NOIDA METRO RAIL CORPORATION LIMITED

Detailed Design Consultancy for Design of 25 kV Overhead Equipment (OHE) system and Power Supply & SCADA for Elevated Line of Aqua line extension Corridor of Noida Metro Rail Project.

CONTRACT NO: NGNE-01

E-tender : NMRC/Prj/OHE Design/NGN/ 185R/192/2022

Volume 3

OUTLINE DESIGN CRITERIA

Noida Metro Rail Corporation (NMRC) Limited

Block-III, 3rdFloor, Ganga Shopping Complex, Sector-29, Noida -201301,

District Gautam Budh Nagar, Uttar Pradesh, India

1.0 OVERVIEW OF THE PROJECT

1.1 This Chapter gives an overview of the Project and the information provided in this Para is for reference only.

1.2 Background: -

Noida Metro Rail Corporation is implementing the following corridor of Noida Metro Rail Project.

S. No.	Corridor Details	Length of Corridor			Elevated	
					Stations (E)	FOCS (KM)
1.	Sector 51 to Greater Noida Sector 2	9.605			05	9.605
Total					05 no’s	9.605

1.2.1 Trains Comprises will be electric multiple unit (EMU). Modern rolling stock with stainless steel body and VVVF 3 phase drive with regenerative braking has been utilised. The cars are air-conditioned.

1.2.2 Deleted.

1.2.3 25kV single phase ac traction has been utilised with flexible Overhead Equipment (OHE) on elevated section.

1.2.4 ‘CATC’ (Continuous Automatic Train Control System) based on ‘CBTC’ (Communication based Train Control System will be provided with Automatic Train Operation (ATO)/Automatic Train Protection (ATP) and ATS (Automatic Train Supervision).

1.2.5 Operation Control Centre

The Operations Control Centre (OCC) is located at Depot. *This information is given only for the guidance purpose*.

2.0 DESIGN CRITERIA

The key design criteria that the Contractor shall adhere to are addressed in the following paragraphs.

It should be noted that any design criterion is subject to change, subsequent to review, in the interest of enhancing the System-wide performance, cost and safety.

The DDC may propose improvements in the designs based on the Aesthetics, working experience or financial savings.

2.1 Climatic data

The DDC is required to obtain following Data from the relevant Government agencies for the Noida for design purpose:

1.	Temperature	➢ Minimum Temperature (ambient) ➢ Maximum design temperature (ambient) ➢ Mean temperature adopted
2.	Rainfall	➢ Rains occur generally during Monsoon from June to September and occasional showers in December and January are also experienced.
3.	Humidity	➢ Maximum relative humidity - 100% ➢ Minimum relative humidity - 10%
4.	Wind pressure	➢ Maximum wind pressure ➢ adopted for design - 155 Kg / Sq.m
5.	Thunder storm	➢ The region is subject to thunder during June to September. Isoceraunic level of average 30 thunderstorms per year as per IS2309 may be considered.
6.	Nature of atmosphere	➢ SPM ➢ SO2 ➢ NO2 ➢ RSPM The expected pollution levels in future are likely to be higher than these figures.
7.	Earthquake	➢ Designs as per Zone-4.

Note: The DDC shall authenticate the above parameters as per local conditions as available from certified/government sources.

2.2 Codes and standards

Following codes and standards shall be adopted in that order of procedure:

a) DMRC codes and standards.

b) Indian Railway Standards

c) Indian Standards

d) International Standards

e) Other national standards

The design and construction of permanent works shall comply with codes of practice and standards current at the time of submission of tender documents. Regulations made and requirements issued by the NMRC and Indian Government and by relevant utility companies shall be followed.

Alternative or additional codes, standards and specifications proposed by the DDC shall be internationally recognised codes and shall be equivalent to or better than, Indian standards issued by the Bureau of Indian standards, subject to being, in the opinion of the Employer's Representative, suitable for incorporation into the specification.

