

## **Annexure 6.13**

### **(Section 6: Scope of Work)**

#### **CHAPTER 1**

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#### **SERVICES TO BE PERFORMED BY THE GC PRIOR TO THE AWARD OF CONSTRUCTION CONTRACTS:**

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##### **1.1 Detailed design of the alignment**

GC shall be responsible for detailed design of alignment and prepare a review report about strategic proposed station location, location of the stations Entry/ Exit based on Land-Take Plans and topographical survey.

###### **1.1.1 Scope of services**

Detailed geometric design of the track alignment including all elevated, underground, ramps and connection to Depot. The design shall be carried with the relevant standard practice/codes/NCRTC SOD by using an internationally accepted software.

The detailed geometric design shall include the details of the horizontal and vertical curves be supported by detailed calculations, wherever necessary. The GC shall submit the alignment drawings in soft and Hard Copy along with reasons and details of alternate options explored for the stretches where speed potential is less than 180 Km/h in elevated section & 140 Km/h in underground section. The speed potential at tunnel portal/entry/exit shall be planned equivalent to the underground section and necessary requirements such as funnel/trumpet shaped portal, pressure relief vents etc. shall be planned and suggested in concept design. In case of non-feasibility due to site-specific constraints, specific approval with detailed reasons shall be taken from NCRTC on case-to-case basis.

It is to note that the alignment design requires multiple iterations due to various considerations and GC shall incorporate all the comments before final approval, Also GC shall support in alignment modifications during execution of Civil works due to site conditions and provide revised drawings till contract period of GC.

###### **1.1.2 Alignment design based on topographical survey**

The GC shall work on the alignment design for maximum design speed of 180 km/h and operational speed of 160 km/h after receiving the survey drawing from NCRTC for the said stretch and in brief the services shall include:

- a. Desk study of available data, documents, drawings and maps.
- b. Field visit(s) as required.
- c. Preparation of Alignment DBR, getting approval from NCRTC of the same before moving ahead with alignment design.
- d. Review of Concept Alignment Design (DPR Design) received from NCRTC based on approved DBR, Suggestion for modifications / improvements, based on the Final Survey conducted by NCRTC.
- e. Preparation of Track Diagram based on DPR and discussion with NCRTC and getting approval from NCRTC of the same before moving ahead with alignment design.
- f. Consideration of approved Track Plan in the planning of viaduct structural arrangement. No expansion joint shall be provided in the turnout zone from SRJ to BOC and accordingly all turnout locations to be planned as continuous spans.
- g. Geometric design of the track alignment (Centre line of girder, Up & DN tracks) including finalization of track layout diagram for all stations including connecting lines.
- h. Design of alignment geometry, suitable for 180 km/h design speed, in horizontal and vertical planes for UP and DN lines, following the parameters of SOD and meeting with the

requirements of NCRTC, using internationally accepted software (Bentley Open Rail designer/Autodesk Civil 3D).

- i. Alignment design shall be done on basis of shared Survey and ground level data. Approved alignment will be transferred on ground by NCRTC/Contractor. GC shall incorporate modification in alignment if any discrepancies is found or modification is required for constructability/site constraints.
- j. Joint review of the alignment design post site verification by NCRTC. Incorporation of remarks on the alignment design from the client and other stake holders. Modifications to alignment design to comply with various / remarks to the extent possible.
- k. Preparation and submission of Final Plan and Profile drawings on 1:1000(H) and 1:250(V) scales.
- l. Preparation and submission of Alignment Design Report.

### **1.1.3 Deliverables**

- a. Drawings shall be submitted only in soft copies (pdf & .dwg format) and all documents shall be in soft copies in pdf format (for reports etc.). The following deliverables shall form part of the services.
- b. Alignment Design Basis Report.
- c. Alignment Review Report for NCRTC provided Alignment.
- d. Alignment Design Horizontal & vertical Drawing shall be submitted in AutoCAD DWG and PDF format in A1 paper size (1:1000 for horizontal scale and 1:250 for vertical scale).
- e. Report on the stretches where proposed speed is less than 180Kmph on viaduct & 140 Kmph in underground along with details of options explored for enhancing speed.
- f. Report highlighting the modifications incorporated in Alignment design and drawing.
- g. Index Plan & Section shall be submitted in PDF only 1:10,000 scale or client requirement.
- h. Alignment in KMZ/KML Format.
- i. Land Plans

### **1.2 Information and data to be furnished by NCRTC to the GC**

The following information and data shall be provided by NCRTC to the GC for the performance of the services:

- a. Topographic-Survey in AutoCAD compatible format.
- b. Ground Level Data in CSV format.
- c. Any Ground Constraints/ obligatory points shall be identified along with NCRTC officials to be considered in alignment design. Any civil structure and building as-built information that could affect the design of the GC.
- d. Turnout / Cross-over data and designation or other vendor design related information, if available (e.g. buffer stop) that could affect the alignment design of the GC. In case no data is available, design shall be done based on mutually agreed value of such constraints.
- e. Approved SOD (*used in Delhi-Meerut Namu Bharat corridor*).
- f. Typical cross section of elevated, at-grade and underground station and viaduct.
- g. Rail Level at station and running section for Elevated, at-grade & Underground.
- h. Typical cross section of TBM and NATM.

**CHAPTER 2**

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**SERVICES TO BE PERFORMED BY THE GC PRIOR TO THE AWARD OF  
CONSTRUCTION CONTRACTS:****(Study of GTI & Traffic Data)**

- 2.1** The GC shall review all subsurface and sub-soil data made available to it. The GC shall suggest and recommend to NCRTC along with justification, if any additional borings, geophysical surveys, Soil resistivity and field and laboratory tests etc., that it may require for the performance of the GC services. In case the same is agreed with NCRTC and directed the GC for execution of such additional test etc., the GC shall be responsible for all conducting by engaging any suitably qualified agency fir such tests. Post in-principal agreement by NCRTC, the cost of such additional investigations will be paid separately by the Employer (NCRTC) either through GC or directly to the agency hired for such Geotechnical investigations.

The GC shall prepare a Geo-technical Survey Report incorporating the additional Geo-technical data and shall submit to the Employer for acceptance.

The soil samples and rock cores obtained in the course of the additional geo-technical investigations shall be delivered to the employer by the GC on acceptance of the Geo-technical Survey Report by the employer.

