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

SCOPE OF WORK

OUTLINE DESIGN CRITERIA

Noida Metro Rail Corporation (NMRC) Limited

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

District Gautam Budh Nagar, Uttar Pradesh, India

SCOPE OF WORK

This section comprises the detailed Scope of work for the Items included in the Tender.

1. The scope of work under this contract includes the following, but not limited to:-

a. Preparation of Design of Over Head Traction Equipment (25 kV), Auxiliary Power Systems (33 kV) and associated SCADA for construction of the Aqua Line Extension Corridor from Sector-51 Noida (Existing station) to Sector-2 Greater Noida as per the requirements of the Engineer/Employer. This will include working out the sizing of all the equipment, supported by mathematical calculations, preparation of design reports, preparation of typical drawings.

b. The Design work of the OHE for the existing two no's IBL's in the existing NMRC Depot is also included in the scope of work.

c. Assessment of the quantity of each material required for OHE, Auxiliary Power Supply and SCADA, preparation of Technical specifications and related drawings and preparation of interface matrix for finalization of BOQ based Tender document to finalize Traction contractor.

The DDC shall study the existing design of corresponding systems of NMRC Aqua Line and prepare the design for the OHE, ASS and SCADA works accordingly. The DDC shall ensure that the proposed designs are compatible with the existing systems of Aqua line Corridor for seamless integration of all the equipments.

A. OHE Works:

i. The DDC shall submit the OHE design for Extension Line Corridor after studying OHE Systems of existing Aqua Line. Scope of OHE design shall include but not limited to the followings:

- Interconnection of OHE at existing Sector-51 station of NMRC for extension of supply in the Aqua Line extension corridor.
- Traction equipments sizing.
- Preparation of 25 kV Sectioning Diagram covering complete mainlines (Elevated) and depots and finalization of locations of OHE posts (SP/SSP/SS/FP), considering future provision of RSS at Sector 123.
- Based on the track plans and layout plans of stations and other structures, DDC shall prepare pegging plans and detailed OHE plans for main line & depot. Typical Cross section drawings will be prepared for each design, as required by Engineer/Employer.
- Detailed design of structure foundations for OHE, BT, FP, SS, SP and SSP including any future FP, SSP, as applicable, and the arrangement of electrical connections from BT/FP/SP/SSP to OHE matching with the skyline of city, shall be furnished by DDC.

  The designer shall submit the detail design of OHE using conventional mast as used in Indian railways/Metros.

  The designer shall also give the detailed drawing of the OHE fittings required for flexible OHE.

- Calculations to determine the equipment sizing, catenary voltage drop, maximum catenary current, maximum rail potential rise, maximum Contact wire and catenary wire temperature rise etc. taking into consideration the Normal as well as extended feed Conditions.
- The DDC shall prepare detailed earthing and bonding plan for the Aqua Line Extension Corridor to ensure safety of equipment and human beings. For collection of data and drawings regarding structures requiring earthing, reinforcement bars and tracks, track-circuiting and signaling plans, the DDC shall interface with concerned designer/designated contractor.
- OHE Span is to be maximized and calculations supporting maximum span is to be submitted.
- Activities enumerated at Para 1 to 6 mentioned below w.r.t. OHE Works shall also be done in addition to above works.

The design should include the Lightening Arrestors at all switching posts in its design.

B. <u>ASS Works:</u>

The DDC shall submit the ASS design for Extension Line Corridor after studying of the ASS Systems of existing Aqua Line. Scope of ASS design shall include but not limited to the followings:

- Preparation of Auxiliary Power Supply scheme, consider future provision of RSS at Sector 123.
- Selection and sizing of Auxiliary Transformers, Power and Control cables, lightning arresters, isolators, bus bar arrangement, circuit breakers, CT's , PT's, metering panels and other equipment at each ASS.
- Interconnection of 33 kV Double Circuits at existing Sector-51 station ASS of NMRC for extension of supply in the Aqua Line extension corridor. DDC shall visit the existing ASS for assessing the requirements to have seamless integration between existing Sector 51 ASS and future ASS of Aqua Line Extension Corridor and incorporate the same in the design submissions and Specifications accordingly.
- To prepare the detailed equipment layout and other drawings & specification pertaining to ASS as per the land availability, site conditions, and track layouts keeping in view the various clearances to be observed as per applicable rules and standards.
- Preparation of Power Supply diagram for whole 33 kV network for full corridor including, elevated, involving ASS wise SLD, layouts, design calculations.
- Planning and Designing of earthing system for ASS, structures, gantries, cable sheath, foundations of various equipment etc.
- 33 kV protective covers,/ shrouds on terminals, etc are to be designed/identified as per Cable length and size for 33 kV feeder for transformer to be selected considering VCB switching transients.
- Prepare the layout of various indoor type auxiliary substations equipment layout, preparation of layout of control and distribution panel including indoor

circuit breakers, other switchgear and bus bar arrangements. DDC scope of work excludes the work of design of distribution and control for station load (design of distribution system at 415 V level and below).

- The power cable layout and its design shall be done for its compliance of IEEE 575.
- DDC to Plan & design Power and control cable run layout in the ASS premises, control room, cable trenches, supporting and clamping arrangement, cable termination etc.
- Activities enumerated at Para 1 to 6 mentioned below w.r.t. ASS Works shall also be done in addition to above works.

C. SCADA Works:

Existing section of NGN line is provided with Siemens make Traction SCADA and Siemens make SAS at both the RSS. DDC will prepare following options:

1. Extend the existing traction SCADA to new Section.
2. To replace the Siemens make SCADA of the existing section with the new SCADA and integrating the new sections on the new SCADA.
3. Providing standalone Traction SCADA for the new section.