2.3 Design philosophy

Traction design shall be based on the following principles

- Materials and design shall be proven by service experience. This shall not preclude the use of improved technology where this may be regarded as a single incremental advance from a proven base, and shall be applied as appropriate to improve quality and reduce maintenance expenses.

- Critical materials shall be readily available from more than one source. As far as possible use of Indigenous product should be encouraged.

- Dimensions of all materials and equipment shall be specified in the System International (SI) units. Standards equipment and components available as an industry standard only in imperial units shall remain specified in imperial units with metric equivalents stated.

- The selection of materials and the OHE, ASS and SCADA design shall facilitate the routine maintenance of the respective systems and replacement of components on the assumption that the NMRC will operate 19 hours per day, every day of the year.

- The NMRC operating requirements for speed, frequency, comfort, and reliability demand tight tolerances and high levels of workmanship and quality during construction, facilitated by an effective construction management programme.

2.4 Train Operation Plan

The peak hour train operation plan for year 2021 and 2031 given below:

PEAK HOUR TRAIN OPERATION PLAN

Line No.	Corridors	2021		2031	
		Headway in Minutes	Cars per train	Headway in Minutes	Cars per train
1.	Depot Station to Sector 51 station	7.5	4	7.5	4
2.	Depot station to Knowledge Park-v	7.5	4	7	4

6-Car Rake Composition - DT+M+T+M+M+DT and 4 Car Rake Composition – DT+M+M+DT
DT: Driving Trailer Car, T: Trailer Car, M-Motor Car

For construction of platform the civil tenders have been floated for 6 coach design. Therefore, the designer is to consider 6 cars per train for all the purpose.

2.5 Traction power system performance requirement

2.5.1 The Traction Power System shall have adequate capacity to meet the performance requirements specified hereunder.

Normal Operating Conditions

The traction power system is to be designed for the ultimate 6-car train (having 03 motor Car+01Trailer Car+ 02Driving Trailer Car) operation at headway of 90-seconds corresponding to 40 trains per hour for corridor of Sector 51 to Greater Noida Sector 2

Emergency operating conditions

For the complete loss of 1 RSS (out of 2 for a particular corridor), the System shall be able to provide 100% of the peak train services at the headway and train composition given in Para 2.4 above.

Maximum speed

For design purpose maximum speed potential of the catenary system shall be taken as 120 Kmph.

2.5.2 POWER SYSTEMS

While the study for Power supply requirement is to be done for final / designed headway, the power required at the time of Commissioning stage headway is also to be calculated.DDC shall be required to develop and propose the methods and tests to validate the results of simulation after the commissioning.

2.6 Overhead line voltage

The traction System shall be designed and constructed to operate in such a way so as to ensure that the Overhead Line System voltage complies with the following requirements:

1. Nominal voltage of OHE : 25kV
2. Maximum voltage of OHE : 27.5kV
3. Minimum continuous voltage of OHE : 19kV
4. Minimum instantaneous voltage of OHE : 17.5kV
5. Occasional maximum voltage for OHE: 31 kV

2.7 Auxiliary Power Supply Voltage

The 33 kV auxiliary power supply system shall operate in such a way to ensure that system voltage shall comply with the following requirements:

1.	Normal system voltage	33 kV
2.	Maximum system voltage	36 kV

3.	Minimum voltage under normal feeding	33 kV-5%
4.	Minimum voltage under loss of any one supply	33 kV-10%

2.8 Track gauge

Standard Gauge (1435 mm) for both the corridors.

2.9 Schedule of Dimensions (SOD)

The SOD will be made available to the DDC within one month of award of work. Any changes in the approved SOD will also be communicated to the DDC time to time.

3.0 DESIGN PARAMETERS

3.1 Overhead Equipment (OHE)

Presently, NMRC using FOCS system comprising of, 107 sq mm contact wire for main line (Cu-Ag) and depot (CU ETP) and 65 sq.mm Catenary wire. After scrutinizing the failure analysis of the past, DDC shall submit the Techno-economic analysis of the following items based on reliability, maintainability, life cycle cost etc.