- 2.2** Analyse traffic data for design of traffic ingress/ egress and Multi –Modal traffic integration and design of efficient traffic inventories.

### CHAPTER 3

#### SERVICES TO BE PERFORMED BY THE GC PRIOR TO THE AWARD OF CONSTRUCTION CONTRACTS:

#### (CONCEPTUAL & PRELIMINARY DESIGN STAGE)

#### A. CONCEPTUAL DESIGN STAGE

- 3.1 The GC shall submit a comprehensive system integration report describing their proposal to ensure seamless integration with the existing modes of transport.
- 3.2 Conceptual architectural planning should be based on the principles of state-of-the-art international Nam0 Bharat planning standards, new/innovative ideas, modern technology and methodology, sustainable ideas/features, national/international experience, expertise and best practices including sound principles of transit oriented development, multi-modal integration, property development, environment friendly green building design, barrier-free designs for differently abled, inclusive planning, general site planning and landscaping. The GC is required to produce national & international case studies and should design the station elements & structures with suitable type/scheme/pattern of architectural finishes, fixtures etc. based on environmental (green), life safety, fire, maintenance and noise requirements apt for Nam0 Bharat stations and for all structures in an absolutely exhaustive manner and with due diligence. The stations should be designed to allow for maximum natural light air flow through the concourse and platform areas
- 3.3 GC shall develop a schedule of space requirements for individual structures within the limits of land and refine the space requirements to translate them into design submissions.
- 3.4 Design Options Studies (Civil, Structural, Architectural, and all systems)**
  - 3.4.1 The GC shall produce minimum three design options for all architecture, structures, systems and services covered in this contract. GC shall also review the station locations (Underground, at-grade and Elevated) including entry/exit structures, vent shafts cum escape shaft, all ancillary buildings/structures & develop designs considering adoptability of the design as per site conditions.
  - 3.4.2 GC shall produce sufficient design, drawings, BOQ, milestones cost, Outline Design Specification for Tender purpose for all structure, Architecture and all systems and service covered in this contract. GC shall provide all tender purpose requirement for station (Underground, Elevated, and at-grade) including entry/exit structures, roofing (PEB) design elevated viaduct, tunnels, cross passages, Shafts, ramps, Mid Ventilation Building/Shaft, ramps, Mid Ventilation Building/Shaft, steel structure, culvert, vent shafts cum escape shaft, and all ancillary buildings, other supporting building required to be constructed for Delhi-Bawal Nam0 Bharat Corridor in consultation with NCRTC. GC shall develop designs for all structure considering adoptability of the design as per site conditions. The limits of land may undergo changes after final survey, and the GC shall make any adjustments necessary to the design to acknowledge the changes to the limits as defined. The GC shall develop alternative layouts and concept designs for the substructure, superstructure, elevated, at-grade and underground station, tunnel, ramps, ventilation shaft, Mid Ventilation Building/shaft, cross-passages and architecture of all elements to reduce construction cost without adversely affecting required transit system functions such as capacity, service life, and reliability, economy of operation or ease of maintenance. GC should prepare Alternate designs to explore various options for review/ recommendations and approval from Employer 's/stakeholder 's.
  - 3.4.3 GC shall be responsible for coordinating with all stakeholders while finalizing the various alternatives of station, viaduct, tunnel.
  - 3.4.4 Upon agreeing to alternative design options, GC shall submit preliminary design, drawing and quantities of viaduct, underground, at-grade and elevated stations, tunnel, ramps, shafts, cross-passages, shafts, Mid ventilation building/shafts, entry-exit structure, ancillary building for tender purposes. Based on the finalized quantities, GC shall also submit construction cost. GC shall submit the quantity and type of the Lift, Escalators &

Moving Walk as per the finalized Architectural Drawing for tender of the Lift, Escalators & Moving walks.

3.4.5 GC shall also be responsible for getting approval of all above works from client and statutory body if required.

3.4.6 The GC shall also provide soft copies (editable) of all design (Excel, Software models etc.) and drawings to the employer

3.4.7 Each design alternative shall be presented in sufficient detail to clearly define the proposed design alternative including:

- i) A description of the difference between each proposed design alternative and the comparative advantages and disadvantages of each.
- ii) Clearly illustrated sketches with urban form, drawings, diagrams, calculations, published reports, analysis, cost effectiveness, written description and other supporting documents that allows evaluation and shall accompany the Design basis report.
- iii) Concept schedule of materials and finishes.
- iv) A detailed estimate of the amount of savings in construction/system cost.
- v) Drawings showing single line diagrams for MEP services like electrical, fire detection and fire suppression system, plumbing, fire detection system, layout (Floor-wise), fire suppression and details of various sub-systems, sprinkler layout, automatic gas flooding (as applicable) etc.
- vi) Drawings and Schematics for ECS, TVS, BMS and SCADA works and other systems
- vii) Case studies and global best practices if any - National/ International in support of the alternative proposed
- viii) Passenger circulation model/simulation, value addition, space optimization, space proofing, innovative and optimized façade and roofing (PEB) design, structural configuration, horizontal and vertical circulation and passageway requirements.
- ix) Single line diagram of electrical system including panels and Distribution Boxes, cable sizing etc.
- x) Wiring layout floor wise and external areas. This shall include location of Distribution Boxes, fixture sockets, lighting, fans, etc. and wiring details

3.4.8 Upon agreeing to alternative design proposal, the GC shall completely design and detail the Works, provide Tender and Contract Drawings for other documents for the Structure (elevated, at-grade and underground station, viaduct, tunnel), Architectural, Plumbing and all system contracts and be fully responsible for such design, dimensional control, and coordination with various disciplines and detailing.