DDC shall prepare the techno-commercial comparison of all above three options and shall prepare design, drawings and technical specification for the option approved by the Employer.

Activities enumerated at Para 1 to 6 mentioned below w.r.t. SCADA Works shall also be done in addition to above works.

D. Power Supply arrangement:

This work would involve working out the overall power requirement (both traction & auxiliary) for the Entire Aqua Line Corridor including extension as included in the subject Tender. The power required for property development is also to be worked out based on inputs by NMRC. The Headway Data, Train Parameters etc. as required by DDC for calculation of Traction Load, shall be provided by NMRC.

The scope of work under this Work would involve.

- Since new corridor is to be fed from the existing RSS, DDC shall study the maximum loading of each RSS during normal Power Feeding and during failure of any one of the RSS (N-1). Maximum loading of the each RSS is also to be extrapolated for the traffic projections of 2041, to be supplied by NMRC, for the scenarios, normal Feeding as well as N-1 scenario.
- DDC shall indicate minimum headway of the trains in the new corridor, which can be catered without augmenting any of the existing RSS.

- **Power for traction** This will be worked out by DDC by Calculating the Traction Power requirement. The Headway Data, Train Parameters etc. as required by DDC for calculation of Traction Load, shall be provided by NMRC. This will also take into

	consideration of regenerative braking.
• **Power for auxiliaries at stations, and along the line**	This will be worked out by the DDC on the basis of inputs from Employer pertaining to station E&M design.
• **Power for property development**	This will be worked out by the DDC on the basis of inputs from Employer pertaining to Property Development within the footprint of station building and/or in the vicinity of the structure.

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As a part of this Work DDC shall be required to prepare and submit Report on Power Supply arrangement for the entire Power Network, incorporating power requirements under varying train running conditions and headway in Normal operating conditions, Emergency operating conditions and designed headway as explained in Clause 2.4 of Outline Design criteria, and validate these jointly with NMRC.

The power supply arrangement proposed would give due consideration to power reliability. The scope of DDC in interacting with power supply authority is limited to technical aspects and legal/tariff negotiations are not in his scope.

Interface:

DDC will effectively interface with the designers/contractors of the Civil, structural, architectural, E&M, S&T etc. and provide and collect all details as are necessary, so that all the interface issues are in the designs and drawings are addressed and incorporated in the various submissions.

E. Designing of protection and interlocking scheme for each ASS, OHE Post:

- Design and prepare overall protection philosophy, protection settings, relay timings to ensure proper protection coordination from NMRC Extension Corridor for OHE and Auxilliary Networksupto RSS &Grid substation level using load pattern and power flow study. The protection scheme should take into account all parameters including relay settings at GSS, supply cables from Grid, the impedances of OHE and Cables.
- Designing of interlocking scheme for 25 kV OHE and 33 kV Auxilliary Network.

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F. Other Works:

- Prepare BOQ for the systems included in the scope of the tender, technical specifications and drawings, construction cost estimate, interface documents for the associated elevated construction contract for OHE, ASS and SCADA including all spares including maintenance vehicles & construction vehicles keeping in view the uniformity related with the various systems operational in the existing Aqua Line Corridor.

  Technical specifications shall be prepared considering the design of the equipment used in the existing section and as far as possible, should be of similar to the ones

used in the existing sections. All the tests including special tests shall also be included in the test schedule as per the latest standards.

- Make available their service as and when required during the construction activities for amendments/modifications as applicable, if any, in the existing designs/drawings incorporating any site unforeseen site conditions, as applicable.

The DDC will be required to make their services available for providing additional details, modify drawing and issue clarifications whenever required during the construction phase. This would involve attending meeting at design office at Noida whenever required. The DDC shall assist the Employer in approving the as built and other drawing prepared by the construction contractor.

The attendance of DDC at site, if required by employer for construction activity will be payable separately on man-days/visits basis as per rates agreed in the contract.(Activity-II) (Excluding attendance required for design review/clarification/interface meeting, etc.)

Activities to be performed:

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1. SERVICES TO BE PERFORMED BY THE DDC PRIOR TO THE AWARD OF CONSTRUCTION CONTRACTS.

1.1 Available information

The DDC shall study and take guidance from all the available information including those made available during design e.g. DPR of Noida Metro and drawings issued or made available as per the scope of services to carry out all necessary analysis, and request any further information or data which is necessary for its design development from the Employer's Representative which will be provided if available. Any data, information, standards not available with the Employer shall have to be collected by the DDC at their own cost.

1.2 Additional information

The DDC shall, if so required, carry out field survey and soil investigations wherever required. The cost of these services shall be included in the Lump sum set forth in the Agreement.

1.3 Ministry of Railway (RDSO) Approvals, as applicable

If any new type of Overhead mast, Structure or equipment is proposed to be used, its safety worthiness will have to be evaluated and sanction of Ministry of Railways will have to be obtained. Detailed investigation and testing will have to be done in this connection.

The DDC shall prepare requisite design reports, calculations, drawings, test criteria, test procedures etc. as are necessary to obtain the Ministry's approval. The DDC should be in a position to provide necessary support (have experts with adequate qualification, knowledge and experience) to assist NMRC for effective interaction with Indian authorities viz. Ministry of Railways, RDSO and Commission of Metro Rail Safety (CMRS).

1.4 The DDC shall prepare detailed designs based on the principles of Existing Aqua line of Noida Metro and Design Criteria. Any critical difficulty identified shall be immediately brought to the attention of employer's representative, but not withstanding that, the DDC shall remain totally committed to the overall integrity of the design, if necessary actively seeking advice, information and clarification so as to avoid abortive work.