- OHE cantilever :- DDC to compare and examine best suitable type of cantilever arrangement among Single Insulator Cantilever (SIC)/ Modular Aluminum / GI conventional etc. based on reliability, maintainability etc.

3.1.1 **Normally Tramway type OHE may be used in the depot area,** Contact Wire Height

The normal contact wire heights are shown in Table 3.1.1

Table 3.1.1 Contact Wire Height (m)

Item	Height at support (m)
Regulated OHE with 10 cm pre-sag	5.00 (normal)
Depot inspection lines	5.2 – 5.4 (based on interface requirements)

3.1.2 Stagger

Spans and staggers shall be carefully arranged to ensure that the contact wire will never be displaced by more than 200 mm on straight track and 300 mm on curve from the center-line of the pantograph at any point in-span, under the worst operating conditions of the OHE System, the rolling stock and the pantograph.

In calculating the maximum displacement of the contact wire for the stagger, the following shall be taken into account:

- Temperature effect (i.e. the effect of stagger changes due to temperature variation);
- Static and dynamic effect of track tolerances (if they are not included in pantograph sway); and
- Erection tolerance.

3.1.3 Span Length

The standard OHE spans adopted in Indian Railways is from 27 meter to 72 meter generally in steps of 4.5 m. Span length shall be suitably designed based on the practices followed on the corridors of NMRC.

3.1.4 OHE Masts

Presently NMRC using Conventional masts, as used in Indian railways/Metros. DDC shall submit the techno economical comparison and propose the suitable masts based on reliability, maintainability, life cycle cost, aesthetic etc.

3.1.5 Tension and Tension Length

The Contact and catenary tension values shall be reviewed based on design speed. Optimisation of tension length shall be carried out and calculation for tension and speed graph shall be submitted and by DDC. Individual tension lengths shall be designed for crossovers wherever possible.

Techno-economical comparison of Five pulley type/ Three pulley type / Spring type ATDs (standardized design) based on reliability, maintainability, life cycle cost etc. shall be submitted by DDC for main line and depots.

3.1.6 Contact Wire Sag

The auto-tensioned simple overhead line system shall be such that the nominal height of the contact wire at mid-span is lower than that at the supports to improve the current collection quality. The amount of this pre-sag on a straight track shall be decided by the DDC based on system calculations or experimental data. On a curved track, it shall be increased to compensate for the cant.

Calculation of dropper schedule shall be submitted by DDC.

3.1.7 Maximum Gradient of Contact Wire

The height of the contact wire above the rail level shall normally be the same at each support. If, due to local conditions (such as the transition between main line and depot), a variation in height is necessary, this shall be achieved with as small a gradient as practicable.

The maximum permissible gradients of the contact wire above the rail level shall not exceed 3mm/m on main lines and 10 mm/m on sidings. The relative gradient of the contact wire in two adjacent spans shall not be greater than 1.5 mm/m on main lines and 5mm/m on sidings.

3.1.8 Clearances

The minimum electrical **and mechanical clearances shown in Table 3.1.8 shall not be infringed under the worst operating conditions of the overhead line equipment, the rolling stock and pantograph. The values in the right column shall be used only where it is absolutely necessary and prior approval of Engineer as obtained upon review in each case.**

Table 3.1.8 Minimum Electrical Clearances* (mm)

*{As on 31.03.2019, the following Normal clearances are modified in Draft CEA safety regulations. The clearances should meet the CEA safety regulations as amended and published by GOI at the time of design.}

Item	**Normal**	**With Permission of Electrical Inspector**
25kV Live parts to structure (Vertical)		
- Static	320	250
- Dynamic (passing)	270	200
25kV Live parts to structure (lateral)		
- Static	320	250
- Dynamic (passing)	220	200
Gap at Insulated Overlap between conductors of different electrical sections	500	N.A.
Gap at Uninsulated Overlap	200	N.A.