3.4.9 Based on the studies, the GC shall prepare an initial statement of probable construction cost for each work.

### **3.5 Station Planning Report**

The GC shall provide the Employer/Employer's Representative with information of presentation or display as Employer/Employer's Representative may require. Information shall consist of material in the form of descriptions of the Works and shall include graphs and sketches and photographs for inclusion in publications or for making into displays and exhibits. BIM Models/3-D walkthrough movie of minimum 05 minutes duration, showing exterior and interior architectural features of each station including passenger flow within the station premises shall be provided at preliminary stage for stations and viaduct. GC shall submit a report for review and notice of Employer/Employer's representative specifying the basic characteristics of the station, highlighting them in the order of importance. The report shall include the specific characteristics of each station. The report shall also include, but not be limited to, the following:

- 3.5.1 A set of CAD 3-dimensional simulated photographs/views for each station showing platforms, concourse and various passenger handling elements of station.
- 3.5.2 A computer simulated passenger flow model generated with “VISSIUM/ VIS- Walk / AIMSUN” etc. or equivalent showing the peak flow, delayed and emergency conditions, for each station as decided by the Employer. The software shall be able to simulate level of service (LOS) at platform, concourse staircases and in queuing areas showing passenger handling from the point of arrival of train on a platform to the next arrival and finally to the exit of station. It should be able to locate the critical areas of the station for expected overcrowding and conflicts in passenger flows.
- 3.5.3 This software generated model shall be a computer graphic presentation of the station planning done by the GC from the point of view of passenger handling and it shall be treated as a supplement to the design calculation.
- 3.5.4 Acoustics report
- 3.5.5 Green Building Implementation Report, complying with GRIHA(5-Star) (as per IGBC norms (Ref- Appendix 1) enclosed in this chapter.

### **3.6 PRELIMINARY DESIGN STAGE:**

- 3.6.1 The Preliminary Design shall be developed based on SOD, DBR and planning criteria along with updated codes and developed sufficiently to define the main structural elements, systems and services.
- 3.6.2 The Preliminary design of the specified works and the incorporation of all system-wide requirements are the responsibility of the GC. The GC 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. Preliminary Design shall accord with and incorporate the Conceptual Design and shall be the design developed to the stage at which all elements of the structures are defined and specified.
- 3.6.3 Study of project requirements and control drawings and preparation of design philosophy, basis & criteria for individual buildings, structures, external and internal services and their holistic integration, passenger flow requirements/ circulation & systems.
- 3.6.4 Preparation of preliminary architectural/structural/ E&M, plumbing / Fire Detection and Fire Suppression System, ECS, TVS, BMS, SCADA /VAC/ Restoration & landscaping plans including but not limited to BIM (as per defined scope), dimensioned plans, existing condition plans, existing utility plans, Layout and material plans, MMI Plans, MEP/service arrangements along with relevant cutout/opening and integration of services with other modes, grading and drainage plans, plan enlargements, elevations, internal layout, sections, Roofing (PEB) & façade plan, details & arrangement, landscaping details, schematic electrical plans, structural designs, water supply and sanitary arrangements & Interior design of stations such as false ceilings, flooring wall cladding, furniture, location of HVAC units, Internet connectivity points, surveillance schematics, building management system/ SCADA, other relevant services etc.
- 3.6.5 Site development plans should include elements like landscaping, public realm & public facilities, compound wall, roads, boundary wall, footpath, pavements, storm water drains, rainwater harvesting pits, mechanical equipment (including fire safety fixtures), pavements, street-scaping, public/street furniture & fixtures, public amenities etc.
- 3.6.6 The GC shall submit lift shaft dimensions, overrun and pit requirements, equipment and plant room sizes, accessibility to firemen’s staircase, fire control and smoke management systems, requirements for lifts and escalators, escalator pits, typical floor beam depths, column size, maximum duct dimension requirements, floor-to-floor heights, etc.
- 3.6.7 The GC shall produce indicative Station Reflected Ceiling Plans, and integration of ceiling mounted services, structural and architectural elements, MEP equipment, Ventilation and Air-Conditioning system, Tunnel Ventilation System, SCADA and, BMS system wide components, and the like.

- 3.6.8 Passenger flow calculations for normal and emergency egress conditions, Acoustical analysis shall be performed by GC and reports shall be submitted to Employer/ Employer 's representative for review.
- 3.6.9 Preliminary Traffic Management plan consisting of probable diversion routes, Suggested alternatives, Preliminary bus stop relocation plan etc.
- 3.6.10 Ascertain Employer 's/ stakeholder's requirements and examine site constraints & potential for individual buildings/basement parking/ multi-modal integration, external and internal systems/ services and prepare brief/presentation for Employer's/ stakeholder's review / recommendation and approval including conceptual/ control designs/ drawing/ documents and incorporate required changes, if any.
- 3.6.11 GC shall complete the preliminary design in all respects and produce the tender drawings.
- 3.6.12 The GC shall incorporate in its design, the relevant high flood level data (HFL) pertaining to the region.
- 3.6.13 Traffic management Proposals/Landscaping/ Multi-Modal Integration
- Traffic management Proposals, Landscaping, Multi-Modal Integration - Preparation of Preliminary designs of intermodal transfer facilities for road, rail and pedestrian traffic, landscaping plans and Including planning for storm water drain, street furniture, ramps and footpaths for commuters, streetlights and medians. Requirements of green building report should be submitted along with plans for review by the Employer along with suggested measures related to Sustainable site, water conservations, energy efficiency, materials conservation, air quality management and innovative points pertaining to reinstatement etc.
- 3.6.14 Study of input data and preparation of design calculations, schematic drawing for all external services & individual buildings pertaining to internal services such as:
- i. External & Internal Sewerage (grey & black) System.
  - ii. Rainwater harvesting system by way of recharge pits, sumps etc.)
  - iii. Connection of Internal Services Systems like water supply, sewage/ sewerage disposal, electrical etc. with external services network owned / maintained by concerned authorities.
  - iv. Street Furniture
  - v. Internal and External Electrification along with aesthetics lighting
  - vi. Communication System.
  - vii. Passenger flow calculations for Normal & emergency Egress condition & Passenger simulation
  - viii. Acoustical analysis
  - ix. Traffic Movement/circulation
  - x. Overcrowding Control
  - xi. Fire hydrant and fire-fighting provisions internally and externally
  - xii. Flood protection
  - xiii. interior design
  - xiv. signage illumination
  - xv. Property development
  - xvi. Advanced parking management including bicycle parking
  - xvii. Boundary wall
  - xviii. Precipitation Report of the region for the drainage design on viaduct for designing drainage of track system

3.6.15 Drawings and Documents to be submitted incorporating:

- i. All necessary Design Report, Calculation, Analysis, Passenger Simulation.
- ii. Preparation of Drawings and Estimate of all works/ packages for the project.
- iii. Integrated Property development in proposed stations area of Namoo Bharat.
- iv. Infrastructure accommodating all necessary amenities.
- v. All necessary critical and typical details
- vi. calculations for staircase, lift, escalator and access for especially/differently abled commuters.
- vii. Barrier Free Design implementation
- viii. GC will consider acoustic and ergonomic consideration as per best practices in their design.
- ix. Passive design features.
- x. Implementation of Green building concepts (Ref- ANNEXURE-I) enclosed in this chapter.
- xi. Ecologically sustainable design, efficient use of energy and natural resources (like solar, wind etc.)
- xii. Waste management and recycling proposal.
- xiii. Optimization of constructability, operability & maintenance.