The DDC's design shall take into account the installation requirements of the system wide information. The DDC shall prepare detailed designs based on the principles of program for the inclusion of these requirements at a later date as these may not be finally determined until after the award of the system wide contracts. The DDC shall incorporate the requirements of the system wide contractors into its design as appropriate and as they become available. DDC will be required to suitably interface with designer/contractor of various systems for their proper interface/interconnection with the Elevated portion (with specific reference to OHE, internal 33kV cable, earthing & bonding systems etc). Further the SCADA system design has to take into account 25kV switching station and 33kV station ASS.

1.5 List of drawings

The details by DDC of various drawings which would be required to be submitted are as under: The soil testing report for the foundation design for the depot will also be done by the DDC.(the list is not exhaustive and if necessary additional drawings may also be prepared by the DDC without any additional cost.)

TRACK ELECTRIFICATION FOR MAIN LINE & DEPOT

- Pegging Plan
- OHE layout drawing
- OHE profile drawing
- Cross section drawing
- Structure Erection Drawing
- Feeder drawing
- Dropper Schedule

POWER SUPPLY DISTRIBUTION, SWITCHING STATIONS AND BOOSTER TRANSFORMERS

- Total Supply System Layout Plan, Location plan for Power Installations and Power Schematic diagram.
- Single line diagram of ASS and OHE system
- Protection drawings of OHE Posts & ASS
- Location plan and schematic diagram
- Layout drawings of ASS & Switching stations
- Power and control cable run layout diagram
- Structural assemble and structures drawings
- Foundation layout drawings
- Control room panel layout diagram
- Control, protection scheme and metering arrangement drawing
- Earthing system layout drawings for ASSs and 25kV system.

SCADA SYSTEM

- General arrangement drawing
- Overall layout diagram
- Power supply Schematic and wiring layout diagram
- Control wiring and equipment interface diagram
- List of other special drawings.

OTHER GENERAL LAYOUT DRAWINGS

- Fencing layout
- Bonding/Earthing layout
- Miscellaneous drawings
- Employment Schedule and charts
- The DDC shall review and furnish following typical drawings for traction overhead equipment, power supply distribution system including switching posts
- Uninsulated overlap
- Insulated overlap
- Termination arrangement
- Neutral section arrangement
- FP/SP/SSP/SS feeding arrangement to OHE
- Through bare conductor
- Through cable
- Jumpering arrangement of various equipments of sub stations.
- Cable laying profile diagram at grade and viaduct
- Any other drawing required for proper execution of work

1.6 Track electrification drawing

Pegging Plans

The pegging plans indicating the location of OHE structures, arrangement of overhead equipment and other general particulars are to be prepared.

OHE layout diagram

- The OHE layout plan incorporating following information shall be submitted:
- The run of wires in different thickness or colour in special cases and terminations.
- The run of wires for future wiring indicated to the contractor, in dotted lines
- Exact position of all cut out-in-insulators, including section insulators
- Direction and value of stagger at each traction structure location
- Clearance of live conductors to structures in the vicinity including bridges, signals, gantries etc.
- Layout of feeders
- Jumper connections and connection to switches and switching stations

- Location and numbers of switches
- Schematic sectioning diagram drawn to a convenient scale showing section insulator number of switches, elementary sections and connections to switching stations.
- Tables giving references of approved profile drawings, feeder layout plans and other relevant drawings.

OHE profile drawings

After completion of the overhead equipment layout plans, the contractor shall prepare an overhead equipment profile drawing showing the actual height of the contact wire under each over line structure the gradient and height of the contact wire on either of structure and the encumbrances at structures until normal height of contact wire and encumbrances are restored.

Cross section drawings

Cross Section drawings for each structure showing guy rods, if any, indicating the cross section of formation/viaduct, height and nature of bank, whether new or old, nature of soil, type of foundation block, structure proposed, reverse deflection of the structure and all necessary particular for erection of the foundation.

Structure erection drawing

The DDC shall prepare structure erection drawings indicating track layout, cantilever arrangement and stability analysis of cantilever, height of contact wire, catenary wire, stagger, setting distance of masts etc.

Feeder drawings

On the basis of these general alignment drawings, the DDC shall prepare and submit the longitudinal profile drawing for the feeders running from Noida Metro, SP, SSP and BT stations to OHE showing the details of structures, jumpering arrangement and the clearances of live conductors from ground. After approval of these drawings, the DDC shall submit drawings for the foundations and structures proposed to be used at locations of supporting structures.

Dropper Schedule

The DDC shall submit dropper schedule for various span lengths and encumbrances covering overlaps neutral sections turnouts crossovers and any other typical locations after reviewing the dropper schedule adopted over Existing line for Noida Metro.

1.7 Power Supply distribution, Switching stations and Booster transformers drawing

Location Plan and Schematic diagram:

- The DDC shall prepare the location plans and schematic connection diagram for, all the switching stations, booster transformers and auxiliary substations of the stations and depots incorporating following details:
- OHE/Track layout in the vicinity of the receiving cum traction substation, switching stations and BT location.
- Location/orientation of feeding post, other switching posts BT and arrangement of cross and longitudinal feeders to be anchored, if any, including jumper connection with the OHE and busbar of switching posts.

- Location of auxiliary substation w.r.t the station building and other land-marks including cable entry and exit.
- Scheme of connection of the interrupters and other equipments.
- Fencing out line at the, ASS, switching posts and BT locations.
- Auxiliary substation, switching station layout drawings.
- Layout drawing for ASS and switching stations indicating the arrangement of various equipment, bus bar arrangement, cable run layout, location and position of the pedestal insulators on different structures, high level/low level gantries and other steel framework and fencing. The drawing shall also indicate the space requirement and clearances for each equipment, structures and control room within the earmarked land area for the substation and switching posts.