The values shown in Table 3.1.8 shall be used as a minimum. In the event of additional space being available, the space shall be used to enhance the electrical clearances above the stated values, before consideration is given to increase the system height.

3.1.9 Insulators

Proven type composite or porcelain insulator with minimum creepage distance of 1600mm shall be proposed along with the GTP.

3.1.10 Clearance at Power Line Crossings

The minimum vertical clearances between the conductors of utility's power line and all the conductors of the OHE shall be as per Indian Railways Traction Manual.

3.1.11 Electrical Sectioning

- OHE shall be divided into electrically isolated sections by provision of interrupters at insulated overlaps and with section-insulator at turnouts. Sectioning shall be provided to permit isolation of OHE in small sections for maintenance or to isolate damaged OHE in case of breakdown/accident and to permit diversion of train from up line to down line and vice-versa.

- The sectioning shall be such that in case of failure of OHE on one track, the faulty section can be isolated quickly and the train (EMU) lying in the healthy section on the same track can either be brought to station or can be taken on the other track through emergency cross-over depending upon the operational requirement. Where practicable, insulated overlaps shall be provided instead of section insulators, for the sake of better dynamic performance.

- ***Following items shall be studied and explored for inclusion in tender, and a life cycle cost comparison studies to be submitted by DDC. After scrutinizing Suitable suggestions of design, make and suppliers of Indian/ international to be submitted by DDC :-***

  1) Isolators, Interrupters, Load Break Switches at Switching posts (SSP, SS).

  2) Provision of Lightning Arrestors on OHE posts to be examined

  3) PT / Capacitive Sensor on OHE posts to be examined. Provision of Blast proof PT arrangements to be explored.

  4) Jumpering arrangement and use of PG clamps/fittings etc.

3.1.12 Earthing and Bonding

3.1.12.1 Overhead Line Equipment Earthing System

DDC shall design a suitable and effective earthing system for the entire OHE system. The present arrangement and requirements specified for the earthing and bonding facilities shall be studied in detail by the DDC and amended. In addition to requirement laid down in IS-3043 and IEEE-80, earthing and bonding shall be provided in accordance with norms laid down in following documents: -

a) CCITT limits on induced Voltages (60V under normal conditions and 430 Volts under fault conditions).

b) EN50122 limits on Rail Voltages and touch potential.

c) AC Traction Manual (ACTM) of Indian Railways/Metro.

3.1.12.2 General Bonding

The bonding shall ensure safety of passenger, equipment, adjacent building, structures and passage of return current back to substation.

3.1.12.3 Traction Return Rail Bonding

On the main line, single or both rails of both the tracks shall be utilized as the traction return rails. DDC shall suggest bonding at following locations:

- Special bonding at expansion joints.
- Impedance bond/ ITL/ MET locations.
- Intertrack bonds. etc.
- Power Supply System.

3.1.13 General

The requirement of traction power at each substation / section shall be calculated based on the frequency of train services during peak hours with maximum no. of passengers, permissible voltage drop at the farthest end under emergency feed conditions in case of failure of one traction substation and without any curtailment of commuter services, power consumption by train auxiliaries, losses in OHE, local loads at the substations, sectioning and sub-sectioning posts and by the trains moving in the car depot yard.

Similarly the auxiliary power requirement shall be calculated based on the station-wise loads of utilities, lights, fans, lifts and escalators & other essential loads and loads of depots-car sheds / workshops etc. Property Development loads shall also be taken into account. The permissible voltage drop / regulation at the farthest end, in this case, is to be considered taking into account the failure of one main auxiliary substations at a time.

Accordingly the sizing of equipments is to be proposed by DDC, keeping in view the standardization of equipment.

Optimisation of ASS layout in coordination with E&M DDC shall be taken care of.

To meet the eventuality of outage of a auxiliary power transformer at ASS, another transformer shall be provided to act as 100% Standby.