3.6.16 The GC shall submit Schedules and Tables Comprising:

- (a) Schedules of Accommodations, indicating room and space dimensions, functions, and requirements for stations, ancillary facilities and property development, if applicable.
- (b) Schedules of Finishes for stations & Viaduct, indicating materials and finishes, type and extent for each station room or space.
- (c) Provisions for advertisements, artwork/murals/graphics.

3.6.17 GC should keep in mind that architectural finishes should govern the MEP and system fixtures and should be designed with utmost care to conceal, hide those services in civil structures and architectural finishes only should prevail in finalization of scheme and pattern. During preliminary design stage all such coordination issues should be resolved, and GC is expected to be providing concealment, routing, trucking solutions for the transport of core system services, based on the experience achieved and lesson learnt from previous projects in a well-structured manner and should adapt and design accordingly real time solutions.

3.6.18 The major equipment loads, pressure, major openings and major embedded items and other similar interface are also to be shown on these Preliminary drawings. During the Preliminary design phase GC shall co-ordinate with all system-wide GC to obtain system-wide requirements such as embedded conduits, floor trunking, wall and floor openings, equipment concrete plinths, equipment space, sleeves, hoisting hooks, earthing, lightning arresters etc., and incorporate into the structural/architectural drawings for Design and Built contracts.

3.6.19 GC shall repeatedly interface with Employer/ employer's representative to ensure compatible complete design of Architecture, Civil and ancillary structures.



## CHAPTER 4

### Functional Design requirements for Civil structural design

- 4.1 The GC shall perform civil and structural design for typical structures within the contractual provisions, including, the preparation of calculations, drawings, specifications, cost estimates and other documents, as required but not limited to:
- a) General arrangement drawings.
  - b) **Design Calculations:** Calculations relevant to the Design shall be submitted for assessment with the respective Design Packages or Submissions.
  - c) The Employer/ Employer's Representative requires accessibility to applicable software including in-house software programmes/ worksheets developed by the GC, computer input and programme logic for his assessment prior to the acceptance of the computer output.
  - d) Soft copies of Design EXCEL spread sheets (linked & un-protective) and computer model data files sufficient to regenerate the model and re-run the analysis should be submitted together with the calculations to the Employer.
  - e) The GC shall submit all calculations necessary to support proposals relating to the construction methods. (Colour copies).
  - f) Track supporting structure within station area, viaduct & track alignment design.
  - g) Preliminary Design of Viaduct, Station (Underground/at-grade/Elevated), integrated double decker arrangement (if agreed with stakeholder/statutory authorities), tunnel, ramps, tunnel portals (funnel/trumpet etc.) foot over bridge, underpass, shafts, ancillary building, culverts, Property Developments and any other structure required for completion of project.
  - h) Foot over bridge under-bridges, sub-ways/underpass, culverts etc.
  - i) Detailed typical sections.
  - j) Initial Traffic Management Plans and report for approval from authorities before commencement of works.
  - k) Earthwork cross sections.
  - l) Line side and security fencing.
  - m) Escalators and Lifts.
  - n) Fire Fighting Arrangements.
  - o) Preliminary Drainage scheme for Stations (Underground/at-grade/elevated), Viaduct, ramps and track within station area etc and interface with GC and employer's representative. Preliminary Surface drainage plans; roads, parking lots and bus bays in station traffic integration areas. Preliminary Drainage scheme shall be clearly incorporated in both Civil and track drawings.
  - p) Ancillary buildings such as ventilation shafts, exhaust shafts, DG rooms, pump house; sub stations; and police post; chillers, plant rooms etc.
  - q) Platform Screen Doors for Elevated stations
  - r) Road Restoration & Reinstatement plans with landscape, public furniture and fixtures reinstatements and MMI.
  - s) External Electrical/ Plumbing/ Sewerage/ Water Supply, Fire Fighting Systems, Fibre Optic Connectivity-IT Infrastructure, Communication Networks, Roads, Pathways, Street Lighting, Campus Landscape/ Horticulture, Urban Furniture, Water (Rainwater harvesting) and Waste Management (STP/ETP) Solar Energy Panels etc. Sustainable Model, Energy Conservation, or any other infra structural facilities as required as part of Master Plan).

- v) The GC shall co-ordinate its design with the relevant agencies and all system wide departments of Employer to develop their design and drawings.
- w) In preliminary design, GC shall provide dimension of typical structure with reinforcement/prestressing after considering all loads and load combination applicable on the structure, this shall be provided with accuracy, after doing design and analysis of the structure.
- x) PD building loading details along with type of occupancy w.r.t applicable IS code.
- y) Particular attention shall be paid to locations where flooding could enter station areas. In particular,
  - i. Design of surface water drainage systems including plinths and ducts shall be avoided in the vicinity of traction substations to obviate any risk of flooding of electrical equipment areas.
  - ii. Entrances and all other points of access to the station area shall be adequately protected against flooding.
  - iii. Equipment rooms and pits for lifts, escalators and other facilities shall be adequately protected against flooding.

4.2 The key aspects covered by the GC will be:

- a) Reference standards.
- b) Design Basis Report.
- c) Design Criteria;
- d) Interpretation of the geotechnical and hydrogeological investigations;
- e) Identification of the initial geological, geotechnical and construction risks and quantification of the mitigation measures and contingency measures during construction to reduce the residual risks;
- f) Construction method and construction sequence;
- g) Applied load cases and design assumptions;
- h) Methods of analysis, which have to be appropriate and valid;
- i) Geotechnical and preliminary design of permanent works.
- j) Ultimate and service design capacities of all components;
- k) Roofing & Façade (PEB) solutions and its components
- l) Tunnel and viaduct crossing/intersection with other metro structures/railways/ bridges/ heritage & important building.
- m) Overall stability of the structures in both the short and long term conditions;
- n) Water tightness requirements and proposed technical solutions;
- o) Design of the mitigation measures;
- p) Suitability of the design to the construction methodology adopted by the Contractor;
- q) Integrity of structural member and structures as a whole.
- r) Constructability.
- s) Interface drawings civil works / MEP equipment.