The drawing shall also give a schematic connection diagram and an isometric view of bus bars and their connections. The drawings shall include sectional elevation views at various cross sections of the switching posts to cover plan and sectional views at the level of transmission line conductor/cable termination, busbar/; Insulators/Isolators beams, CT,VT and LA's beams as applicable .Drawing shall include the schedule of all equipment required along with drawing references of details of these equipments.

Power and control cables run layout diagram, including cross section drawing.

These drawings shall indicate the power and control cables run ASS and switching stations premises and power cables run layout along the section. The layout drawing for cable run along the section would include cross section drawing for each typical location showing erection arrangement, spacing and also space for S&T and other system wide cable. The drawing shall indicate the details of cable trenches/cable-ducts/basement trays/conduits/trough/under platform voids/cable hangers and other cable supports. The cable joints and end terminations shall be shown in the drawing apart from indicating interconnection of cables between various equipment and SCADA cubicles, control panels along with schematic arrangements and physical disposition of equipment, colour coding/ code numbering and index scheme adopted for terminals. The drawings shall also indicate the cable size grade of insulation (also voltage grade for which cable is meant) and quantity of each cable. Cable route shall also show the important landmarks and cable route indicators. The DDC shall submit separate drawing of each ASS, switching stations and along the corridor. The DDC shall check the design and capacity of 33 kV voltage level cables as submitted by the other contractor keeping into consideration of cross bonding, wherever required, and also check the design of cross bonding scheme accordingly.

Structural assembly drawings for switching posts and BTs indicating the steel structures for mounting individual equipment, high level steel structures and other steel frame works/ assembly shall be prepared. The drawings shall also have a schedule of component members along with reference of various members. The weight of component members shall be indicated in the separate weight and drilling schedule.

Foundation layout drawings

Foundation layout and cross section drawings for each ASS, switching stations and BT locations shall be prepared indicating the layout of all the foundations in plan, transverse cross-section of various foundations through center line of structures and all equipments. The drawing shall show the details of foundation of various structures, gantries, equipment mounting structures, circuit breakers, interrupters, transformers etc. cable trenches and

fencing uprights. All foundations shall be marked serially on the drawing and listed in a schedule on the drawing indicating the volume of concrete for each foundation blocks.

Control room panel layout diagram

The diagram shall indicate the physical layout of various control and protection panels e.g. transformer protection panel, circuit breaker and interrupter control panel, SCADA panel, 415 Volts LT distribution control panel of ASS, AC/DC power supply distribution board, incoming and outgoing power supply control panels, battery sets and chargers and any other such equipment's/boards/panels inside the substations and other switching posts building/control room. The drawing shall mention the size (length, width and height) of panels, location, distances from the walls/trenches and other such measurements details. For indoor substations (like ASS of station),location of the transformer and HT/LT cabling route shall also be indicated .Size of ASS room to be optimized after considering all equipment sizing and space optimization.

Control, Protection scheme and metering arrangement drawing.

1.8 Drawings for control, protection scheme in all the ASS and metering arrangement of ASS shall be prepared in detail to facilitate award of construction contract.

1.9 SCADA drawing

General arrangement drawing

Drawing for general layout arrangement of various SCADA equipment. This shall indicate the size and location of various equipment viz master computer, interface/server equipment between master and RTU, work stations, printers, MDB communication facilities, power supply equipment like UPS, battery, battery charger and other relevant details.

Power supply schematic and wiring layout diagram

This drawing shall indicate schematic arrangement of power supply system feeding to all SCADA equipment of OCC and BCC and RTUs in ASS and other switching stations. It shall also show alternate power supply scheme from UPS/battery, wiring/cable layouts/routes, distribution boards and other such details to facilitate easy detection of fault and corrective action.

I/O schedule and corresponding cable schedule of SCADA for ASS, OHE, switching stations, SP, FP etc.

Control wiring and equipment interface diagram

This drawing shall indicate the schematic details of master equipments, RTU's and Mimic Diagram Board indicating therein all the equipment to equipment interface connections.

List of other special drawings

The DDC shall prepare a list of other important relevant drawings of SCADA equipment like hardware configuration, component level wiring and connection diagram and drawings for integrating Aqua line extension SCADA with existing SCADA systems and other minute drawings to be submitted by the construction contractor later on.

1.10 Other general layout drawings

Fencing layout plan

Fencing layout drawing for each switching station, BT station, Auxiliary sub-station indicating the layout of the entire fencing and anti-climbing device in part shall be prepared. Each up-right, fencing panel and fixture on the up-right shall be indicated on the drawing by its

reference number. A schedule of components viz. up-rights, panels, fixtures and barbed wire shall be included in the drawings indicating the drawing references of components .An individual drawing shall be made for each type of panel, fencing post and fixture for mounting the anti-climbing device. The drawing of each fencing post shall indicate the unit weight of the fencing post. The design of the fencing should also match with the station building architecture.

Earthing layout plans

Earthing layout drawings for OHE systems on elevated decks, each complete ASS and Switching station indicating the layout of full earthing system/earthing mat in plan shall be made. The drawings shall show the location of earth electrodes and earth pits and mark the runs of earthing strips and connections, to each equipment and structures, fencing post, fencing panel and control panel. All components shall be marked with their reference numbers. For future details of the runs of conductors and connections, separate drawings, which may be common to all switching stations, may be made and references to these drawings marked on the layout. A schedule of components shall be made out in the drawings giving drawing references of components. The SCADA earthing system shall be separate and not connected to power supply earthing network.