The power supply at RSS-cum-TSS shall be received from power supply authority's network either at 220kV or 132 kV or 110 KV or 66 KV. The short-circuit / fault levels of grids at different voltages will be provided to succesfull bidders

The overhead system is designed for sparkless current collection at all speeds, but a limited degree of sparking may occur and the equipment shall be capable of withstanding the resultant transient effects.

The operation of I.G.B.T. traction units produces range of harmonics into the 25KV supply voltage and the equipment shall be capable of withstanding with these harmonics.

Due to the exposed nature of the system and the prevalence of lightning, frequent short circuits of varying severity are likely to occur and the equipment must be capable of withstanding the effects of such short circuits up to the maximum value of fault current.

The DDC shall design all necessary surge arrestors to adequately protect the equipment against lightning strikes.

DDC Shall compare and suggest provision of phase to phase and phase to ground surge arrestors for Auxiliary Transformers to be included in Transformer specifications.

3.1.14 Safety

All equipment shall be adequately earthed, insulated, screened or enclosed as may be appropriate to ensure the protection of the equipment and safety of those concerned in its operation and maintenance and also to other NMRC staff or members of the public. The equipment shall comply with the requirements of all relevant statutory acts, rules, regulations and orders. The earthing design shall be as per IEEE 80, IS 3043 and ACTM requirements.

3.1.15 Design Parameters of Sub-stations

3.1.15.1 Substation Layout

One of the primary requirements of a good substation layout is that it should be Aesthetic and economical as possible and the layout should not lead to breakdown in power supply due to faults within the substation, as such faults are more serious than those occurring on the lines away from the substations. While designing the equipment physical layouts, it shall be borne in mind that transformer bays are visible from control room and that sufficient space is available for ease of operation, carrying out service maintenance, transportation and the replacement of faulty equipment, no effect on adjoining equipment in case of any problem to other equipment, efficient performance of equipment and over all their aesthetic values. Location of land and site limitations shall also be one of the important considerations in deciding the type of equipment/layout of the substations.

Gas insulated switchgear (GIS) type substation are envisaged. However, outdoor Switchgear may also be used depending upon land availability and other considerations.

3.1.15.2 Busbar Arrangement

Single bus bar with bus sectioning or double bus bar with bus- coupler may be used. Certain amount of sectionalisation shall also be provided in a substation so as to ensure that in the event of fault, a large power source does not get disconnected. Apart from these, exposure of a substation to atmospheric hazards such as lightning, and industrial pollution etc. and future expansion shall be considered for the type of busbar system.

The size of busbar, pipes, connections, material, and its support on pedestal insulators shall be decided on the load/ fault current to be handled, system voltage and corona loss effect etc. The height of busbar and connections from ground level, minimum clearances with equipment shall be as per Indian Railway Traction Manual (ACTM).

3.1.15.3 Circuit Breakers and Interrupters

The selection of circuit breakers and interrupters, laying down their technical and performance specification shall be done by DDC on the considerations of type of duty they shall be subjected to perform, periodicity of maintenance, operational requirements, reliability and cost of the equipment. 25 kV (single-phase) sides for traction load shall be outdoor type or GIS type. While the 33 kV side for the auxiliary loads shall be indoor type with drawn-out type circuit breaker control panel. (Either SF6 or vacuum type depending upon the application in elevated or underground stations).

3.1.15.4 Isolators (Disconnect Switches)

Type of the disconnect switches whether vertical break type or horizontal break type shall be decided on the space requirements, **reliability** and its effect on the substation layout.

Location and foundation shall be considered on the criteria of easy maintenance accessibility to their contacts.

.The technical rating and performance specification of equipment shall be based on their constructional features, mechanical strength, robustness, vibration level, manual/motorized type, ease of operation, electrical load to be handled during normal/fault conditions and such other parameters.

