourRated current: In ground 423 A @ amb30°C In Air 583 A @ amb40°CShort circuit capacity @ 250 °C: 34.32 kA for 1 sec. | IEC-60502-2, IEC-60332-1, IEC-60228 |
| | | <ul style="list-style-type: none">33 kV AC Power cable (Cu):95 sq.mm, Single Core, XLPE, 33 kV FRLS, Annalaed plain copper Power CableConductor screen material – Extruded semiconducting compound.Non-Metallic Insulation Screen material – Extruded Semi-conducting Compound (Bonded Type)Metallic Screen Material: Copper wire screen followed by open Helix copper tapeOuter Sheath- Extruded FRLS PVC ST-2, Black colourRated current: In ground 257 A @ amb30°C In Air 329 A @ amb40°CShort circuit capacity: @250°C: 13.59 kA for 1 second | IEC-60502-2, IEC-60332-1, IEC-60228 |
| 9.0 | Insulator | Bulk molding compound (BMC) insulator |  |
| 9.1 | Creepage Distance | 159.1 mm | |
| 9.2 | Water Absorption | 0.3 % (Max) in 24 hrs. at 23°C | |
| 9.3 | Dielectric Strength | 10 kV/mm | |
| 9.4 | DC Insulation Resistance (minimum) | 100 MΩ | |
| 10.0 | Horizontal & Vertical Clearances of Third Rail | As per MPMRCL's SOD, approved by Railway Board | |

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| 11.0 | Over Voltage Protection Device (OVPD) | <ul style="list-style-type: none"> Rated Voltage: 900 V Permissible operating voltage: 3600 V Rated Current: 900A Rated Short time current: 100 kA for 0.1 Sec. Rating of Voltage sensing device: ± 150 V (Linear until ± 280 V) Rating of Current sensing device: ± 1000 A. | EN-50122-1 |
| 12.0 | Control, Relay & Protection System | <ol style="list-style-type: none"> 132 kV Incomer Feeder Protection: <ol style="list-style-type: none"> Integrated Line Differential Distance protection Backup O/C and E/F directional and non-directional with inrush block future Under voltage Over Voltage Phase unbalance protection Trip circuit supervision Master trip 132 kV Bus Bar Protection: <ol style="list-style-type: none"> Busbar Differential Protection Under voltage Over Voltage Master trip relay Breaker Failure protection 132kV/33 kV Power Transformer Protection: <ol style="list-style-type: none"> Biased Differential Protection HV and LV Restricted earth fault Protection Standby earth fault Protection Backup O/C and EF protection (Both time delayed and Instantaneous) Tank EF Protection. Trip circuit supervision Master trip relay The buchholz relay, installed on main tank and tap changer tank, PRV relay Oil and winding temperature protection 132KV Bus-Coupler Protection: <ol style="list-style-type: none"> Over current and Earth fault Protection Synchro Check Trip circuit supervision Master trip relay 33KV Incoming Feeder Protection: <ol style="list-style-type: none"> O/C and E/F non-directional Under Voltage Over Voltage Synchro Check Trip circuit supervision Master trip 33KV Outgoing Feeder Protection (to | IEC 60255, IEC 61850 |