Miscellaneous drawing

Miscellaneous drawings applicable to all ASS, BT station, SCADA system and switching stations shall be prepared. These drawings shall include drawings or sketches made for study of clearances, scheme of interlocks, number plates of various equipments, caution and instruction boards, outriggers for busbar support and non-standard bus bar connectors.

Employment schedule and charts

The DDC shall prepare employment schedule and charts for:

- Volume charts and equivalent chart for foundation of OHE structure.
- Employment schedule for pure gravity type of foundations if any or other arrangement for OHE and all other type of substation structures for various direct loads and bending moments.
- Employment schedule for all other foundations for various depths of parent soil from the datum level.
- Employment schedule for masts/structures.
- Dropper schedule.
- Sag tension charts for cross feeders for various spans and tensions.
- The DDC shall co-ordinate its design with the relevant agencies and interfacing DDC's and contractors.
- The Employer's representative shall provide the DDC with the relevant data for the preliminary track alignment. The DDC shall verify/adjust the alignment data as necessary and prepare the plan and profile sheets as required for the Tender Documents.

1.11 Deleted

1.12 System wise Requirements

For system wise requirements preliminary information in the form of preliminary Civil Engineering chainage shall be given to the DDC. The DDC has to make liaison with the system wide DDC/Contractors to get additional information.

During the detailed design phase and continuing through the construction phase the DDC shall coordinate with the Employer's Representative, and other system wise DDC's to obtain systemwide requirements such as station layouts, signaling location, cross over locations, via duct arrangement. The DDC shall attend layout and station building compatibility review meeting during design stage.

During design and continuing through the construction phase, the DDC shall revise the completed or partially completed drawings to incorporate the additional systemwide requirements.

Additional layout details and system wide requirements requested by systems and Civil Engineering Contractors during design/construction shall be incorporated into the drawings. Sub-section 2.2 describes construction stage services regarding system wide requirements.

1.13 Interface with other system wide design consultants/contractors/utilities.

The DDC shall co-ordinate all design work with various systemwide consultants/contractors/utilities including but not limited to:

- Interface with via duct construction DDC/Contractor for informing the location and design of OHE structures and foundations.
- Interface with station building DDC/contractors so as to finalize details of structure foundations and method of supporting the OHE at stations and for suitably locating the BT, SP and SSPs.
- Interface with other system wide DDC/Contractors viz. signaling and telecommunications, rolling stock and other systemwide contractors.
- Employers representative/System wide Contractors for interfacing SCADA with OCC.

1.14 **<u>Construction Cost Estimates</u>**

The DDC shall prepare and submit to the Employer's representative, construction cost estimate for complete **ASS, cable network, SCADA system, switching stations and OHE for depot and main line under separate heads.** This estimate shall be based on quantity take-off from prepared drawing's but where no drawings exist the quantities shall be determined by using similar job information and typical relationship of quantities. All modifications of the cost estimate before contract award shall be in the DDC's Scope of Services.

The estimate shall show the unit rates and quantities adopted and shall give details of methodology for adopting the unit rates. Due considerations will be given to rates accepted on existing line of Noida metro for similar works and/or rates accepted in the other metros for similar works of substantial magnitude. The estimate shall be broken down into separately identifiable sections of works as directed by the Employer's Representative. The DDC shall prepare input cost estimate data and submit in accordance with Section pertaining to Submission of Documents herein.

The Employer's Representative shall review design drawings and prepare a Bill of Quantities separately to verify the DDC's take-off from the prepared drawings. The DDC shall revise the Bill of Quantities as required by the Employer's Representative and modify the Cost Estimate accordingly.

1.14 Documents and Drawings

The tender documents for the construction contract shall be finalized by the Employer representative. It shall be DDC's responsibility for preparing draft material for these documents in electronic format based on documents issued by the Employer's Representative. The DDC shall prepare the Bills of Quantities, Special Conditions of Contract and detailed technical specifications, drawings including the Scope of Work. The DDC shall assist the Employer representative in the preparation of any other documents as required. In general, the DDC shall try to follow the format of tender of existing line of Noida Metro(including subsequent amendments up to date and Technical Instructions if any) but would also incorporate changes as are necessary based on experience of existing line of Noida Metro and/or specific features of the section.

1.15 Amendments to Documents

The DDC shall provide such further pertinent information not included in the Tender Documents as may be required by the Employer's Representative. This shall include, but not be limited to:

Amendments to documents and drawings arising from tenderer's questions.

1.16 Construction Drawings

The DDC shall submit to the Employer's Representative, prior to the award of each construction contract, a complete set of "For Construction" contract drawings for that contract that has been produced as a coordinated package. The DDC shall also furnish a complete sets of CAD file CD/DVD/PEN DRIVE for contract drawings. The CD/DVD/PEN DRIVE shall be fully compatible with the Employer's Representative computer system.

2. SERVICES TO BE PERFORMED BY THE DDC DURING CONSTRUCTION

Services during construction shall be deemed to commence for each construction package on award of this construction contract. The DDC would be required to extend services as indicated in scope of work. DDC shall deploy required staff during the construction stage in case necessitated by the Engineer/Employer. The attendance of DDC at site, if required by employer for construction activity will be payable separately on man-days/visits basis as per rates agreed in the contract. (Activity-II) (Excluding attendance required for design review/clarification/interface meeting, etc.)

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2.1 Contract Drawings

Additional contract drawings or revisions to the contract drawings previously issued for construction shall be prepared by the DDC and submitted to the Employer's Representative. Where changes to the contract drawings are required, the DDC shall be responsible for preparing all data related to the detailed design onto drawings to be issued to the Contractor. The Employer's Representative will then issue the drawings to the contractor for construction of the Works.