3.1.15.5 Lightning Protection Equipment

Substation equipment's shall also be protected against travelling waves due to lightning strokes on the line entering the substation by providing Lightning Protection Equipment (LA). The technical rating and performance specification of LA shall be made on the consideration of power frequency over voltages, switching over voltages, lightening voltage and other parameters. Insulation co-ordination shall be done with LA as the focal point.

3.1.15.6 Structures

DDC shall evolve the design depending upon the choice of the busbar arrangement (strain type or rigid type) and possibility of using few numbers of heavy structures or the large number of smaller structures.

Material of the structure commonly used in India shall be steel with hot dip galvanized so as to protect them against corrosion. In the polluted area like Delhi, galvanizing may not prove effective and therefore, in such cases, painting of the structures may be essential.

3.1.15.7 Instrument Transformers

Voltage transformers (VT) of the metal-enclosed encapsulated type shall be preferred but the DDC shall consider the design of other types of VT's also. The primary & secondary windings shall be protected by fuses & they shall have appropriate ratio for their application. For revenue (tariff) metering VT's shall be of class 0.2.

Selection of VT's shall be made considering above all factors including their location, Impulse Level etc.

All the current transformers (CT) shall have a short time current rating of not less than the equivalent fault current of the fault MVA on the system. They shall have appropriate turn ratio, accuracy class and burden in line with functions they are used for. For tariff metering application their accuracy shall be of class 0.2 with suitable burden. For differential protection of transformers and their protection / measurement / indication functions class of accuracy & burden shall be decided & laid down by the DDC while preparing the detail technical specification.

3.1.15.8 Main Power and Distribution Transformers

The 33 kV /415 V distribution transformers for ASS shall be cast resin dry type with all the associated accessories. The transformer shall comply relevant IEC and IS standards and shall incorporate the latest proven design and manufacture for the type of transformers required as currently employed in the industry.

The category of voltage variation shall be of constant flux variable voltage type in accordance with IEC76

The DDC shall work out the capacity and optimization of each type of transformer based on the load they shall be subjected to handle. The transformer shall be suitable in all respects to work continuously at the specified rating under the climatic condition prevailing in India. The transformer shall be capable of operating at their rated power irrespective of the direction of power flow.

The transformer shall be designed for continuous operation at its rated power without exceeding the temperature rise limits for the windings as specified.

The temperature of the transformer winding, & maximum hot spot temperature shall not exceed the specified limits.

The transformer shall be capable of withstanding the mechanical and thermal effects associated with short circuit currents in accordance with the requirements of IEC-76/IS-2026 when operating on any tapping position.

The harmonic voltages of the transformers, particularly the third & fifth harmonics, shall be kept to a low level to minimize possible interference to communication circuits.

The transformers shall be designed with radiators with low noise level, which shall not be more than as specified in the relevant IEC.

3.1.15.9 Protective Equipment

Protective equipment shall be designed to disconnect faulty circuits with speed and certainty, without interference with the healthy circuits. Protection shall be immune from transient phenomenon to avoid incorrect operation of the circuit breakers during faults or disturbances on the system.

The relays shall be so arranged that their replacement can be effected quickly and with the minimum amount of labour. The contacts of the relays shall be capable of making and breaking the maximum current which can occur in the circuit which they have to control and shall not be affected by mechanical shock or vibration, or by external magnetic fields consistent with the place or method of mounting.

Fast acting numerical relays shall be used with Compatibility to SCADA systems.

Modern numerical relay specification should be part of the DDC tender. DDC to elaborate the relay specification for every protection.

