APPENDICES

CONTRACT PACKAGE – CE – 08

APPENDIX A

DEFINITIONS AND LIST OF ABBREVIATIONS

APPENDIX A DEFINITIONS AND LIST OF ABBREVIATIONS

APPENDIX A1 DEFINITIONS

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

Standard Terminology	In general definitions applied to traction power and protective relay functions conform to the British Standards (BS) or the American National Standards (ANSI) or IEC (International Electromechanical Commission) standards or BIS (Bureau of Indian Standards).
Additional Terminology	Additional terminologies used in this document are as follows:
Air Gap	Term used for rigid traction overhead current collection system where two discontinuous sections of conductor rail run parallel to each other for smooth passage of pantograph.
Available Fault	The maximum fault current at rated voltage that the power system can deliver to a point in the system.
Contact wire	Electric conductor of an overhead current collection system with which the train pantographs (current collectors) make contact.
Rail bonding	The term used to describe insulated or bare conductors that electrically link longitudinal or transverse sections of rail to ensure continuity of the traction return current and reduce voltage drop in the running rails, as well as potential to earth.
Earthing	Synonymous with grounding. The connection of equipment enclosures and non current carrying metal parts to earth to provide safety to personnel, public and to the equipment.
Earth Fault	Failure of insulation of a conductor having a potential above earth resulting in a short circuit to earth.
Earth	Means the Conducting mass of the earth or any conductor in direct electrical connection there with.
Earth Mat	A system of bare conductors and/or bare driven conductor rods/pipes usually installed as a totally interconnected grid and buried in the earth to provide a low impedance and high current capacity connection to the earth
Earthing Switch	25 kV manually operated switch to earth the OCS/ OHE. The switch is interlocked with the associated isolating switch /interrupter against earthing of a live OHE/OCS.

Earth Bus	An uninsulated electrical conductor to intentionally provide multiple low resistance connections from the equipment enclosure (s) to earth.
Ground/Grounding	Synonymous with earth/earthing.
High Speed Circuit	A direct current circuit breaker protecting the positive output side breaker of a rectifier.
High Voltage	As applied for this Contract, the high voltage is 25 kV, 33kV ac or 66 kV or 220 kV ac line to line.
Headway	The time interval between following trains.
Interrupter	25 kV load break, fault making switch generally remote control.
Interrupting Capacity	This is the capability to interrupt a maximum rated short circuit or fault current at a rated maximum voltage. It is usually expressed in, kilovolt amperes, or megavolt amperes or kilo-amperes at rated voltage.
Low Voltage	As applied to this Contract, low voltage refers to voltage not exceeding 1000V ac between conductors.
Overlap	Used for flexible overhead equipment where two tension lengths of OHE run parallel to each other for smooth passage of pantograph.
PCU (Protection and Control Unit)	PCU is an intelligent microprocessor based, self-diagnostic, protection, control and metering unit. The PCU consists of Protection relay module, control module and metering module functioning as a complete unit for continuous controlling, monitoring, metering and protection of the system.
PLC (Programmable Logic Controller)	PLC is a programmable controller, which utilises ladder diagram programming and advanced instructions for use in Automation environment.
RTU (Remote Terminal Unit)	Interface unit between PCU and SCADA
Receiving Substation	Receiving Substation receives incoming supply at 220 kV or 66 kV from DVB Power Grid (local power utility company) and transforms distributes the supply at 33kV and 25 kV for auxiliary and traction power respectively for distribution to MRT system.

Return Conductor	Means a conductor which carries a proportion of return current from the tracks to the substation.
Rail Bond	Means an electrical Connection across a joint in or between adjacent lengths of running rail.
Sector	Term used for 25 kV ac traction and denotes the section of OCS being normally fed by one power source.
Sub Sector	Term used for 25 kV ac traction and denotes the smallest section of OCS controlled by remote operated switchgear (interrupter/circuit breaker).
Switchgear	Means Isolator Switches, Circuit Breakers, Interrupters, Cutouts and other apparatus used for the operation, regulation and control of electrical circuits.
Withstand Capability	Rated capability of equipment to survive without damage the mechanical forces of a short circuit or the thermal effects of a short circuit down stream from the equipment. Also the rated capability to withstand without damages for a short time a specified power frequency over voltage and/or a specified voltage surge or impulse.
System	Receiving, traction and auxiliary power supply systems and SCADA system for Metro Corridor.

END OF APPENDIX - A1

APPENDIX A2 LIST OF ABBREVIATIONS

A or Amp	Ampere
AC or ac	Alternating Current
AFC	Automatic Fare Collection
AIR	All Indian Radio
ANSI	American National Standards Institute
ASS	Auxiliary Substation
ASTM	American Society for Testing and Materials
ATP	Automatic Train Protection
ATO	Automatic Train Operation
ATS	Automatic Train Supervision
AWG	American Wire Gauge
BIL	Basic Impulse Level
BIS	Bureau of Indian Standards
BIT	Built in Test Diagnostics
BWA	Balance Weight Assembly
cm^2	Square Centimetre
CATC	Continuous Automatic Train Control
CB	Circuit Breaker
CBT	Computer Based Training
CD ROM	Compact Disk Read Only Memory
CT	Current Transformer
dBA	Decibels (A Scale)
DC or dc	Direct Current
DCC	Depot Control Centre
JDA	Jaipur Development Authority
DIN	Deutshes Institute Fur Normung
DOT	Department of Telecommunications
DP	Double Pole
DPCS	Digital Protection Control System
RVB	Rajasthan Vidyut Board

EEPROM	Electrically Erasable Programmable Read Only Memory
EMI	Electro Magnetic Interference
EMC	Electro Magnetic Compatibility
ETI	Employer's Training Instructor
ETS	Emergency Trip System
FRLS	Flame Retardant Low Smoke
FP	25 kV Traction Feeding Post
FRLSOH	Fire Retardant Low Smoke Zero Halogen
g/m^2	Grams per metre squared
G5/3	Limits for Harmonics in the United Kingdom Electricity Supply System.
GI	Galvanised Iron
GIS	Gas Insulated Switchgear
Hr, h	Hour
HT	High Tension
Hz	Hertz
IR	Indian Railway
IRJ	Insulated Rail Joints
JTC	Joint-less Track Circuit
kA	Kilo Amperes
kg	Kilogram
kgf	Kilogram force
km	Kilometre
km/h	Kilometres per hour
kPa	Kilo Pascal
kV	Kilovolt
kVA	Kilovolt Ampere
kVAR	Kilovolt Ampere Reactive
kVp	Kilovolt pulse (peak)
kW	Kilowatt
L/R	Ratio of Inductance to Circuit Resistance
LAN	Local Area Network

LBS	Load Break Switch
LED	Light Emitting Diode
LSOH	Low Smoke Zero Halogen
LT	Low Tension
m	Metre
m/s/s	Metres per second per second
m/s/s/s	Metres per second per second per second
MBCC	Microprocessor Based Communication Controller
MC	Motor Coach
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MCJ	Municipal Corporation of Jaipur
MDP	Main Distribution Panel
mm	Millimetre
MRT	Mass Rapid Transit
MRTS	Mass Rapid Transport System
MS	Mild Steel
MSL	Mean Sea Level
MTNL	Mahanagar Telephone Nigam Limited
mV	Mill volt
MVA	Mega volt Ampere
MW	Megawatt
N	Newton
NC	Normally Closed
NDTs	Non Destructive Tests
NO	Normally Open
ºC	Degree Celsius
OCC	Operations Control Centre
OCS	Traction Overhead Current Collection System pertaining to rigid conductors.
OHE	Traction Overhead Current Collection System pertaining to flexible conductors.