2.2 Systemwide Information

The DDC shall incorporate full and final information relating to systemwide equipment and services into suitable drawings. The timing for issue of these drawings will be determined by the Employer's Representative dependent upon the award of the systemwide Contracts. Final systemwide requirements defined by systemwide contractors shall be incorporated into the

drawings for construction. The DDC shall prepare and issue intermediate submissions of the drawings as necessary to meet the constructions schedule.

2.3 Site Meetings

DDC shall attend site meetings when requested by the Employer's Representative.

2.4 Site Visits

At the request of the Employer's Representative the DDC shall visit the site to provide his expert opinion on the performance, quality, progress etc of the Works and to report whether the work is progressing generally as designed. The result of such visits shall be reported to the Employer's Representative immediately, if urgent actions are required.

2.5 As-Built-Drawings of the works

The DDC shall review the contract record drawings and as-built drawings information submitted by the contractors to the Employer Representative on a continuous basis prior to the issuance of the Certificate of Completion for the construction contract. The DDC shall prepare relevant calculations reconciled with as-built conditions, and information necessary for the maintenance of the works.

2.6 Co-ordination with Construction Contractor& Designer

During the construction phase, the DDC shall be responsible for expeditious implementation of the evolved designs and sorting out any design interface problems with the construction contractors and other contractors working on the section including the depot.

3. ORGANISATION OF THE DETAILED DESIGN CONSULTANT

3.1 General

The DDC shall establish an efficient organization for carrying out all services according to program requirements. The organization shall provide effective management of the Works of the contract including those that must be carried out concurrently by separate disciplines and teams. The organization shall also ensure that all information that becomes available during the design period is directed to the appropriate design teams and effective checking procedures are continuously maintained to ensure that required standards are met.

Upon its appointment, the DDC shall promptly commence setting up its organization to the satisfaction of the Employer's Representative, which shall be same as mentioned in Clause 1.1.3.4 of NIT.

3.2 Performance

Notwithstanding any review of its organization structure, staff or manning schedules, the DDC shall remain wholly responsible for providing the services. If, in the opinion of the Employer's Representative, the progress or performance of the DDC's work is seen to be at any time inadequate to meet those requirements, the DDC shall take the necessary steps to improve them on being so notified. If within a reasonable period the DDC has not improved its progress of performance, the NMRC may by written notice require it to take additional measures, including changes in its organization, at no additional cost to NMRC .Such notice shall be in no way deemed to constitute a waiver of NMRC's rights to terminate the agreements by reason of the DDC's breach of contract. Failure by the NMRC to issue such a notice shall not relieve the DDC of its obligation to achieve the required rate of progress and quality of work.

4. STANDARD OF SERVICES

4.1 General

The DDC shall be responsible for correctness and technical merit of its design, calculations, drawings and all other documentation prepared by it in carrying out the services.

The DDC shall ensure that qualified and experienced staff are employed in sufficient number and that accurate, consistent, clear and easily read drawings and documents are produced in time.

The DDC shall comply with the provisions and procedures covering standards and codes, drawings and calculations outlined in section 4.2 below. The DDC shall also comply with the checking procedures in section 5 hereof.

4.2 Standard and Codes

The standards and codes referred to in the design criteria, drawing, and documents issued by the Employer's Representative to the DDC shall be used in it's design and where appropriate ,shall be quoted on drawings and other documents by it. Normally the DDC shall use the Standard given in it's design requirements in preference to other national standards except when higher standard or better quality is required. Should the DDC propose to adapt other standards or codes for its designs, it shall submit to the Employer's Representative copies thereof, together with a statement as to the cost implication of adoption and substantiation that substitution is necessary. The DDC shall also demonstrate that other standards are equivalent or superior to those they intend to replace and it shall obtain the written approval of the Employer's Representative prior to adoption.

4.3 Extent of Information

All designs and documentation produced by the DDC shall provide sufficient information and detail for tenderers to determine accurately the extent of the works, submit firm prices and during construction, execute and maintain the works.

Tender and Contract Drawings, specifications and other information produced by the DDC for construction, or revisions of such documents, shall be submitted to the Employer's Representative, in sufficient time for review and further issuance of a comprehensive package to the contractor. The DDC shall ensure that these documents are produced in a timely manner such that the construction contractor is able to plan and execute its works in accordance with the contract, including the construction program.

Drawing for construction shall be in such details as not to require further design or detailing to be carried out by the construction contractor except as provided under Section 4.5 hereof. The drawings to be prepared by DDC shall show or include of any unusual features of construction.

4.4 Calculations

Calculations shall be prepared according to the best professional standards and compiled into sets that relate to particular aspects of design.

Each set of calculations of OHE, Power Supply (both traction and auxiliary)and Remote control (SCADA) system design shall include, but not be limited to a method statement including:

- Power & Voltage at farthest ends of the Aqua Line extension corridor taking feed from each TSS & AMS of existing NMRC Aqua Line at normal &extended feed conditions are within acceptable limits for trains and Auxiliary system.
- A brief description of the OHE and Auxiliary substation structure design.

- Size of equipment foundation.
- Size of cables, traction conductors, earthing conductors/busbars.
- This would give due consideration in laying method, derating factors, voltage drops & other such factors before working down the final result.
- Capacity of transformers of ASS's, circuit breaker, interrupters, disconnecting switches booster transformers, Instrument transformers and other equipment.

Due consideration should be given to the load cycle based on the Train operation, and the transformers to be designed for maximum efficiency accordingly. All other associated equipments & items are also to be designed accordingly.