The scope of GC covers the preliminary design of all the structural component of Viaduct, station and its building and its ancillary components including entries, exits, connecting corridors/FOBs, ramps etc.

It also includes Design of structural works for architectural finishing, Interfaces and functional requirements such as design of louvers, ACP, cladding, structural glazing, counters, GRC Jali, etc.

#### **4.3 Scope of Services for Civil Structures of Elevated Station, at-grade station and Underground section**

##### **A. Scope of Services for Civil Structures of Elevated/At-grade Stations**

The scope of GC covers the Preliminary design, outline design specification, outline construction specification and preparation of tender reference drawings and BOQ (Construction Cost) of all the structural component of station building and its ancillary components, entries-exits structure, PEB of station roof structure over platform, PEB of entry-exit, any steel structure, connecting corridors/FOBs, crash barrier, retailing wall, boundary wall, including Multimodal Integration Scheme properties development structures and any structure required for completion of project etc.

- I. Submission of bill of quantities for various items of work and cost estimates
  - a) On approval of the design and drawings, complete bill of quantities for various items of work required for the construction of above works as per the approved design/drawings shall be submitted to Employer for approval.
  - b) The GC shall also submit cost estimates for the work based upon prevailing rates for various items of work along with basis for the adopted rates in the cost estimates.
- II. Provision of Tender Drawings
  - a) For the purpose of invitation of tenders for the construction of above works, the GC shall provide, Tender drawings for incorporation in the tender documents.
- III. Broad scheme of construction
  - a) The GC shall submit a broad scheme of construction of above work considering the existing site conditions, requirement of construction programme, ease of construction, traffic condition in the project area etc. The above scheme shall also include the requirement of casting yards including likely locations and other enabling works.
- IV. Interaction with various stakeholders engaged by Employer and other stakeholders such as Indian Railways/ RDSO/ DMRC on matters related to scheduling, design and drawings.

##### **B. Scope of Services for Civil Structures of Underground Section including Stations**

###### **GENERAL**

1. Preparation of tender reference preliminary structural analysis, design and drawings of Underground Ramp, Cut & Cover Tunnel, Underground Stations, Bored Tunnel, NATM Tunnel, Cross-Passages, Ventilations shafts, Launching & Retrieval Shaft, Walkways, Ancillary Buildings, Property Development Buildings PEB structures (If any) and any other associated structures (if any).
2. Preparation of Geotechnical Interpretive Report (GIR) for Underground Section of the corridors.
3. Preparation of Outline design specifications (ODS), Outline Construction Specifications (OCS), Design basis report (DBR) & employer's requirements (ER) for Underground section.
4. Tender reference drawings for Interface of underground structures/tunnels crossing at all critical locations like railway crossings, Metro crossing, Flyovers, Airport runway, underpasses, Highways, Important / Heritage buildings, major utilities etc. along the alignment.

5. Preparation of Bill of Quantity (BOQ) and Costing of Underground section.

#### **RAMP STRUCTURE**

1. Preparation of GADs, sizing, dimensional drawings of Underground Ramp, Elevated Ramp, funnel/trumpet shaped portals, pressure relief ducts, Walkways, Central railing, Side railing, joint details etc.
2. Preparation of Construction of sequence for Underground Ramp & Elevated Ramp including temporary as well as permanent structures.

#### **CUT & COVER TUNNEL**

1. Preparation of GADs, sizing, dimensional drawings of Cut & Cover Tunnel, funnel/trumpet shaped portals, pressure relief ducts, Walkways, Central railing, joint details etc.
2. Preparation of Construction of sequence for cut & cover tunnels including temporary as well as permanent structures.

#### **UNDERGROUND STATIONS**

1. Preparation of GADs, sizing, dimensional drawings of Underground Stations, Entry-Exit Structures, PEB structures (If any), Ancillary buildings, Property Development buildings and any other associated structures etc.
2. Preparation of Construction Sequence/Construction Methodology for Underground Stations e.g. Bottom-up construction methodology or Top-Down construction methodology including temporary structures as well as permanent structures.

#### **BORED TUNNEL**

1. Preparation of GADs, sizing, dimensional and segment arrangement drawings of Bored Tunnel, and Walkway etc.

#### **NATM TUNNEL**

1. Preparation of GADs, sizing, dimensional drawings of NATM Tunnel, and Walkway etc.

#### **CROSS-PASSAGES**

1. Preparation of GADs, sizing, dimensional drawings of Cross-Passages with Sump and without sump, Walkway etc.
2. Identification of Locations and Numbers of Cross-Passages, as per codal provisions, along the alignment of Underground section.

#### **SHAFTS**

1. Preparation of GADs, sizing, dimensional drawings of Ventilation shaft, Launching shaft & Retrieval Shaft.
2. Identification of locations & numbers of Launching & Retrieval shafts.
3. Identification of locations & numbers of Ventilation shafts.
3. Preparation of drawings for construction of sequence for Ventilation shaft, launching shaft & Retrieval Shaft including temporary structures as well as permanent structures.

The purpose of above scope of works is for invitation of tenders for the construction of underground works as mentioned above.

### **4.4 Design of Viaduct**

#### **The detailed scope of work under each activity is as under:**

- i) Finalization of span configuration including special spans and locations of piers. After approval of the geometric design of the alignment, the GC shall work out the span configuration (length of each span) including standard spans, for the elevated viaduct and finalise the locations of viaduct piers/portals in the above section. The above span

configuration /pier location shall be worked out considering economy, aesthetics, ground position, presence of ground utilities, ease of construction etc. Employer shall be engaging a separate agency for identifying various utilities within the Namu Bharat alignment in the above section and details in this regard shall be provided to the GC. At some locations, it may not be feasible/possible to provide single piers or single piers may not be adequate and at such location's portals may have to be provided. Similarly, special spans will have to be provided at locations requiring special arrangements. The alignment crosses the river, expressways, National/State Highways, CPWD/PWD flyover/ROB, Indian Railway tracks and metro lines, etc at these locations special spans will have to be provided. The GC shall submit proposals duly supported by calculations/reasoning etc. for such crossings and obtain approval for the same from Employer. On approval of the preliminary designs and drawings, GC shall submit tender drawings, BOQ along with construction cost in hard and soft form as stipulated in this document. The GC shall submit drawings showing the proposed location of piers/portals.