O and M	Operation and Maintenance
ONAF	Oil-Immersed Forced Air Circulation Cooled
ONAN	Oil-Immersed Natural Air Circulation Cooled
OVPD	Over Voltage Protection device
PC	Power Controller: Traction/auxiliary
PCU	Protection and Control Unit
P.E.	Professional Engineer
Ph	Phase
PLC	Programmable Logic Controller
PS	Technical Specification
PRF	Pulse Repetion Frequency
PT	Potential Transformer
PWD	Public Works Department
QRA	Qualified Risk Assessment
QRA	Quantified Risk Assessment
RAMS	Reliability, Availability, Maintainability and Safety
RCC	Reinforced Cast Concrete
RDSO	Research Design Standards Organisation (IR)
RF	Radio Frequency
RMS	Root Mean Square
RRSW	Running Rail Sectionalising Switch
RSS	Receiving Substation for 25 kV ac traction and 33 kV auxiliary supply
s	Second
S/S	Substation
SCADA	Supervisory Control and Data Acquisition System
SCB	Shunt Capacitor Bank
SCR	Station Control Room
SE	System Earth
SEM	Structural Electrical and Mechanical Drawings
SF6 or SF^6	Sulphur Hexa-floride
SPS	Small Steel Parts

Sq m	Square metre
Sq mm	Square millimetre
SRU	Shop Replacement Unit
SP	25 kV ac traction sectioning and paralleling post
SS	25 kV ac traction sub-sectioning.
SSP	25 kV ac traction sub-sectioning and paralleling post
tc	Trailer Coach
TEFC	Totally Enclosed Fan Cooled
TP	Triple Pole
TSS	Traction Substation
µsec	Micro second
V	Volt
VA	Volt Ampere
VCB	Vacuum Circuit Breaker
VDU	Visual Display Unit
VSNL	Videsh Sanchar Nigam Limited
VT	Voltage Transformer
VVVF	Variable Voltage Variable Frequency
XLPE	Cross-linked polyethylene

END OF APPENDIX - A2

CONTRACT PACKAGE JP/EW/1B/E2

APPENDIX B

LIST OF STANDARDS

APPENDIX B LIST OF STANDARDS

Following is the List of National, International standards of other countries which have been referred to in the various specification. However, this list is not exhaustive. Other lists of standards exist elsewhere within the Specification.

List Consist of:

I Indian Standards

II IECs

III American Standards

IV British Standards

V Other Standards

The latest edition with amendments shall be used.

Indian Standards

IS NO.	Title
10028	Code of Practice for selection, Installation and maintenance of transformers
10118-1982	Codes of practice for selection, installation and Maintenance of switch-gear and control-gear
10136-1982	Code of Practice for selection of disc insulators fittings of highest system voltages of 72.5kV and above.
10561 - 1983	Application guide for power transformers
10810	Test Methods for cables
11171-1985	Dry type Power Transformers
11353-1985	Guide for uniform system of marking and identification of conductors and apparatus terminals
1248 (Pt I to IV)	Direct acting indicating analogue electrical measuring instruments and their accessories
1255-1983	Codes of practice for installation and maintenance of power cables up to and including 33kV rating
1271-1985	Thermal evaluation and classification of electrical insulation
13947 – 1993	Low voltage and Medium voltage switchgear
1554 (Pt I-1988)	PVC insulated (Heavy Duty) Electric cables for working voltage up to and including 1100V

IS NO.	Title
1570	Schedule of wrought steels
1646-1997	Codes of Practice for fire safety of Buildings (general) - Electrical Installation
1818-1972	Alternating current isolators (disconnectors) and earthing switches
2026 (Pt I to IV)	Power Transformer General, Temp Rise, insulation level and dielectric tests, terminal marking
2071	Methods of tapping and connections of High Voltage Testing
2074-1992	Ready mixed paint, air drying, red oxide, zinc chrome, priming
209 – 1992	Zinc ingot
2099-1986	Bushing for alternating voltage above 1000V (with amendments No2)
2121-1962	Fittings for Aluminium and Steel Cord Aluminium conductors for overhead power lines
2147-1962	Degrees of Protection provided by enclosures for low voltage switchgear and control gear
2165	Insulation Co-ordination
2208-1962	HRC Cartridges fuse links for voltages above 650V
226-1975	Structural Steel
2274-1963	Code of Practice for electrical wiring installations system voltage exceeding 650V
2309-1989	Practice for the protection of buildings and allied structures against lightning (Code of Practice)
2339-1963	Aluminium Paint for general purposes in dual container
2516	Circuit breakers
2551-1982	Danger notice Plates
2667-1988	Fittings for rigid steel conduits for electrical wiring
2705-1992	Current Transformers (with amendments)
2713 (Pt. I - III) 1980	Tubular steel poles for overhead power lines
2959-1985	Conductors for voltages not exceeding 1000V ac or 1200V dc
3034-1993	Fire safety of industrial building, electrical generating and distributing stations: Code of Practice

IS NO.	Title
3043 –1987	Codes Practice for Earthing
306-1983	Tin Bronze Ingots and Castings
3070	Lightning arresters for alternating systems
3072-1975	Code of Practice for Installation and maintenance of switch gear
3156-1992	Voltage Transformers
3188-1980	Characteristics of string insulator units
3231	Electrical relays for power system protection
325-1996	3 Phase Induction motors
3347	Dimensions for porcelain transformers bushings for use in lightly polluted atmosphere
335-1993	New Insulating oils
3427-1997	AC Metal enclosed switchgear and control gear for rated voltage above 1000V and up to and including 52 kV
3534 – 1976	Outline dimensions of electric lifts.
3618-1966	Phosphate treatment of Iron and Steel for protection against corrosion.
3637-1966	Gas operated Relays
3639-1966	Fittings and Accessories for Power Transformers
3716-1978	Application guide for insulation co-ordination
375	Marking and arrangement for switch gear, bus bars, main connections and auxiliary wiring
3837-1976	Accessories for rigid steel conduits for electrical wiring
3842 (Parts 1 to 12)	Application Guide for electrical relays for ac systems
3895-1966	Mono-crystalline semi conductor rectifier cells and stacks
3961 (Pt II)	Recommended current ratings for PVC insulated and PVC Sheathed heavy duty cables
3975-1988	Mild Steel wires, formed wires and Tapes for armouring of cables
398	Aluminium conductors for overhead transmission purposes
4064-1978	Air Break Switches, air break disconnectors, air break switch disconnectors and fuse combination units for voltages not

IS NO.	Title
	exceeding 100V ac or1200V dc
4146-1983	Application guide for voltage transformers
4201-1983	Application Guide for Current Transformers
4540-1968	Mono-crystalline semi conductor rectifier assemblies and equipment
4710-1968	Switches and Switch isolators above 1 kV but not exceeding 11 kV (with amendment 1)
5082-1998	Wrought aluminium and aluminium alloy bars, rods, tube sections, plates and sheet for electrical applications
5133 (Pt II) 1969	Boxes for enclosures of Electrical Accessories : made of insulating materials
5133(Pt I) 1969	Boxes for enclosures of Electrical Accessories Steel and Cast iron Boxes
5216-1982	Guide for safety procedures and practice in electrical works
5547-1983	Application guide for capacitor voltage transformer
5561-1970	Electric Power Connectors
5578-1984	Guide for marking or insulated conductors
5621-1980	Hollow insulators for use in electrical equipment
5728-1970	Guide for short Circuit calculation
5831-1984	PVC insulation and Sheath of Electric Cables
617-1994	Aluminum and aluminium alloy ingots and castings for general engineering purposes
6380-1984	Elastomeric insulation and sheath of electric cables
6600-1972	Guide for loading of oil immersed transformers
6619-1972	Safety codes for semi conductor rectifier equipment
6875	Control Switches (switching devices for control and auxiliary circuits including contactor relays) for voltages up to and including 1kV ac and 1200V dc
7098 Part I, II and III	XLPE insulated PVC sheathed cables for working voltages upto 220kv
722	AC electricity meters
731- 1971	Porcelain insulators for overhead power lines with a nominal voltage greater than 1kV

IS NO.	Title
7987-1976	Guide for selection of high voltage ac circuit breakers
800-1984	Code of Practice for General Construction in Steel
808-1989	Dimensions for hot rolled steel beams, column channel and angle sections
8468-1977	On load tap changers
8623-1993	Low voltage switchgear and Control Gear assemblies
8686-1977	Static Protective Relays
8828-1996	Electrical accessories – circuit breakers for over current protection for household and similar installations
9537 (Pt II)	Conduits for electrical installations: Part 2 - Rigid Steel Conduits (with amendment 1)
9921	A C Disconnector (Isolators and earthing switches for voltage above 1000V)
9968	Elastomeric insulated cables
SP 30-1985	National Electrical Code

II INTERNATIONAL ELECTRO TECHNICAL COMMISSIONS (IECs)

IEC NO.	Title
IEC 60 296	Specification for unused mineral insulating oils for transformers and switchgear
IEC60 034	Rotating electrical machines
IEC60 038	IEC standard voltages
IEC60 44-1	Current Transformers
IEC60 44-2	Voltage Transformers
IEC60 050	International electromechanical vocabulary
IEC60 051	Direct acting indicating analogue electrical-measuring instruments and their accessories
IEC60 056	High-voltage alternating current circuit breakers
IEC60 060	High-voltage test techniques
IEC60 071	Insulation Co-ordination
IEC60 076	Power transformers
IEC60 077	Rules for electric traction equipment