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| | | <p>ASS and TSS):</p> <ol style="list-style-type: none"> Cable differential protection Backup O/C and E/F directional and non-directional Under Voltage Over Voltage Trip circuit supervision Master trip relay <p>7. 33KV Auxiliary Transformer Feeder Protection:</p> <ol style="list-style-type: none"> O/C and E/F protection non-directional Standby Earth fault Trip circuit supervision Master trip Transformer Winding Over Temperature Protection Alarm Transformer Winding Over Temperature Protection Trip Door interlock switch Phase unbalance protection <p>8. 33KV Bus coupler Protection :</p> <ol style="list-style-type: none"> O/C and E/F directional and non-directional Trip circuit supervision Synchro Check Master trip relay <p>9. 33KV Auxiliary network at ASS and TSS (Mainline and Depot):</p> <p>(9.1) 33KV Ring Feeder Protection (Incoming & Outgoing):</p> <ol style="list-style-type: none"> Cable differential protection Backup O/C and E/F directional and non-directional Under Voltage Over Voltage Trip circuit supervision Master trip relay <p>(9.2) 33KV Auxiliary Transformer Feeder Protection:</p> <ol style="list-style-type: none"> O/C and E/F protection non-directional Standby Earth fault Trip circuit supervision Master trip Transformer Winding Over Temperature Protection Alarm Transformer Winding Over Temperature Protection Trip Phase unbalance protection Door interlock switch <p>(9.3) 33KV Bus coupler:</p> <ol style="list-style-type: none"> O/C and E/F protection non-directional Trip circuit supervision Master trip relay <p>(9.4) 33KV Rectifier Transformer Feeder:</p> <ol style="list-style-type: none"> O/C and E/F protection non- |  |
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| | | <p>directional</p> <p>b. Trip circuit supervision</p> <p>c. Master trip</p> <p>d. Transformer Winding Over Temperature Protection Alarm</p> <p>e. Transformer Winding Over Temperature Protection Trip</p> <p>f. Door interlock switch</p> <p>10. 750V DC Network protection:</p> <p>(10.1) Rectifier Unit Protection:</p> <p>a. Rectifier over temperature</p> <p>b. 1st Diode failure alarm</p> <p>c. 2nd Diode failure trip</p> <p>d. Rectifier surge protection fuse failure</p> <p>e. Door Interlock switch</p> <p>f. Frame ground protection</p> <p>(10.2) Rectifier Feeder HSCB Protection:</p> <p>a. Reverse Power Relay</p> <p>b. DC Overcurrent protection (Imax of CB)</p> <p>c. Under Voltage Close Inhibit Protection</p> <p>d. Instantaneous over current protection</p> <p>e. Inverse time overcurrent protection</p> <p>f. Over voltage relay</p> <p>g. High Speed Tripping Lock-out</p> <p>h. Frame fault</p> <p>i. Inter tripping relay</p> <p>(10.3) Feeder HSCB Protection:</p> <p>a. DC Line Testing device</p> <p>b. Under Voltage Relay</p> <p>c. Over voltage Relay</p> <p>d. Instantaneous over current protection</p> <p>e. Inverse time overcurrent protection</p> <p>f. DC Overcurrent protection (Imax of CB) (76) (100% -400% bi-directional, direct-acting, instantaneous trip)</p> <p>g. di / dt, Rate of current rise protection</p> <p>h. Frame fault</p> <p>i. Inter tripping</p> <p>j. DC feeder HSCB Auto reclosing</p> <p>k. High Speed Tripping Lock-out</p> | |
| 13.0 | DC Switchgears | <ul style="list-style-type: none"> • High Speed Circuit Breaker (HSCB) • Rated Voltage - 900 V • Max. operating voltage- 1000 V • Rated Cont. Current- 4000A (for feeder CB) and 6000A (for Rectifier CB) • Rated Short time current for 10 Sec - 10.90kA (for feeder CB) and 18.0 kA (for Rectifier CB) • Rated Breaking Capacity- 125 kA for 100 ms • Tripping Time- Opening time not more | <p>EN 50123, IEC 61992-2</p>  |

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|---------|--------------|---|--|----------|--------|--------|----------|-------|-------|-------------|----|------|-------------|--------------|--------------|------------------------------------|
| | | than 5ms and total breaking time not more than 20ms | | | | | | | | | | | | | | |
| 14.0 | SCADA System | <p>In SCADA system</p> <p>a. RTU is provided with redundant Ethernet switches at stations and RSS.</p> <p>b. Redundant communication link between RTU and TER network for communication to OCC/BCC servers.</p> <p>c. Redundant communication server, application server, database server at OCC & BCC.</p> <p>d. Redundant communication link between TER network to SCADA servers.</p> <p>e. Data transfer protocol as per IEC 60870-5-104.</p> <p>f. Network protocol between RTU and Relays/IEDs/OVPD as per IEC 61850.</p> <p>g. Protocol between RTU and EM/MFM/Temp scanner through MODBUS.</p> <p>h. Data Speed- 100 mbps</p> | <p>IEC 60870-5-104,</p> <p>IEC 61850</p> | | | | | | | | | | | | | |
| | | <table><tr><td rowspan="4">Battery</td><td>Capacity</td><td>180 AH</td><td>300 AH</td></tr><tr><td>material</td><td>Ni-cd</td><td>Ni-cd</td></tr><tr><td>No. of Cell</td><td>85</td><td>2x85</td></tr><tr><td>Electrolyte</td><td>KOH solution</td><td>KOH solution</td></tr></table> | Battery | Capacity | 180 AH | 300 AH | material | Ni-cd | Ni-cd | No. of Cell | 85 | 2x85 | Electrolyte | KOH solution | KOH solution | <p>IEC 62259,</p> <p>IEC 60410</p> |
| Battery | Capacity | 180 AH | | 300 AH | | | | | | | | | | | | |
| | material | Ni-cd | | Ni-cd | | | | | | | | | | | | |
| | No. of Cell | 85 | | 2x85 | | | | | | | | | | | | |
| | Electrolyte | KOH solution | KOH solution | | | | | | | | | | | | | |
| | | <p>UPS:</p> <p>4KVA, 415 V AC \pm15% input.</p> <p>4KVA, 230 V AC \pm 1% output</p> | <p>IEC 60529,</p> <p>IEC 62040,</p> <p>IEC 62623</p> | | | | | | | | | | | | | |
| | | <p>Battery Charger:</p> <p>Input Voltage : 415 V + 10%, -15%</p> <p>Output current: 50A, 100A & 150A</p> <p>Thyristor based dual float Cum Boost charger</p> | <p>As per technical details submitted by MPMRCL for the priority section of corridor 1 of Bhopal Metro Rail Project.</p> | | | | | | | | | | | | | |

Note: Any suo moto dilution in the stipulation/compliances as submitted by MPMRCL for Bhopal Metro Project and detailed above shall automatically invalidate the technical clearance.