- ii) Preliminary design and typical tender drawings, BOQ along with construction cost of foundations (open or pile or well), sub-structure (pier or portal) taking care of existing major utilities and other site requirements.

The details of geo-technical investigations done by the agency engaged by Employer shall be used by the GC for taking up the typical design of viaduct foundation and sub-structure. The GC shall ascertain the adequacy of the above details and advice NCRTC about additional details required by him, if any. The survey details of the above section including ground levels at the locations of pier/portal shall be provided by Employer to the GC.

- iii) Preliminary Design and drawing of viaduct superstructure (Except Standard span – Provided by NCRTC)

The design should be economical, aesthetic and suitable for faster construction including optimum cross section for accommodating Signalling & Telecommunication, OHE installations, Cables, other equipment, maintenance, emergency evacuation requirements etc. The above shall cover viaduct superstructure designs mainly of double U girder, I girder, segmental box, cast in situ or any other suitable type (Except Standard superstructure provided by Employer), along with recommendations for adoption of design at various locations. In case of special spans e.g. River /Indian Railway track crossing/DMRC lines, there may be need to adopt special spans with steel girders. The GC shall submit the designs to Employer and obtain approval for the same from Employer. On approval of the designs and drawings, GC shall submit tender drawings, BOQ along with construction cost (including standard superstructure provided by Employer) in hard and soft form as stipulated in this document.

#### **4.5 Functional requirement of Permanent and Temporary Drainage (Water supply, Drainage and Disposal).**

The GC shall prepare preliminary design of permanent drainage works of various structures including the connections of these to the existing drainage systems located outside The Employer perimeter. The drainage systems to be detailed as part of the design shall include but not be limited to:

- a. Sumps and pumps inside any building or structures, whether above ground or below ground, for the collection of water other than foul sewerage.
- b. Drainage systems inside and outside any building or structure for the conveyance from the sump(s) or other collection points to the appropriate sewer or drain of the drainage authority, Storm water drainage management.
- c. Systems for the surface water drainage of reinstated roadways, landscaped areas, car parks and other paved areas associated with the works and for the conveyance of the surface water to the appropriate drainage system of the relevant drainage authority; and

- d. Drainage systems for the conveyance of water from Namo Bharat track, to discharge points acceptable to the appropriate drainage authority.

#### **4.6 Co-ordination with Utility Services**

The GC shall provide utility required for Viaduct, all stations, and ancillary buildings, etc. to include but not be limited to:

- a. Sewerage;
- b. Provisions for future installation of all utilities;
- c. Fresh water supply;
- d. Electrical ducts;
- e. Fire protection and detection systems.

#### **4.7 Traffic Management Plan:**

A presentation of the proposed traffic management plan will be given to meet the required schedule of connected activities. A tentative traffic management plan (including restoration of roads, circulating area & landscaping) shall be suggested by GC.

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**CHAPTER 5**

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**Functional Design requirements for Architectural Design**

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**Architectural Design Requirements:**

The Architectural services shall include the preparation of concept design, preliminary design and tender stage drawings/documents of all Architectural including finishing and landscaping works, etc. and review the land requirement for stations, preparation of drawings, technical specifications, BOQs/cost estimates and other documents, as required, in order to prepare Design-Built tenders, together with such other services as are set out and referred to in this contract. The Works also include assisting Employer/Employer's Representative in obtaining the necessary In-principal approvals from concerned local Authorities/statutory bodies/ fire authorities. All the Architectural drawings to be prepared in coordination with Structure and other Services like Electrical, Firefighting, fire alarm, HVAC, plumbing, lifts, escalators, lighting boom, traction, S&T, AFC, PSG, Track, RS, etc for Design layout of the stations, other ancillary buildings/facilities, property development and finalize the requirement of equipment rooms, platform, operation services, ticketing systems and other related services for preparation of Design-Built tender. The same shall be prepared incorporating the necessary structural arrangements and member sizes to guide the station design/layout like SOD, Height of buildings, clearances, services arrangement, Vertical circulation, BIM model etc. to effectively guide the design process and ensure compliance with design guidelines. Station layout designs should ensure that emergency evacuation criteria are met as per relevant codes/ standards. GC would also suggest alternative to conventional air conditioning to achieve climate control i.e. reduction in dust & temperature.

The General GC shall prepare and submit to the Employers/Employers Representative for approval of cost estimates for the architectural works at each station. These estimates shall be based on quantities taken off by the General GC from the produced BIM models. Cost estimates are required for each submittal. All modifications of the cost estimate before D & B contract award shall be in the General GC's Scope of Service. The estimates shall show the unit rates and quantities adopted (with take-off sheets) and shall give the detailed analysis of how the unit rates were developed.

- (i) The GC shall submit a **Design Brief Report** outlining architectural objectives considering factors like maximum natural light, and air flow green building rating/ IGBC, climate-resilient solutions, and ease of maintenance. The design should optimize space planning, prevent water ingress, and incorporate multi-modal integration. It should also ensure durability and maintainability of materials. The design should also ensure architectural finishes are coordinated with structure and other services like firefighting systems, signaling & telecom, complete signage, etc. The brief should address complete signages and integration with existing facilities, prioritizing passenger convenience and safety. The design should incorporate innovative concepts, value engineering, and global best practices, while adhering to seismic zone requirements and wind load calculations.
- (ii) The GC shall prepare "**Concept Design**" with Concept Design Report including minimum 3 Design Alternatives (in the form of drawings & rendered 3D views) and other relevant supporting documents for Stations, Property Development areas & other supporting buildings like public convenience structures such as facility areas, skywalks/FoBs/ Subways/ underpass, etc.
- (iii) The GC shall prepare **Coordinated Preliminary design**, Documents, drawings & BIM models for Stations, Property Development areas & other supporting buildings like public convenience structures such as facility areas, skywalks/FoBs/ Subways/ underpass, etc. including but not limited to Architecture (space proofing, Roof, facade, urban form, finishes, complete signage, MMI, landscape, etc.) in coordination with Structure (structural member location & sizes, etc. excluding rebar) and Services (Electrical, Firefighting, fire alarm, HVAC, plumbing, lifts, escalators, lighting boom, traction, signage, S&T, AFC, PSG, Track, RS, etc.)