IEC NO.	Title
IEC60 085	Thermal evaluation and classification of electrical insulation
IEC60 099-4	Surge arresters – Part 4: Metal oxide surge arresters without gaps for ac systems
IEC60 129	Alternating current disconnectors (isolators) and earthing switches
IEC60 137	Insulating Bushings for alternating voltages above 1000V
IEC60 156	Insulating liquids – Determination of break down voltage at power frequency – Test Method
IEC 60 185	Current Transformer
IEC60 214	On-load tap changers
IEC60 228	Conductors of insulated cables
IEC60 230	Impulse test on cables and their accessories
IEC60 255	Electrical relays
IEC60 258	Direct acting recording electrical measuring instruments and their accessories
IEC60 265	High voltage switches
IEC60 269	Low-voltage fuses
IEC60 287	Electric cables - Calculation of the current rating of cables (100% load factor)
IEC60 298	AC metal-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 52kV
IEC60 332 Part 1	Tests on electric cables under fire conditions-Part 1: Test on a single vertical insulated wire or cable
IEC60 332 Pt. 3	Tests on electric cables under fire conditions-Part 3: Test on bunched wires or cables
IEC60 354	Loading guide for oil-immersed power transformers
IEC60 376	Specification and acceptance of new sulphur hexa-fluoride
IEC60 420	High voltage alternating current switch fuse combinations
IEC60 439	Low-voltage switchgear and control gear assemblies
IEC60 502	Power cables with extruded insulation and their accessaries for rated voltages from 1kv up to 30 kV
IEC60 517	Gas insulated metal enclosed switchgear for rated voltages of 72.5kV and above.

IEC NO.	Title
IEC60 521	Class 0.5, 1 and 2 alternating-current watt-hour meters
IEC60 529	Degrees of protection provided by enclosures (IP code)
IEC60 542	Application guide for on-load tap changers
IEC60 551	Determination of transformer and reactor sound levels
IEC60 664	Insulation co-ordination for equipment within low-voltage systems
IEC60 694	Common specifications for high-voltage switchgear and control gear standards
IEC60 722	Guide to the lightning impulse and switching impulse testing of power transformers and reactors
IEC60 726	Dry type Power Transformer
IEC60 754-2	Test on gases evolved during combustion of electric cables-Part 2: Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity
IEC60 811	Common test method for insulating and sheathing materials of electric cables
IEC60 859	Cable connections for gas-insulated metal-enclosed switchgear for rated voltages of 72.5kV and above
IEC60 871-1	Shunt capacitors for ac power systems having a rated voltage up to and including 1000V
IEC60 904-3	Photo voltaic devices. Part 3: Measurement principles for terrestrial photo voltaic (PV) solar devices with reference spectral irradiance data
IEC60 913	Overhead Electric Traction Lines – Clearances.
IEC60 947-1	Low-voltage switchgear and control gear. Part 1: General rules
IEC60 947-2	Low-voltage switchgear and control gear-Part 2: Circuit breakers
IEC60 947-3	Low-voltage switchgear and control gear-Part 3: Switches disconnectors, switch disconnectors and fuse-combination units
IEC60 947-5-1	Low-voltage switchgear and control gear-Part 5: Control circuit devices and switching elements. Section1Z: Electromechanical control circuit devices
IEC60831	Shunt power capacitors of the self-healing type for ac systems having a rated voltage up to and including 1000V
IEC61 000 5-1	Electro magnetic compatibility (EMC) Part 5: Installation and mitigation guidelines – Section 1: General Considerations

IEC NO.	Title
IEC61 000-4-8	Electromagnetic compatibility-Part 4: Testing and measurement techniques. Section 8: Power frequency magnetic field immunity test basic EMC publication
IEC61 034	Measurement of smoke density of electric cables burning under defined conditions
IEC61 131	Programmable Logic Controllers.
IEC61 133	Electric traction – Rolling stock – test method for electric and thermal/electric rolling on completion of construction and before entry into service

III AMERICAN

(A) IEEE

IEEE 48 (1996)	IEEE Standard test procedures and requirements for high-voltage alternating current cable terminations.
IEEE 383	Standard for type-test of Class E electrical cables, field splices and connections for nuclear power generating stations.
IEEE 404 (1993)	Cable and joints for use with extruded dielectric cable rated 5000 to 13800 V and cable joints for use with laminated dielectric cable rated 2500 V to 50,000 V (50kV)

(B) MIL

MIL-STD-880C	Military standard system safety program requirements (VSA)

(C) NFPA

NFPA 70	National electrical code
NFPA 70 E (1988)	Standard for electrical safety requirements for employee workplaces
NFPA 130	Standard for fixed guide way transit systems
NFPA 258	Standard research test method for determining smoke generation of solid materials
SS 299	Specification for fire resistant cables

(D) ANSI

ANSI C3716(1988)	Relays and low voltage power circuit breakers and AC power circuit protectors

(E) ASTM

ASTM D 2863 Method for measuring the minimum oxygen concentration to support candle like combustion of plastic (oxygen index)

ASTM B 173-64 Specification for rope lay-stranded copper conductors having concentric members, for electrical conductors

IV BRITISH STANDARDS

BS 88 Specification for cartridge fuses for voltages up to and including 1000 V AC and 1500 V DC

BS 142 Information and requirements for all protection relays

BS 159 Busbars and busbar connection

BS 729 Specification for hot-dip galvanized coatings on iron and steel articles.

BS 731 Flexible steel conduit and adapters for the protection of electric cable.

BS 951 Specification for clamps for earthing and bonding purposes

BS 2692 Fuses for voltages exceeding 1000 V AC

BS 4444 guide to electrical earth monitoring and protective conductor provision.

BS 4568 Specification for steel conduit and fittings with metric threads of ISO from for electric installation

BS 5372 Specification for dimensions of cable terminations for 3-core and 4-core polymeric insulated cables of rated voltages 600/100 V and 1900/3300 V having aluminum conductors

BS 5472 Specification for low voltage switchgear and control gear for industrial use. Terminal marking and distinctive number, general rules.

BS 5493 Code of practice for protective coating of iron and steel structures against corrosion

BS 6231 Specification for PVC insulated cables for switchgear and control gear wiring

BS 6290 Lead-acid stationary cells and batteries

BS 6360 Specification for conductors in insulated cables and cords

BS 7430 Code of Practice for earthing

BS EN 6012994 Specification for alternating current disconnectors and earthing switches

V European (CENELEC)

EN50052 Standards for pressure vessel construction

EN50121-5 Railway Applications – Electromagnetic Compatibility

Part 5: Fixed Power Supply Installations.

EN50122-1 Railway Applications, Fixed Installations, Protective Provisions relating to electric safety and earthing

EN50124-1 Railway Applications – Insulation Coordination.

EN50163 Supply Voltage of Traction System.

VI OTHERS

ISO 1459 Metallic Coatings- Protection against corrosion by hot dip galvanizing – Guiding principles

ISO 1460 Metallic Coatings- Hot dip galvanized coatings of ferrous materials – Gravimetric determination of the mass per unit area.

ISO 1461 Hot dip Galvanized Coating on fabricated ferrous products – specification

ISO 2064 Metallic and other non-organic coatings definitions and conventions concerning the measurement of thickness.

ISO 2177 Metallic Coatings measurements of coating thickness - coulometric method by anodic dissolution.

ISO 2178 Non-magnetic on magnetic substrates – measurements of coating thickness – magnetic method

ISO 2859 Sampling procedures and tables for inspection by attributes.

UL 94 Tests for flammability of plastic materials for parts in devices and appliances

UL 508 Industrial control equipment

UL 746C Polymeric materials used in electrical equipment evaluations

VDE 0115 Part 1 Traction systems general construction and safety

VII RDSO (Indian Railways)

ETI/OHE/3 (2/94) Annealed stranded copper conductor jumper wire.

ETI/OHE/13 (4/84) Galvanisation of steel structures

ETI/OHE/14 (9/94) Stainless Steel wire rope

ETI/OHE/37 (12/73) Hard drawn Copper catenary wire.

ETI/OHE/42 (6/97) Hard Drawn grooved Copper contact wire.

ETI/PSI/116 (4/88) 220 / 132 / 110 / 66 kV DP / TP SF^6 gas circuit breakers

ETI/PSI/117 (7/88) Current Transformers

ETI/PSI/122 (3/89) 245 / 145 / 123 / 72.5 kV double pole and triple pole isolators

ETI/PSI/137 (8/89) metal oxide gapless type lightning arrestors.