- Power factor correction equipment in substations.
- A brief statement/description of the method of analysis used.
- A brief statement/description of the method of design.
- Details of the computer programme used
- A key to symbols used and
- A design summary
- Any other relevant calculation pertaining to design work.

Each set of calculations shall be bound and shall include a cover sheet and index. A statement certified by the DDC'S authorized representative that the accepted checking procedures, as defined in section 5, have been carried out in full shall be attached to each set of calculations submitted to the Employer's Representative.

Original calculations shall be submitted to the Employer's Representative for proof checking. Each sheet shall be signed in accordance with the requirements of section 5.Original calculations shall be returned and retained by the DDC and shall be produced at such times as may be required by the Employer's Representative. The original calculations shall then be handed to the Employer's Representative on completion of the services.

4.5 Drawings prepared by DDC

Preliminary, Tender and Contract Drawings shall be prepared and issued by the DDC in accordance with the current requirements issued to it by the Employer's Representative (refer to Section 7 for submission of documents)

All drawings shall be prepared in A-1 size and shall be produced by CAD graphic system compatible with the NMRC system and as approved by the Employer's Representative. Drawings are defined as:

- Preliminary drawings are drawings prepared by the DDC prior to their acceptance by the Employer's Representative as Tender or Contract Drawings.
- Tender Drawings are drawings prepared by the DDC and approved by the NMRC which, with other relevant documentation, contain all the information necessary for tendering purposes; and
- Contract Drawings are drawings that have been prepared by the DDC from Tender drawings that have been approved by NMRC and which, together with other relevant documentation, will form the Construction Contract. The Contract Drawings shall be stamped "issued for construction" and will be added or revised as noted in Section 2.1.

Following drawings are excluded from the DDC's scope:-

- Shop drawings and working drawings
- Fabrication drawings;
- As-Built drawings; and
- Details of elements of proprietary systems.

DDC shall submit to the Employer's Representative as part of a progress register, a list showing drawing numbers, titles, scales and the progress status of all drawings planned for inclusion in the documents for obtaining tenders. The format of the progress register shall be as directed by the Employer's Representative. The DDC shall update the register as required .All drawings shall be checked for compliance with design specifications and for accuracy by the DDC's design staff and shall also be subjected to the checking procedures as detailed in Section 5 hereof.

4.6 Drawings prepared by Construction Contractors

The drawings excluded from the DDC's scope above are to prepared by the construction contractor.DDC shall however assist the employer in their scrutiny/comments.

4.7 Documents

Documents shall be prepared by the DDC in accordance with the requirements issued by the Employer's Representative. Documents produced by the DDC shall be listed as part of the Progress Register.

4.8 Computer Programs

The DDC shall submit details and verification of all computer programs it intends for use to the Employer's Representative for acceptance prior to use in making calculations. These shall include the computer program manuals, input and output printout of a typical example and previous records of its use by the DDC. The DDC may also be required to perform test calculations using the program so that the results may be compared with those obtained by other means.

5 CHECKING PROCEDURES

5.1 General

Deleted.

5.2 Validation of Design and Installation

Deleted.

5.3 Deleted.

5.4 Design Calculations

Each page of design calculations, including any amendments thereto, shall be endorsed as checked and approved prior to issuing to the Employer's Representative by being initialed and dated by both the originator and the checker.

5.5 Drawings and Documents

Each document and drawing, including any revisions thereto, shall be endorsed as checked and approved prior to issue to the Employer's Representative by being initialed and dated by both originator and checker .In addition to compliance with the requirements of the

documentation each drawing, where appropriate, shall be checked to ensure compliance with the DDC's certified design calculations.

5.6 Certification

Certificate signed by the Project Manager of the DDC or his accredited representative stating that all drawings and documents have been checked and approved in accordance with the agreement, shall accompany all documents and drawings issued by the DDC to the Employer's Representative for acceptance.

5.7 Quality Assurance Plan

The Quality Assurance Plan (QAP) shall be submitted by the DDC to the Employer's Representative for approval before any work is submitted by the DDC for approval by the Employer's Representative.

- Organizational structure.
- Design control-including study and design input/analysis;
- Checking of documents
- Documents control;
- Subcontractor control;
- Internal quality audit; and
- Corrective action;

The DDC shall also identify the requirements of Quality Level List in the QAP for the contract.

5.8 Not used.

5.9 Responsibility

Notwithstanding acceptance by the Employer's Representative, the DDC shall remain responsible for the quality of the documents.

6 DESIGN SUBMISSION AND REVIEWS

6.1 Inception report – The DDC on mobilization would submit an inception report indicating the details of manpower deployment and strategy for delivering the work as per required time frame and comparative study as required:

6.2 A detailed methodology and action plan will also be submitted. Appendix B3 for "Schedule of Payment" may be referred in this regard.

6.3 Design Submission

The DDC shall prepare and present calculations and drawings describing the design which shall at a minimum include

- Report on power supply arrangement
    - Detailed Design Consultant will submit detailed feasibility cum techno economic comparative studies for: -
        - With 25 kV BT/RC (OHE & PSI)
        - Without 25 kV BT/RC (OHE & PSI)

DDC to submit the detailed comparative study report for all the above 2 options and submit its recommendations for the best option, with drawings based on which NMRC may decide the system to be followed for OHE and Power Supply

- Sectioning diagram for main line
- Auxiliary supply schematic .This would include design of the run and installation of 33kV auxiliary power cables along the corridor.
- The design calculations as detailed at item 4.4
- OHE pegging plan, OHE layout drawing & OHE profile drawings.
- OHE configuration in via duct, at grade and stations
- Arrangement of OHE termination at anchor points
- Earthing & bonding arrangement
- Switching station layout and their connection to OHE
- BT layout if placed in gantry on via duct or at platform end or under deck to located BT and switching stations at one end of the platform.
- Design of auxiliary power substations(ASS) at each station
- Design of the overall protection scheme for OHE ,power supply and auxiliary network.
- Design of SCADA system.