3.1.16 Substation auxiliary facilities

3.1.16.1 Fire protection facilities

DDC shall design a proper fire protection system of sub station for quick and efficient isolation, limitation & extinguishing of fire so as to avoid damage to costly equipment and reduce chances of serious dislocation of power supply and ensure safety of personnel. The first step in this direction is design of substation layout itself with adequate spacing, fire isolation walls between oil filled equipment, soak / drain pits, approach for quenching etc. as per National Building Code

3.1.16.2 Substation building layout

Deleted

3.1.16.3 Auxiliary supply

The design of auxiliary power supply system shall have following features:

- Design of arrangements for AC supplies single & three phase for internal use in the sub station for several function such as illumination, battery charging, transformer cooling system, breakers & disconnect switch meters, fire protection system, space heaters in cubicles & marshalling kiosks, air-conditioning / ventilation equipment's.
- Reliability of AC supply should be the prime criteria while designing the system standby arrangement.
- Design of D.C. auxiliary power supply system shall consider the requirement for closing and tripping of circuit breakers, emergency lighting, control board indications etc.
- Storage battery arrangement with double set of battery charging rectifier shall be considered with voltage as 110 volts. The battery should be capable of supplying – momentary current required for operation of switch gear, continuous load of indicating lamps, holding coils for relays, contractors etc. and emergency lighting load.

3.1.16.4 Interlocks

- To ensure the safety of equipment & operating personnel & to prevent unauthorised and inadvertent operation of equipment, interlocks of mechanical type or key type or electrical type shall be designed.
- Normally, the interlock between isolators to isolators, isolator to circuit breaker & circuit breaker to circuit breaker shall be designed depending upon the safety and operational requirements.

3.2 Cabling system

. 33kV Cable feeders shall be provided for auxiliary power transmission from Station ASS to various Stations ASS's, There would be requirement of 415V LT Cables, Control Cables and Communication Cable in the Project.

The cabling System shall meet the requirements of IEC and IS standards. low smoke zero halogen (FRLS) type cables shall be proposed with XLPE insulation and metallic sheath/ armouring as applicable for underground and elevated sections respectively. A colour code scheme shall be used for different cables for easy of identifications.

33 kV cables for auxiliary power supply are laid in cable troughs on viaduct. Study on requirement of sheath voltage limiter (SVLs) & verification of bonding in 33 kV & 25 kV cable sheath shall be carried out (33 kV cable for elevated section)

The 33 kV cables are proposed to be laid on cable brackets/ hangers on the parapet walls of viaduct. DDC shall be required to design the cable laying arrangement of viaduct including cable clamps, cleats, cushioning etc. and accordingly suggest and interface with DDC and civil contractor. The specifications of 33kV cables to be designed accordingly keeping into consideration of outdoor atmospheric conditions including UV rays.

Cable length and size for 33 kV feeder for Transformer to be standardised considering VCB switching transients.

3.3 SCADA System

The DDC shall prepare design, technical and performance specifications for the supervisory control and data acquisition system monitoring, Control and tele-metering of the entire Power Supply & Traction system.

The SCADA system shall be essentially based on the power management system of master station or a central terminal unit (CTU) installed at the operation control center (OCC) and back-up control center (BCC) and many remote terminal units (RTU) scattered along the railway line and connected to the CTU through line and MODEM.

The basic functions of SCADA system shall be the switching operation of the equipment at the auxiliary power supply stations (ASS) and switching stations e.g. FP/SSP/SP (controlled stations) to monitor the status of equipment and to collect, store and analyze information and data relating to traction and auxiliary power supply. The system shall monitor, record, perform the reporting of network control and exercise the management functions of measurements & statistical data.

3.3.1 Technical Requirements of SCADA System.

The proposed SCADA system shall be generally compatible in respect of speed, protocol, control & monitoring Philosophy etc widely used all over the Metro network

DDC shall design the SCADA for integration of the SCADA of Aqua Line Extension with the existing OCC (NMRC Metro Depot) and BCC (Sector 148 RSS) in such as way so as to have a seamless integration with the existing Aqua Line SCADA network. In case of any compatibility issue on technical grounds, the DDC may design the SCADA accordingly.

SCADA system architecture should be based on latest technology so that it should enhance response time, fault detection of panel and building control for restoration of system with minimal human interface. Scope of Work as per Volume-3 of the tender may be referred.