- (iv) The GC shall prepare **Coordinated Tender Drawings**, Documents & BIM models, BOQs (DSR and NDSR items including rate analysis, if required & reference detail drawings), Quantities with base calculations, Cost Estimates and Detailed Technical Specifications for Stations, Property Development areas & other supporting buildings like public convenience structures such as facility areas, skywalks/FoBs/ Subways/ underpass etc. including but not limited to Architecture (Station drawings, Roof & façade including member sizes & skin details, finishes, signage including graphics in cdr format & fabrication drawings with item-wise specifications, MMI, landscape, etc.) along with complete coordination with Structural system as per requirement (structural member sizes, etc. excluding rebar) and Services (Electrical, Firefighting, fire alarm, HVAC, plumbing, lifts, escalators, lighting boom, traction, Signage, S&T, AFC, PSG, Track, RS, etc.) . Also, GC to include adequate Space Provisions for Property Development Areas including E&M, Plumbing, Firefighting, Water tanks, waste management, etc.
- (v) The General GC shall prepare drawings with sufficient detail to fully describe the architectural design of the stations, property development and ancillary building/facilities including MEP & other Services and any structures visible to the public. These drawings shall address at a minimum such issues as:
  - a. Station, public convenience structures such as facility areas, FOB/subway/underpass/skywalks, other ancillary buildings including roofing and facade structures.
  - b. Site design, landscape design, Multi-modal Integration, modification to existing infrastructure like roads/ culverts, etc. and urban design in conjunction with the existing site characteristics which are to remain including heritage structures and TOD norms/ policy.
  - c. Proposed land uses and relationships to surrounding properties.
  - d. Visual corridors to and from proposed property development.
  - e. Pedestrian paths, equitable access path and vehicular links;
  - f. Interfaces with proposed and potential future development projects
  - g. Environmental considerations including flood control.
  - h. Hierarchies of public and private spaces;
  - i. General concepts of building massing;
  - j. Integration with existing and proposed property development;
  - k. Floor and ceiling finishes having good light dispersing properties to enhance illumination.
  - l. Cost effective, construction friendly, green concepts to be incorporated in internal and external finishes of all structure and holistic approach shall be ensured
- (vi) The GC shall collect and analyze the flood data from the relevant authorities and propose solutions for flood control at interfaces and thresholds between proposed grade levels and stations and ancillary facilities. As a thumb rule, the Entry podiums of the stations shall be designed based upon the highest level among HFL+0.60 mtr. (Highest flood level observed in last 100 years).
- (vii) The GC shall prepare Standard Specifications for architectural standard design elements and for the supply and installation of architectural standard finishes and materials with the consent of Employer/Employer 's Representative. covering site work, concrete, flooring, roofing, wall finishes, metals, doors, windows, finishes, mechanical, electrical, plumbing and landscape works, etc. The specifications will ensure standardization and quality control for the project's architectural elements, incorporating sustainable and durable materials, and facilitating ease of maintenance.
- (viii) The following considerations which relate to the type of finishes in stations shall also be taken into account:
  - a. Location



- b. Services interface
  - c. Faster construction
  - d. Acoustic requirements/ treatment required
  - e. Durability including following:
    - i. Corrosion protection is required for all exposed and hidden metallic elements
    - ii. Precautions must be taken to prevent bimetallic corrosion
    - iii. The choice of finishes shall take into account durability and ease of maintenance, passenger & staff safety, fire resistance, and cost effectiveness, source of supply, replaceability, aesthetic considerations, etc.
  - f. Where structural and service elements are used as part of the finished architectural effect (for example exposed ductwork or light fittings at ceiling level) the layout, configuration and detailing of those services elements shall be considered as being part of the architectural finishes and shall require Employers/Employers representative acceptance.
- (ix) The GC to ensure that the design of the station is safe in the event of a fire/emergency and that the necessary details are incorporated into the design as per the latest rules, regulations, code and practice in accordance with the egress, station sizing requirement/ ridership figures.
- (x) The GC shall prepare compliance report for each station & other Buildings as per requirement of Green Building design/ IGBC Certification and suggest measures related to Sustainable site, water conservation, energy efficiency, materials conservation, air quality management etc. for achieving Green Building Implementation in our Namoo Bharat systems. Measures for rainwater harvesting, harnessing renewable energy resources of nature, mitigation of heat island effect etc. should be clearly spelt out before preparation of tender documents and materials, methodologies and technologies should be proposed in advance for review by the Employer.
- (xi) The GC to ensure that all designs are in compliance with the provisions to be made for “differently abled people” as per the latest applicable codes/ standards.
- (xii) The GC will prepare Site Plans based on urban planning design standards, aligning with land acquisition plans approved by Government of Delhi & Haryana, and obtain necessary approvals for Namoo Bharat works.
- (xiii) The GC shall be responsible for all Submissions/obtaining approvals for ground and above & underground Namoo Bharat works to all statutory bodies including fire clearances, etc. as applicable.
- (xiv) The GC will also submit drawings for multi-modal integration with existing/ proposed modes of transport, modification to existing infrastructure like roads/ culverts, etc , restoration, landscaping, street lighting, and traffic management, etc.
- (xv) The services shall also include landscape design, site planning, and detailed design of open spaces including planting design, landscape structures, illumination, and street furniture, coordinated with Multi Model Schemes covering aspects from site appraisal to external services coordination.

The GC shall incorporate and co-ordinate its designs, and prepare drawings and documentation to be incorporated in the following system wide elements drawings which will be used in all stations but not limited to:

|      |  |
|------|--|
| I.   | Finishes Schedules: Floor Finishes; Wall and Column Finishes; Ceiling Systems and Finishes, Roofing (PEB) & Façade finishes etc. |
| II.  | Railings, Barriers and Gates   |
| III. | Stair and Handrail Details   |
| IV.  | Escalator and moving walks Finish Details  |
| V.   | Lift Finishes Details  |