END OF APPENDIX B

APPENDIX C

INTERFACE BETWEEN

SIGNALLING AND TELECOM
AND
JP/EW/1B/E2

INTERFACE REQUIREMENTS BETWEEN TELECOM CONTARCTORS (All signalling & telecom contractor deputed for Jaipur 1B works, GSM/CDMA, AFC) AND E&M/ TRACTION/ OHE CONTRACTORS FOR STATIONS/ DEPOTS/ TUNNELS/ RSS

Following requirement are listed for installation/ provision by E&M/ Tunnel/ OHE contractors for Telecommunication work for Lighting, Air-conditioning, Cable tray/ladder, earthing, etc. requirements at Stations/Depot/Tunnels/RSS.

A. General Interface Requirement:-

1. Cable Trays connectivity from TER to Various location of Station and Tunnel as per Combined Services Drawing (CSD).
2. During handover of TER availability of following items are to be ensured, as a minimum - AC power, Cable tray Risers, Air-conditioning, Lighting, AC power sockets, data /power tray connectivity.
3. Telecom Data and Power trays to be marked with distinct colour codes to avoid any ambiguity between telecom and other services trays.
4. Cable tray junctions and T points should not have sharp bends and edges to avoid cable damage. The bending radius of minimum 1.5m shall be provided.
5. Data and power tray should have separation of at least 150mm between them at any place and if crossing is required there should be provision of a bridge to cross the cable tray. No electrical tray closer than 300mm should be provided near Telecom trays

B. Lighting requirement

6. AC power points, indoor lighting facility and fire protection system to be done in TER, UPS, GSM/CDMA etc. Minimum 300 lux. level of lighting at FFL to be provided with some lights with emergency supply.

C. Cable Tray installation requirement

7. Data and Power cable trays are to be provided from TER to Concourse, Platform, Road level areas, All Station Entrance/Exits, Technical Rooms, SCR, TOM, EFO, Security Room, Ancillary Buildings, DG Room, Pump Room, Under croft in underground stations etc. Cable tray Risers/Droppers to be provided in TER and S&T shafts with connectivity from nearby Telecom trays provided.
8. Cable Tray connectivity from Optical fibre cut-outs in platform beam is to be provided up to TER with dropper up to floor level with route diversity.
9. Data / Power Cable tray risers / droppers up to FFL to be provided in TER, TOM, EFO, SCR, Platform supervisory booth/Panel and any other Room with connectivity from nearby Telecom trays.
10. Provision of Telecom Trays connectivity at Road level to be done for parking areas.

11. In case there is double height area at PF level, the provision of cable trays and mounting structures for GSM/CDMA antennas, CCTV cameras and PAS/ PIDS/ Clock equipments should be designed at appropriate height away from PF edge. Cable Trays should be provided in a manner so that minimum no. of sleeves/cut outs is required for Telecom equipment installations.

12. Provision for Telecom Data and Power Cable/ Cable tray connectivity to be done in all the utility buildings in Depots (All levels) with connectivity from the S&T trench.

13. Data/Power Tray Riser/Droppers in TER, DCC, S&T shafts and other locations to be provided in connectivity of nearby telecom tray in Depots.

14. Data/power tray connectivity is to be provided in all utility building (All levels) including main gate in Depots from the pull pit connected with the trench. Data/Power Cable tray risers / droppers to be provided in TER, DCR etc.

15. Telecom Cable Tray connectivity for Platform Supervisory Booth/Panel (PSB/PSP) from the nearest S&T Tray.

16. Provision of cable trays connectivity is to be done on portals for installation of clocks, speakers, CCTV cameras in workshop, inspection bays and stabling yards etc in Depots.

17. For stations with radio base equipments, cable tray connectivity for two different locations (with route diversity) from TER to open sky at ground level to be provided for installation of GPS antennas.

D. Earthing requirement

18. At Elevated Stations/Depot, Provision & Extension of Main earth (<2 ohm) to be done from Main Earth Mat location to TER, UPS (S&T) Room and SCR. Copper Bus bar with min.20 holes (10 per row) to be provided in TER, UPS (S&T) Room, SCR and DCC in Stations and Depots. Main earth extension with copper earth strip to be done in the GSM and CDMA Rooms.

19. At underground stations, extension of Clean Earth (<1 ohm) & Main Earth (<2 ohm) to be done from Earth Mat (Provided by Civil) to TER. Copper Bus bar with min.20 holes (10 per row) to be provided in TER.

20. In tunnel main earth strips at cross passages for emergency telephones to be provided.

E. Air conditioning Requirements.

21. Air conditioning to be installed for TER & UPS rooms. Drainage system of Air conditioning should be installed outside TER, & UPS rooms and only air outlet is to be provided inside rooms to maintain temperature nominal 25 degree continuous.

22. Clear height of 3 meter should be available in TER for telecom equipments installations. Installations of other contractors' equipments (Air conditioners etc) shall be above 3 meter height.

23. There should not be any water flow or drainage pipe passing through TER.

24. Confirmation of Fire Safety Provisions.

F. TSS/RSS requirements.

25. For providing Telecom facilities at TSS/ RSS (Out side the JMRC Premises), connectivity either by trench or by trenchless is to be provided by traction contractor along with their own cable route.

26. Telephone cabling inside the TSS/ RSS buildings to be provided by E&M.

27. In RSS/ TSS building control room, table for providing telephone, telephone rosette with connectivity required.

28. Provision of Cable trough/ Trench with one bracket inside RSS boundary for laying telecom cable.

29. Provision of AC 230V for telecom (CCTV, CLOCK etc) equipments.

In addition to above following requirement to be installed/ provided at underground stations & Tunnels:-

30. Brackets/hangers are to be provided on tunnel inner edge for laying of optical fibre cable, emergency telephone cables, GSM/CDMA Cables.

31. Cable tray connectivity is to be provided from Telecom brackets in tunnel to telecom cable trays in nearest S&T shaft.

32. Data/ power cable tray connectivity is to be provided in mid shaft with connectivity from Telecom brackets in tunnel.

33. Provision of Temporary power and illumination in Tunnel to be provided for installation of emergency telephone and stand offs for LCX cable of GSM/ CDMA/ TETRA system. Temporary lighting in Tunnel should not be provided in space reserved for GSM/ CDMA/TETRA cables in Tunnel.

G. GSM/CDMA requirements.

34. During handover of GSM and CDMA rooms availability of following items are to be ensured, as a minimum:- AC power, Air-conditioning , Lighting, AC power sockets, power supply cables, Main Earth (<2ohm) copper strip with min.20 holes (10 per row)

35. GSM/CDMA cable trays are to be provided from GSM/CDMA Room to Concourse, Platform, under croft level areas and riser/droppers in S&T shafts etc. as per GSM/CDMA requirements.

36. Cable tray connectivity from GSM/CDMA room to open sky at ground level to be provided for installation of GPS antennas as per GSM/CDMA system requirements.

37. Provision of Power supply to be done in GSM and CDMA equipment Rooms as per GSM/CDMA operator equipment load requirements.

38. Clear height of 3.5 meter should be available in GSM/CDMA room for their equipments installations.

Signalling and Traction Supply Interfaces

1. INTRODUCTION

1.1 Definitions and Scope

1.1.1 This specification covers the interface requirements between Train Control & Signalling Contractorsand Traction Power Distribution and Overhead Line Contract(s).

1.1.2 In this Specification, unless otherwise stated, the term "Contracts" refers to the Signalling Contractors, Traction Supply Contract(s) and the term "Contractors" refers to Signalling Contractors, Traction Contractors. The individual Contractor is referred to by the corresponding Contract number.

1.1.3 This document shall be read in conjunction with the relevant paragraphs of the General Specification. The Contractors shall ensure all requirements of the General Specification and PS pertaining to interfaces are fully resolved and implemented.

1.1.4 In the event of a conflict between any Technical Specification and this specification, the requirements of the Technical Specification shall prevail.

2. CONTRACTORS' RESPONSIBILITIES

2.1 Coordination and Interfacing

2.1.1 This specification outlines the Contractors' interface requirements, which are based on the Technical Studies carried out during the early stages of the Project. However, the requirements herein specified are by no means exhaustive and it remains the Contractors' responsibilities to develop, update and execute jointly Interface Management details during design & throughout the execution of Works, to ensure that:

(i) All interface issues between the two contracts are satisfactorily resolved

(ii) Supply, installation and testing of equipment and software are fully coordinated

(iii) All equipment supplied in the contracts are fully compatible with each other

2.2 Interface Management

2.2.1 Each contractor shall establish a structured process to integrate with other sub-systems to ensure safe, reliable and efficient operations under both normal and degraded conditions to the satisfaction of the Employer's Engineer.