6.3.1 Progress Review Meeting

DDC shall attend such meetings whenever required by employer's representatives.

6.4 Intermediate submission

When the design, including design drawings, Bill of Quantities and specifications, is substantially developed by DDC to define the works including locations, shapes and size, it shall be submitted to the Employer's Representative for review. After review these shall be advanced adequately for submission by NMRC to the Ministry of Railway as described in sub-section1.3.

- Documents for Ministry of Railways approval (as applicable).
- Design calculations incorporating corrections/modifications, as required.
- Technical specification in sufficient detail of material and workmanship to permit tenderers to tender for the work.
- Drawings detailed in item 1.5 (including drawings submitted at design submission stage) to define the Works and others as are necessary.
- Bill of Qualities for all the works in sufficient accuracy (with take off sheets) to be able to proceed to Tender.
- An updated draft Design Report which shall include studies undertaken by the DDC.
- An outline Construction Program with consideration of alternative construction methods. If appropriate.
- Initial construction cost estimates, with their basis including references of last accepted rates, budgetary costs etc, including construction cost estimates. The accepted rates of

existing Aqua Line for various items will be made available by the employer's representative.

- Any other documents that may have been requested by the Employer's Representative.

6.5 Intermediate Review Procedure

The Employer's Representative will complete the review of intermediate submission by DDC, and furnish the DDC with his review comments either in writing or on marked up drawings. Within 7 days of receiving the comments, the DDC shall meet with the Employer's Representative to discuss the review comments such that further actions can be determined for the DDC to proceed with its services in a timely and efficient manner. Within seven (7) days of this meeting the DDC shall deliver to the Employer's Representative copies of the minutes of the meeting together with its responses to all comments.

6.6 Submission of Documents for ministry of Railways Review (As applicable)

The DDC shall submit all the technical documents necessary for NMRC to request approval from the Ministry of Railways for use of the Noida MRTS. Documents shall include:

- Appropriate design reports
- Design assumptions
- Calculations
- Drawings
- Test Procedures
- Required test results

6.7 Final Review Submission

When the design and drawings and other details required are substantially complete, the DDC shall submit the documents for the Final Review to Employer's Representative. The quality of this submission shall be such that the entire work can be executed using these documents & all items indicated in scope of service of DDC are covered. The final proposal of DDC after duly modifying/updating all the documents submitted at this stage. Documents submitted for final review by Employer's representatives shall include but not limited to:

- Design calculations which are indexed and checked.
- Drawings sufficiently detailed to define the works, complete and checked
- All design report including specific actions which are necessary to complete the design
- A detailed implementation Schedule detailing the various interfaces during construction stages with other contractors
- A detailed description of the assumed construction methods
- Bill of quantities with quantity take of sheets
- Construction cost estimates with their basis
- All Particular (Technical) specifications and other details required for tender invitation
- General specifications, General& Special conditions of contract. These will be prepared by reviewing existing aqua line jointly with the employer's representatives.

6.8 Final Review Procedure

The Employer's Representative will complete the Final Review of all details submitted within approximately twenty(20) working days, and furnish the DDC with his review comments either in writing or on marked up drawings .Within seven(7) days of receiving the comments, the DDC shall meet with the Employer's Representative to discuss the review comments such that further actions can be determined for the DDC to proceed with its services in a timely and efficient manner. Within seven (7) days of this meeting, the DDC shall deliver to the Employer's Representative copies of the minutes of the meeting together with its responses to all comments.

6.9 Submission of Final Design

These design documents shall be those comprising the Final Review Submission after incorporating the comments of the Employer's Representative. These documents are final design documents, acceptable for issue as part of the Tender Documents for the construction contract. This shall include complete tender documents for floating of tender besides other details.

6.10 Delivery of Documents

After the Employer's Representative has accepted the submission of the final designs, the DDC shall deliver in electronic format on CD/DVD/PEN DRIVE all Documents prepared by it to the Employer's Representative. Original full size Tender Drawings shall be ready for reproduction. The original documents, typed but not bound, shall have been proof read, reviewed, approved and certified, and be ready for reproduction. The DDC shall furnish a complete set of CAD drawings in CD/DVD/PEN DRIVE to the Employer Representative, prepared in accordance with requirements within 60 days of the submittal of the original drawings.CAD drawings File Control log, which describes the contents of each of the CAD drawings CD/DVD/PEN DRIVE, shall also be furnished.

6.11 Delivery of Documents to construction contractor

The DDC shall issue the documents to the Employer's Representative for issuance to the contractor "For construction". This shall also include all "Good for construction" drawing containing all details required by the construction contractor for execution of the work.

SUBMISSION OF DOCUMENTS

The DDC shall deliver the drawings and documents as listed to the Employer's Representative, and packaged as directed by the Employer's Representative.

a. Quality Assurance Plan

Copies of the Quality Assurance Plan

b. Intermediate Review Submission

This submission shall be made in three sets.

c. Final Review Submission

This submission shall be made in three sets.

d. Submission of final design & Tender documents.

This submission shall be in five sets .This shall also be accompanied by soft copies of all documents & drawings required to be issued for construction tender.

e. Submission of documents.

This submission shall be in three sets of hard copies. In addition one set of reproducible drawings and two sets of soft copies shall also be supplied.

f. Delivery of documents for construct contractor

This shall include 4 sets of all the details required to be issued to construct contract contractor. The Good for Construction drawing will however be submitted in 7sets.