2.2.2 Each contractor shall ensure that the equipment supplied under this Contract are properly interfaced and integrated with other systems in JMRC.

2.2.3 Each contractor shall appoint competent and experienced person with no fewer than 5 years of railway project experience who shall be the single point of

contact for all interface design and testing works with the interfacing contractors and the Employer's Engineer.

2.2.4 Each contractor shall be responsible for interface identification, establishment, construction and testing works either in the capacity as the Lead Contractor or Participating Contractor.

2.2.5 Signalling contractor shall be the lead contractor. The Lead Contractor will be responsible to initiate, plan, coordinate and produce jointly with the Participating Contractors all the required interfaces and interface design documents and interface progress reports for submission to the Engineer for acceptance. The Lead Contractor will also prepare and submit all interface meeting minutes and interface progress reports to the Employer's Engineer for information.

2.2.6 Traction contractor will be the participating contractor. The Participating Contractor shall collaborate fully with the Lead Contractor in the development and finalization of the interface design, joint production of the interface documents and interface progress reports.

2.2.7 The costs for all interface design and testing works shall be deemed to be included in the Contract sum regardless of the actual extent of effort required or expended by the Contractor.

2.2.8 The Contractors shall be fully responsible for the management and control of his sub-contractors in relation to all interfacing activities carried out under the Contract.

3. PHYSICAL INTERFACE

3.1 Signal and Mast Locations

3.1.1 Signalling Contractors shall provide chainages of signal posts and radio mast to Traction contractor(s). The Traction Contractor(s) shall provide the Signalling Contractors with the location of all OHE masts & their staggering arrangement in the Depot, and Main line. Signalling contractor may use the OHE mast for fixing radio equipment. Wherever OHE mast is used, the radio equipment fixtures will be provided by the signalling contractor. The signalling contractor will ensure that (a) the radio equipment so provided are immune to EMI/EMC affect of 25 kV, single phase over head equipment (b) the radio equipment is protected against any physical or mechanical damage. The signalling contactor shall provide suitable procedure and arrangement for maintenance of radio antenna equipment fixed on the OHE mast.

3.1.2 The Signalling Contractors shall receive the information of OHE mast location from the Traction contractor(s) and shall ensure that signals are mounted in locations where these are not hidden by OHE masts or other hardware.

3.1.3 The contractors shall co-ordinate for ensuring the minimum safe distance between any signalling field installation and the live OHE contact point for the purpose of human safety apart from EMI/ EMC considerations.

4. ELECTRICAL INTERFACE

4.1 Traction Return

1) The Traction contractor(s) shall advise the Signalling Contractors of the normal and worst short circuit current levels.

2) The Signalling Contractors shall advise the Traction contractor(s) of the locations of the track circuits. The Contractors shall agree on the final location of cross bonds/ impedance bonds and other rail connections related to traction return current.

3) Signalling Contractors shall supply, install and terminate all impedance bonds, bonding cables and continuity bonds, including all bonding in the turnouts, required for proper functioning of track circuits. The Traction contractor(s) shall supply, install and terminate traction bonding cables, if required additionally, at appropriate intervals, which shall be co-ordinated with the Signalling Contractors, contractor to ensure the balanced & unobstructed flow of traction return current. All connections to the rail shall be suitably welded (thermo welding or pin brazing technology) to give resistance & corrosion free smooth contact. The rail welding material shall confirm to IRS: S103-2004 or the latest.

4) For connecting the traction transformer earthed neutral terminal to the running rails, Traction contractor(s) shall co-ordinate with Signalling Contractors.

5) The two Contractors shall interface regarding use of Buried Earth Conductor, if provided along the line, for earthing of outdoor signalling equipment.

6) The two Contractors shall interface to achieve an integrated Earthing & Bonding plan for the main line and depot area.

4.2 Insulated Rail Joint

4.2.1 For track circuits, the Signalling Contractors shall provide the Traction contractor(s) with the location of required insulated rail joints at Depot, and on the mainline.

4.2.2 Traction contractor(s) shall design the traction return system considering the locations of insulated joints.

4.3 Neutral Sections

4.3.1 The Traction contractor(s) shall provide the Signalling Contractors with the length & location of all traction neutral sections.

4.3.2 The Signalling Contractors shall design the Signal Locations such that no train or a part of a train stops within the neutral sections during normal operations.

4.3.3 The signalling contractor will ensure that track circuit (wherever provided) under the neutral section shall be a single continuous track circuit.

5. FUNCTIONAL INTERFACE

5.1 Protection Characteristics

5.1.1 The Traction contractor(s) shall provide the Signalling Contractors with the overhead line feeder circuit rating, the protection tripping setting, the overhead line conductor current carrying capacity, Transient & surge protection and the protection relay setting.

5.1.2 The Signalling Contractors shall ensure that the Train Control and Signalling System makes allowance for the settings as described in Paragraph 5.1.1 when planning for simultaneous start up of several trains. The Contractors shall ensure that there is no degradation with respect to the performance requirement as specified in the respective Specifications.

6. ELECTROMAGNETIC COMPATIBILITY

6.1 Joint EMC Management Plans and Testing Regime

6.1.1 The Traction and Signalling Contractors shall perform a joint study and develop the Electromagnetic Compatibility Management Plans using such data as the emission characteristics, susceptibility levels, filter characteristics, physical layout and construction of their equipment, taking into consideration variation in component characteristics with frequencies. The study shall demonstrate compatibility or highlight areas of potential problems with a view to implement remedial measures in time to achieve compatibility.

6.1.2 Traction and Signalling Contractors shall co-ordinate for any information concerning EMI/ EMC in the overhead line & other structures.

6.1.3 The Contractors shall jointly develop a test plan detailing how the electromagnetic compatibility of the OHE traction System and the Signalling & Train control System will be verified, taking into consideration the study conducted.

7. Operating Modes and Principles Document

The signalling contractor as a lead contractor shall prepare a comprehensive operating modes and principles document (OMPD). The rolling stock contractor, Platform Screen Door contractor and Telecommunication contractor as participating contractors will assist the signalling contractor in preparation of the document. The traction and tunnel ventilation contractors will also assist the signalling contractor in preparation of the document. JMRC will provide necessary inputs such as standard operating procedures etc. The document shall establish the principles related to system and interface design under normal, degraded and emergency modes of operation. For each operating principle the document shall describe the scenario, action to be taken by operator and system in a structured process flow chart.

END OF APPENDIX - C

APPENDIX D

INTERFACE BETWEEN

ROLLING STOCK

AND

JP/EW/1B/E2

APPENDIX D

INTERFACE OF JP/EW/1B/E2 (ROCS CONTRACTOR) FOR ROLLING STOCK

1. INTRODUCTION

1.1 Definitions and Scope

This specification covers the interface requirements for Rolling stock by Contractor=

1.2 Contractor's Responsibilities

This Specification outlines the interfacing requirements of the Contractors identified during the Technical Studies stage of the Project.

The requirements herein specified are by no means exhaustive and it remains the Contractors' responsibilities to develop and execute jointly an Interface Plan after the commencement of the works and throughout the execution of works, to ensure that:

(1) all interfacing issues for Contractor are satisfactorily resolved;

(2) supply, installation and testing of equipment and software are fully co-ordinated; and

(3) that all equipment supplied under the Contractor are fully compatible with the present rolling stock, whilst meeting the requirements of the respective Specifications.

(4) The size & type of equipment selected should be similar to already operating section & should allow smooth transition of operation from present section to new section, without any hindrance.

2.0 Interfaces

Interfaces for Rolling Stock by JP/EW/1B/E2 Contractor shall include the following but not limited to:-

Item No.	Subject	Details to be arranged from the existing JMRC rolling stock operating department*	JP/EW/1B/E2 Contractor's Responsibilities
1.	Size and Types of ROCS Contact wire.	--	JP/EW/1B/E2 Contractor shall provide information to Rolling Stock operating department of JMRC.
2.	Arrangement of the ROCS and	--	JP/EW/1B/E2 Contractor shall provide information to Rolling Stock

Item No.	Subject	Details to be arranged from the existing JMRC rolling stock operating department*	JP/EW/1B/E2 Contractor's Responsibilities
	sectioning		operating department of JMRC.
3.	Detailed drawings of pantograph and pantograph head.	Rolling Stock operating department shall provide information to JP/EW/1B/E2 Contractor	JP/EW/1B/E2 Contractor to incorporate into the design of the ROCS.
4.	Material of pantograph contact strip	Rolling Stock operating department shall provide information to JP/EW/1B/E2 Contractor	JP/EW/1B/E2 Contractor to incorporate into the design of the ROCS.
5.	Detailed masses, springing and damping & pressure of pantograph	Rolling Stock operating department shall provide information to JP/EW/1B/E2 Contractor	JP/EW/1B/E2 Contractor to incorporate into the design of the ROCS.
6.	Pantograph sway calculations	Rolling Stock operating department shall provide information to JP/EW/1B/E2 Contractor	JP/EW/1B/E2 Contractor to incorporate into the design of the ROCS.
7.	Details of harmonic contents of rolling stock power supply	Rolling Stock operating department shall provide information to JP/EW/1B/E2 Contractor	JP/EW/1B/E2 Contractor to incorporate into the design of the ROCS.
8.	Maximum traction return current	Rolling Stock operating department shall provide information to JP/EW/1B/E2 Contractor	JP/EW/1B/E2 Contractor to incorporate into the design of the ROCS.

*all the interface for the details required for the Rolling stock shall be done by ROCS contractor. All the design related requirement shall be provided by the JMRC's rolling stock operating department. The design details have to be shared with the rolling stock department before implementation of the same.

Additional Interfacing Requirement

1.0 Details regarding acceleration, deceleration, coasting and Braking distance of Rolling Stock has to be arranged by ROCS contractor.

JP/EW/1B/E2 Contractor shall also be responsible to fully coordinate with the Rolling Stock Contractor in this regard.

2.0 JMRC's Rolling Stock operating department and JP/EW/1B/E2 Contractors shall also interface for conducting Current Collection test.

END OF APPENDIX - D

APPENDIX E

INTERFACE BETWEEN

CIVIL

AND

JP/EW/1B/E2

APPENDIX E

INTERFACE BETWEEN JP/EW/1B/E2 AND CIVIL CONTRACTOR

1. Civil Contractor shall construct appropriate passages/trenches, ducts, cable shaft and also keep provision of crossing of various cables in the Station along the walls, central column, under the platform including all fire separation requirements in interface with Power Supply Contractor.
2. Civil Contractor shall interface with Power Supply Contractor and as per requirement, provide opening in diaphragm walls of Cut & Cover tunnel for passage of cables.
3. Civil Contractor shall make provision of hatches, gantry beam, Lifting hooks for lifting equipments and travelling hoist to meet the material movement.
4. Civil Contractor shall make provide all hooks for lifting of equipment in SSP, SP and SS.
5. **JP/EW/1B/E2 Contractor shall coordinate with Civil Contractor in order to ensure obligatory Static and Dynamic clearances between OCS/ Pantograph and structure as per standards IEC followed**.
6. Civil Contractor shall be responsible for exposing reinforcement bar of tunnel & station area as per the location indicated by JP/EW/1B/E2 Contractor to meet the earthing requirement.
7. Civil Contractor shall provide cuts in tunnel and Station for fixing OCS warning / Caution / indicator boards.
8. Civil Contractor shall ensure that entire tunnel roof is free from unwanted/ unwarranted material like plywood or any other material etc.
9. JP/EW/1B/E2 Contractor shall interface with Civil Contractors regarding requirement of Niche in tunnel wherever required as per ROCS design. JP/EW/1B/E2 Contractor shall also be responsible for measuring the required dimensions and clearances at critical locations during construction stage.
10. **All cable supports and cable hangers required for installation of all cables and conductors for ROCS in station area as well as in tunnel, is to be provided and erected by JP/EW/1B/E2 Contractor. JP/EW/1B/E2 contractor shall be required to interface with civil contractor for the routes and access.**

END OF APPENDIX E

APPENDIX F

INTERFACE BETWEEN

TRACK CONTRACTOR

AND

JP/EW/1B/E2

INTERFACES BETWEEN JP/EW/1B/E2 AND TRACK CONTRACTOR

1. Definitions and Scope

1.1 This specification describes the interface requirements between Contract JP/EW/1B/E2 and Track contractor for all the underground corridors of Phase-III.

1.2 This specification shall be read in conjunction with the relevant clauses of the General Specification. Both the JP/EW/1B/E2 Contractor and the Track Contractors shall be responsible for ensuring that all requirements of the General Specification pertaining to interfaces are properly satisfied.

1.3 This Interface Specification outlines the interfacing requirement during the execution of the Works. However, the requirements herein specified are by no means exhaustive and it remains the responsibility of JP/EW/1B/E2 and Track contractor's responsibility to develop, update and execute jointly an Interface Management Plan after the commencement of the Works and throughout the execution of Works to ensure that:

(1) all interface issues between the Track contractor and JP/EW/1B/E2 Contractors are satisfactorily identified and resolved; and

(2) all the construction tolerances at the interface shall meet the requirements of the respective specifications.

2 The JP/EW/1B/E2 contractor's scope of works

2.1 Where details of the JP/EW/1B/E2 Contractor's design are required to enable the Track Contractors to implement the interface works, the JP/EW/1B/E2 Contractor shall provide the Track contractor with the necessary information. The level of information provided shall be of sufficient detail to enable the Track Contractors to construct the interface works required.

2.2 The JP/EW/1B/E2 Contractor shall take a lead in developing an Interface Management Plan in conjunction with the Track Contractor to cover all aspects of the implementation of the interface works stipulated in this Specification and all other interface works required to complete all works in the JP/EW/1B/E2 Contract, including but not limited to those listed in clause 4.

2.3 The JP/EW/1B/E2 Contractor shall liase with during the development of the Interface Management Plan for any proposals for amendments or additional works required for completion of Earthing & Bonding and ROCS work.

3 Track contractors' scope of works

3.1 The information and the scope of works to be provided by the track Contractor include but not be limited to those outlined in clause 4 of this specification.

4 FUNCTIONAL INTERFACE

4.1 Track contractor shall provide & mark Track Centre all along the station & tunnel for installation of ROCS even without laying of Track.

4.2 In respect of the location of impedance bonds that may be required by the Train Control and Signalling system, the Contractors shall agree on the final location of impedance bonds, cross bonds or any other rail connections related to traction current return;

4.3 The JP/EW/1B/E2 Contractor shall supply, install and terminate bonding cables at appropriate intervals for which he shall co-ordinate with the Track contractor for Thermosetting welding of cable to rails for providing return current continuity.

4.4 In regard to traction bonding cables between rails and cross-bonding cables, JP/EW/1B/E2 will co-ordinate with Track contractor.

4.5 The JP/EW/1B/E2 Contractor shall coordinate with track Contractor for providing continuity from plinth to plinth by cable of suitable size (which will be informed by JP/EW/1B/E2 Contractor). Providing plinth to plinth continuity shall be the responsibility of the track contractor.

4.6 For any specific requirement of passage of traction cables under the track bed, JP/EW/1B/E2 Contractor shall clearly indicate the requirements to Track contractor. JP/EW/1B/E2 Contractor shall provide the necessary HDPE pipe for the cable crossing under the track, Track contractor shall provide the passage for the pipe for cable crossing.

4.7 Track contractor shall provide the necessary track geometry drawings to JP/EW/1B/E2 Contractor for designing the Rigid OCS installation in the tunnel and station.

4.8 JP/EW/1B/E2 Contractor shall provide drawings showing size and location of non-metallic pipes required for track crossings for 25 kV traction and return current cables.

4.9 Track contractor shall provide drawings showing locations of rail expansion joints.

END OF APPENDIX – F

APPENDIX G

NOT USED

APPENDIX H

INTERFACE BETWEEN

E&M CONTRACTOR

AND

JP/EW/1B/E2

APPENDIX H

INTERFACE BETWEEN JP/EW/1B/E2 AND E&M/ECS CONTRACTOR

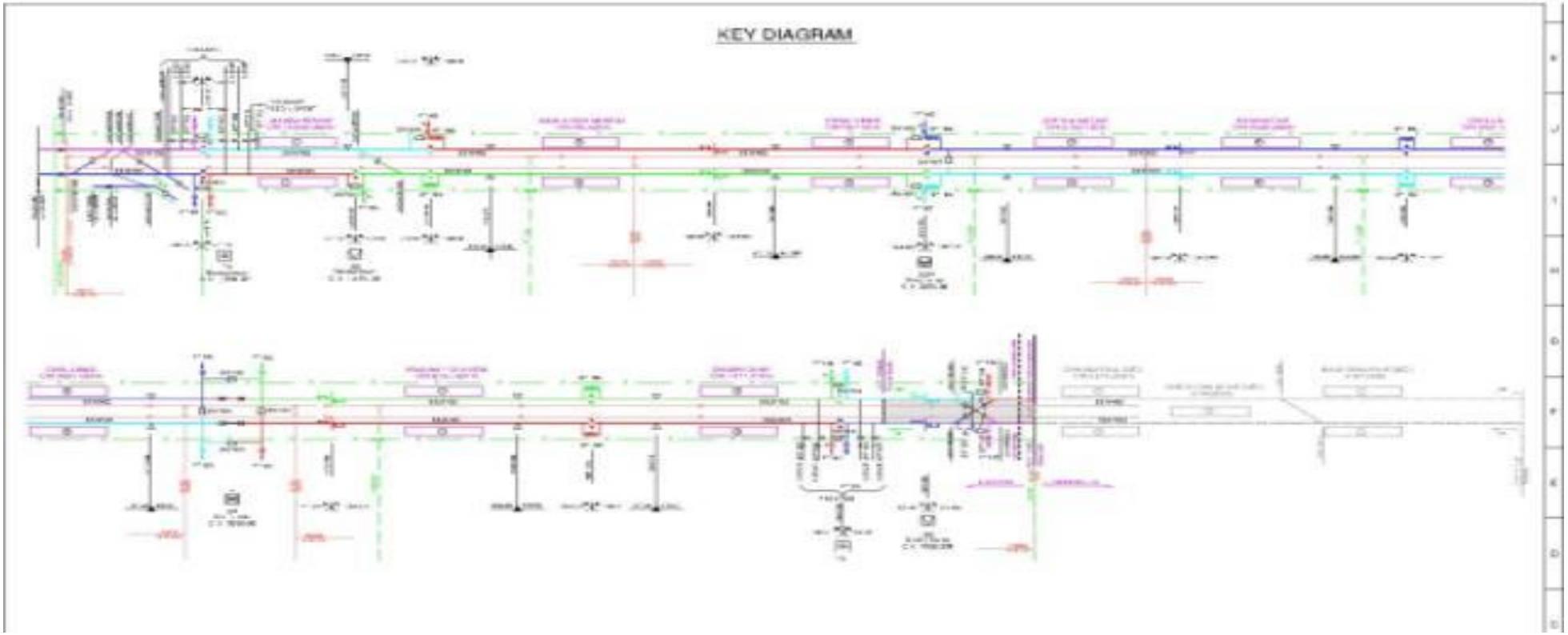
Item No.	Item Description	JP/EW/1B/E2	E&M contractor
1.	415 V AC supply for Switching post rooms	Provide load information and termination points and suitable MCB/ MCCB on Distribution Board. Interface to ensure provision of suitable allocation of MCB/ MCCB on DB of station E&M panel	To lay the cable and terminate at designated point on Distribution Board of Switching post
2.	Ventilation and lighting in SP rooms	Provide information of total Ventilation and lighting requirements in SP rooms	To install Ventilation and lighting in SP rooms
3.	Earthing of equipments in SP rooms	Provide information of total Earth risers and type, design of earthing required in SP rooms. Connection from Earth risers to panels/ equipments.	To provide Earthing as per design and Earth risers in SP rooms

END OF APPENDIX - H

APPENDIX I

DETAIL OF INTERFACE FOR RSS SUPPLY BY JP/EW/1B/E2 CONTRACTOR

The ROCS contractor has to interface for planning the EMI/EMC study details at the existing RSS of Jaipur Phase- 1A project. The 25 kV traction power supply will be extended from the existing RSS's. The power supply details (Schematic) are as under:-



The Transformer capacities provided in different Receiving Sub Stations (RSS) are as follows for reference:-

RSS Name	Traction transformer 66/25 kV or 220/25kV	Auxiliary transformer 66/33 kV or 220/33 kV
MANSROVER ,	**21.5 MVA**	**30 / 45 MVA**
SINDHI CAMP	**21.5 MVA**	**30 / 45 MVA**

APPENDIX - J

NUMBER OF PERSONNEL TO BE TRAINED

APPENDIX J - Number of personnel to be trained in each of the Lot

Table 1 - Man-Weeks of Employer's personnel's Offshore Training at Contractor's Works

	Duty of trainee	Man-weeks
25 kV traction equipment	Operator	2
	Maintenance Staff	2
	ETI	1
OCS		
	Maintenance Staff	2
	ETI	1
	ETI	1

Table 2 - Man-Weeks of Contractor's Training Instructors for training Employer's operating personnel in India.

	Man-weeks
25 kV traction equipment	1
SS/SSP,	2
OHE/OCS	1

Table 3 - Man-Weeks of Contractor's Training Instructors for training Employer's maintenance personnel in India

	Man-weeks
25 kV traction equipment	2
SS/SSP	4
All types of Cables	4
EMI/EMC, bonding and earthing system requirements	1
Electrical safety and earthing	1
OCS	1

END OF APPENDIX - J

APPENDIX-K

The Opening of JMRC/Metro Railway for Public Carriage of Passenger Rules, 2002

CHPATER X

DESIGN AND INSPECTION OF EQUIPMENT FOR ELECTRIC TRACTION

37. Design of electric installations-

1) The design of all electric installations, namely transmission and distribution lines, sub-stations, switching stations, rigid overhead current collection system and regulated overhead equipment, etc, shall be according to approved standards laid down by the central govt. and the Indian Electricity Rules, 1956, or any other law for the time being in force and wherever any departure from accepted norms becomes necessary, approval of the central govt. shall be obtained.

2) Adequate protective arrangement shall be made to ensure that the public cannot come in contact with the electric equipment on line within the metro railway premises.

3) Suitable protective screens shall be provided where live conductors pass under or over bridges.

4) The structures supporting overhead equipment shall be designed in accordance with the relevant international and Indian standards. The wind pressure to be adopted shall be generally in accordance with IS 875-64 (latest revision). Inside metro corridor tunnel, complete overhead current collection system and its supporting system shall be as per relevant international / Indian standards and shall be capable of working safely under air piston effect during train operation.

5) When the distribution system involves overhead wires carried on steel structures including bridges and roofs and return circuit via running rails or earth, all such structures, masts and associated tracks shall be effectively earthed and bonded or other precautions taken to ensure that contact with the steel work of the structure, will not be dangerous to the public and the metro railway staff. In AC and DC traction, bonding and earthing shall be as per the approved code for bonding and earthing in respective areas. In case of elevated concrete structures continuous earth bonding shall be provided by earthing the reinforcement of structures and connecting the same to overhead electrical structures.

6) Earthing arrangements at power supply installations shall strictly conform to the Indian electricity rules, 1956 and accepted codes of practices for bonding and earthing for AC and DC traction. Adequate stray current control system shall be provided to under DC traction systems avoid corrosion to steel reinforcement and other metallic parts of the tunnels and nearby structures. All precautions

shall be taken to avoid electro-magnetic effect in the environment as per relevant standards.

7) The earthing system for DC traction shall conform to requirements of IS-3043 and EN-50122 part-I and the maximum rail potential during, Permanent condition shall not exceed 120 V for main lines and 60 V for depot area in accordance with EN-50122 part-I

8) No earth wire shall cross any track and where structures to be connected to an earth-wire are located on opposite side of a track separate wire runs shall be used for connecting the structures. In complicated areas, structures may be connected to individual earthing stations.

9) When overhead lines transmitting electric power (other than lines forming part of the railway traction equipment) have to be carried across metro railway track, the details of the equipment provided in connection with such lines shall be designed with the object of minimizing danger in the event of breakage and in accordance with Regulation for electrical crossings, 1997. These details shall be approved by the electrical inspector to the Govt. of India.

Note:- The chief electrical engineer of JMRC/Metro rail corporation functions as the electrical inspector to the Govt. of India for JMRC/Metro railways jobs.

10) Lightning arrestors of standard of approved types shall be provided wherever they are necessary.

11) All component parts of the equipment which carry live conductors shall be provided with devices approved by the electrical inspector to the Govt. of India to prevent unauthorized persons climbing them. Anti-climbing devices shall also be provided, wherever necessary, on structures carrying high tension equipment with in metro railway premises.

12) On both sides of the roads at road-under-bridges, height gauges of suitable design shall be provided to ensure that no part of any road vehicle or its load shall come in contact with the road under bridge girders.

13) Warning notices shall be erected in conspicuous position indicating the existence of live electrical equipment.

38 **Display of caution boards and notices**-

The following caution boards and notices of standard sizes written in English and Hindi shall be displayed at the various locations indicated below:

a) Treatment for electric shock boards giving instructions for treatment of shock at all railway stations control rooms, car sheds, sub-stations, switching stations, offices of maintenance engineers of works, signal, overhead electrical equipment and cabs or moving vehicles, etc.

b) General "caution notices" regarding danger of high voltage traction wires for public at various entrances to metro railway stations and for staff at prominent places;

c) "1500V DC Caution" boards and "25 KV AC caution" boards as applicable shall be affixed on to the screen erected on foot over and road over bridges, sub-stations, and switching station and track cabins;

d) Caution boards at such posts (for signal and telecommunication staff) where protective screening shall not be provided;

e) "Caution-Unwired turn-out" boards ahead of all unwired turnouts or cross over taking off from wired tracks;

f) "Warning" boards for neutral sections;

g) Boards for "switching on" and "switching off" of power at neutral sections;

h) Danger boards on height gauges for road-under-bridges;

i) Restricted clearance boards at such identified locations;

j) Power Block limit boards; and

k) Stop boards at termination of over-head electrical equipment in the sections to be energized.

39. Protection of private property against inductive effects of AC traction – Under 25KV AC traction, there is a heavy induction on all metallic structures and conductors in the vicinity of track. Inductive effects show themselves on any overhead conductor, such as metallic clothes lines, power lines and the like belonging to private parties running parallel and close to the electrified tacks. Wide publicity shall be given to the effects of the induction, so that special precautions may be taken by private parties concerned against the possibility of electric shocks frock conductors running their premises.

40. Approval of energization of high tension lines –

1) Application shall be submitted at least a fortnight before energization of high tension lines to the Electrical Inspector of the Govt. for JMRC/Metro rail corporation for the following namely:-

a) Formal approval, if not already received to the design and layout of all high voltage equipment including traction sub-stations, transmission lines, 25KV/33 KV and 1500V DC feeders, switching stations, booster stations, etc.;

b) Approval for energization of high tension installations mentioned above including overhead equipment for AC/DC traction;

c) The application should be accompanied by documents as specified in AC/DC Traction Manual.

2) On receipt of an application under sub-rule (1), the electrical inspector shall scrutinize and inspect the design and installations in respect of the following, namely:

a) The layout and design for receiving sub-stations, traction sub-stations auxiliary sub-stations, 1500 V DC/25KV AC overhead equipment and other installations for compliance with the Indian electricity Act, 1910 (9 of 1910) and the rules

made thereunder and the relevant Indian standards or international standards; and

b) Inspection of completed installations, either personally or by deputing his officers for compliance with the safety requirements.

3) After conducting the inspection under sub-rule (2), the electrical inspector shall convey his approval for the energization of 25kV/33 kV/1500 V DC feeder lines from receding sub-stations, energization of receiving sub-stations, traction sub-stations, auxiliary sub-stations, traction sub-stations to feeding posts, switching stations, booster transformer stations, track cabins and auxiliary transformer stains subject to such conditions as he may consider necessary.

41. Procedure for energization of traction installations –

1)

a) After obtaining the sanction of the electrical inspector to the Govt. of India for energization under rule 39, the sub-stations should be commissioned sufficiently in advance for the energization of overhead electrical equipment;

b) Before energization of the sub-stations, full communication facilities should be available and power supply authorities should be ready to give power supply;

c) On the date on which energization of track installations take place, necessary clearance certificate should be obtained from the electrical construction officers and others who had been hitherto working in the sub-station premises to the effect that their staff had been withdrawn and the sub-station could be energized;

d) After final measuring of the whole installation and check on the satisfactory operation of all equipment including protective relays, the traction sub-stations and other installations may be energized;

e) Energization of overhead electrical equipment and overhead current collection system shall be progressively undertaken starting with 33 kV/ 25 kV/1500 V DC feeders from the receiving sub-stations to the traction sub-stations, track cabins, bus bars of the feeding posts followed by one sub sector after another; and

f) Before running electric rolling stock, a confirmatory field test by the proper operation of the protective relays shall be conducted.

2) In addition to giving wide publicity through newspapers and other media, the station manager shall warn all passengers about the danger of 1500 V DC /25 kV AC overhead equipment/1500 V DC OCS equipment and not allow them to ride on top of rolling stock working on the section.

3) All relevant documents and certificates mentioned in, and notifications issued under the AC/DC traction manual, and the ordinance, along with the approval of electrical inspector for energization shall form a part of completed documents to the commissioner while making reference to the commissioner under sub-rule (2) of rule 3 for opening of the metro railway for public carriage of passenger.

4)

(a) The inspection of the entire section shall be carried out by means of over head equipment inspection car by the commissioner.

(b) An officer equivalent to senior administrative grade rank officer of electrical department nominated by the chief executive officer should accompany the commissioner throughout the inspection.

(c) The engineer-in charge of the section during the construction should also be present.

(d) During inspection, particular attention shall be paid to the safety and operational aspects of the train movements and to see that staff are in possession of statutory rule books, instruction books, registers, forms, etc and the transportation, electrical, permanent way and signal and telecommunication staff are fully acquainted with the duties to be carried out after electric traction is introduced.

5) Subject to inspection being satisfactory, an all concerned message may be issued by the commissioner, communicating his sanction for the introduction of commercial services under electric traction.

6) The signal and telecommunication requirements in electrified sections shall be in accordance with the provision of JMRC/Metro Signal Engineering manual.

Notes:- A catechism dealing with the requirement of signal and telecommunication installations for 1500 V DC and 25 KV 50 Hz AC electrified section are enclosed as Appendix A and B to these rules.

APPENDIX A

(See rule 41)

CATECHISM FOR SIGNALLING AND INTERLOCKING INSTALLATIONS SIGNALLING AND TRAIN CONTROL

Have the requirements and recommendations for signalling and train control systems vide Chapter Ix of these rules and appendix thereto pertaining to signalling and train control systems installed on the section being complied with?

SIGNAL

1. Do the signals comply with the requirements as metro railway General Rules, 2002.

2. Have all the signal posts been placed on the left side of the track of the approaching train to which they refer? If otherwise, for what reason?

3. Are all running signals controlling placed in such a position and at such a height above rail level so they can be clearly seen by the drivers in sufficient time and be readily distinguished by night or by day from subsidiary signals?

4. In case of slotted or controlled signals, can the signals be freely returned to danger by either of the controlling agencies?

5. Are signals not commissioned have their aspects covered and the cover displaying tow crossed white bars on a black background, the bars not being less than 30cms x 10 cms?

POINTS

1. Are the locking of facing points such that the points cannot be or become unlocked while a train is passing over them, i.e, electrically controlled by track circuits or alternative devices?

2. Are detectors (internal / external) fitted to all facing pints and do they efficiently detect with switches the signals controlling the movement of train over them?

3. Are switches adjusted to come tight against stock rails? Does the insertion of 5mm obstruction piece between the switch and stock rails 150mm from the toe of the switch prevent the points being locked and prevent the relevant signal being locked and prevent the relevant signal being taken 'OFF' the giving of which is preceded by the locking of the points?

STATION CONTROL ROOM

1. Are all signals, points and track circuits electrically /electronically repeated on the station control panel/work station as and where provided?

2. Is the station controller provided with necessary means the stopping of train at his station?

3. Have instructions for working been issued to all staff and included in Metro Railway working instructions and are they correct and efficient?

TESTS IN STATION CONTROL ROOM

It is essential that the interlocking of all signals with points must be so effected as to ensure the following conditions, which may be tested from the station control panel or work station.

1. Is it possible to take off conflicting signals at the same time?
2. Is it possible to take off a signal until:

a) All points on the running line including overlap are correctly set and the points locked where required?

b) All points, giving access to the running line from sidings are set against the running line?

OPERATION CONTROL CENTRE

Are all signals, points and track circuits electrically/ electronically repeated on the operation control or work station as and where provided?

CAB SIGNAL

1. Are the various modes of train control clearly distinguishable on the Driver's Man Machine Interface (MMI).

2. Under cab signaling system of working, is Automatic Train Protection System able to bring the train to a stop before an obstruction?

APPENDIX B
(See rule 41)

A. ADDITIONAL CATECHISM FOR SIGNALLING AND TELECOMMUNICATION

Have the requirements and recommendations for signalling and telecommunicate in installation in accordance with the instructions issued for the installation of signalling and Telecommunication equipment in 25 kV 50Hz AC or other traction system as adopted on the section, been complied with?

If not, in what respect the arrangements provided fall short of them?

STATEMENT OF DEVIATION – SIGNALLING AND TELECOM SYSTEMS

	Exiting Parameters	Prescribed Parameters	Deviation / Infringement	Remarks	Approval sanction
Signal Points Track circuits Cables Electric Signalling EQPTS Batteries Earthing Mobile train radio Communications General safety					

END OF APPENDIX - K