|       |  |
|-------|--|
| VI.   | Platform, Platform Screen Doors for stations, coping Details. Platform seating Bench & Litter Bin details  |
| VII.  | Doors and Frames, Window, Glazing, Façade, Fire Door details   |
| VIII. | Miscellaneous Public Area Details such as pump house, RSS/TSS, Parking area, public convenience structures such as facility areas, FOB/subway/underpass/skywalks and other ancillary buildings etc.        |
| IX.   | Platform Edge Lighting, Station internal & external façade lighting, Aesthetic lighting details.   |
| X.    | Public and Staff Toilet Room Details   |
| XI.   | Staff Room Details   |
| XII.  | Complete Signage (Internal & External) and Advertising Details.  |
| XIII. | Landscaping, street furniture, street lighting and External development Works. Facilities for disabled/differentially abled persons, equitable access (including ramps, tactile tile layouts etc.) details |
| XIV.  | Plans, Sections, Elevations and Details of   |
|       | a) Ticket Office   |
|       | b) Ticket Hall Supervisor's Office and Excess Fares Collection   |
|       | c) Information and Enquiries   |
|       | d) Station Control Room, System Equipment Room, Telecom Equipment Room   |
|       | e) Platform Supervisor's Booth, UPS Room   |
|       | f) Other Booth and Office Details  |
|       | g) Door and Window Details   |
|       | h) Countertop and Casework Details   |
|       | i) Station Manager's Room, Security Room, security incharge room, Toilets and other public facility rooms.   |
|       | j) Pump Houses, Auxiliary Substation, Other necessary BOH rooms  |
|       | k) All differently abled person friendly facilities (including ramps, tactile tile layouts etc.)   |

The GC shall prepare Standard Specifications for architectural standard design elements and for the supply and installation of architectural standard finishes and materials with the consent of Employer/Employer's Representative. Architectural Standard Specifications shall include but not be limited to the following:

- a. **Site work:** Granite Kerbs, Concrete Kerbs, Natural Stone Pavers, Brick Pavers, Concrete Block Pavers, Recycle Material Paver Block, Grass-Concrete Pavers, Saucer Drain, Concrete/Metal/Polymer bollards etc.
- b. **Concrete:** Concrete Floor Surface Treatments; Exposed RCC columns/walls finish, VDC/IPS surface, Precast Concrete Architectural Panels; Glass Reinforced Cement Panels.
- c. **Granite/Stone/Tile:** Flooring; Cladding; countertop; ledge wall top; coping
- d. **Masonry:** Mortar, adhesive, Grout and accessories for Granite /Stone/Tile, tiles such as vitrified tiles, heavy duty tiles, acid resistant tiles; Mortar and Grout for Masonry and Exterior Setting Beds;
- e. **Dry wall** system
- f. **Roofing (PEB) & Façade** structure & materials
- g. **Accessories** for Paver Tile; Mortar and Grout for Masonry and Exterior Setting Beds;
- h. **Metals: Vitreous** Enamelled Steel Panels; SS Panel, Aluminium Panel, Barriers and Railings; Drain Grates and Manhole Covers.
- i. **Thermal and Moisture Protection:** Sealants

- j. **Doors and Windows:** Entrances and Storefronts; Hollow Metal Doors & windows and Frames; Fire doors and Frames; Rolling Grilles; Rolling Shutter; sliding folding shutter; Glass and Glazing etc.
- k. **Finishes: Paver** Tile; Wall Tile; Cladding; all type of Floor Tiles; Counter Top Tiles; False Ceilings; Painting.
- l. **Specialities:** Toilet Partitions, Urinal Partition and Toilet Accessories; Equipment Cabinets; Ashtray and Litter Bins; Seating and Benches, Telephone Enclosures; Booths and Workstations.
- m. **Mechanical Work:** Plumbing Fixtures and Trim, ventilation system.
- n. **Electrical:** Lighting, power, air conditioning, system equipment's and water pumping.
- o. **Landscape:** Landscape (Softscape & hardscape) works and Establishment Works.

The GC shall provide continuing support in the form of design data, design calculations, CAD files, and perspective sketches, 3D computer model renderings of each typical station, and the like as requested, whether for promotion, approval or other illustrative purposes for Employer/Employer's Representative. GC will provide technical assistance and drawings for Employer/Employer's Representative as and when required.

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**CHAPTER 6**

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**(BIM Requirements)**

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**Building Information Model (BIM) Requirements**

- (i) The GC shall develop, maintain, update and handover a Building Information Model (BIM) for all the Works. The GC shall bear the cost of BIM software to carry out the works as stipulated herein. The GC acknowledges that the Employer's BIM requirements are evolving and as such the Employer reserves the right to change or replace standards and specifications during the Works.
- (ii) No later than fifteen (15) days after the award of the contract, the GC shall conduct a BIM Execution Plan (BEP) workshop in partnership with the Employer. The GC shall jointly conduct the workshop with other stakeholders to agree upon a common BIM platform for implementation, preferably Autodesk Revit, Bentley. Employer's decision shall be final and binding on the GC.
- (iii) No later than fifteen (15) days after the conduct of the BEP workshop, the GC shall submit a BIM Execution Plan arising from the workshop to The Employer for their approval. This plan shall contain information including but not limited to the BIM Goals or outcomes that are to be realized on the project, software to be used, file formats, collaboration model/workflow, and information exchange requirements.
- (iv) As part of this BIM Execution Plan, the GC shall, in agreement with the Employer also submit a milestone-based schedule that contains key dates, as well as specific models and analysis that meet the Employer's requirements that are to be progressively developed and delivered on these key dates. The scope of each model to be delivered will be indicated in this schedule. The GC will adhere to the deliverables provided in the BIM Execution Plan.
- (v) 3D BIM models to be built shall contain architectural, structural, mechanical, plumbing electrical and other components as per scope of work with relevant parametric information based on the outcomes of the BEP workshop.
- (vi) 3D/4D Models built will be of a BIM Level of Detail (LOD) 250 or as agreed upon at the BEP workshop and will be sufficiently detailed to produce traditional drawings or documents as views of multi-authored data.
- (vii) In addition to developing 3D models, the GC may be required to undertake:
  - a. Station Architecture Modelling
  - b. Station Structure Modelling
  - c. Station Mechanical Modelling
  - d. Station Electrical Modelling
  - e. Station Plumbing Modelling
  - f. Station HVAC Modelling
  - g. Rolling Stock Modelling
  - h. Power Traction Modelling
  - i. Signalling and Telecommunication Modelling Rail Track Modelling
  - j. Develop visualizations and walk-throughs as and when required,
  - k. Preliminary Bill of Quantities,
  - l. Preliminary 4D model,
  - m. Detect and resolve clashes leading to the creation of a clash free model,
  - n. In addition to other requirements as specified in the EIR or that may emerge from the BEP workshop.

- (viii) The BIM models should support activities during all the stages of the project till tender stage including planning, conceptual design, preliminary design, scheduling, etc.
- (ix) The GC shall organize physical or virtual coordination meetings on a bi-weekly or monthly basis, as mutually agreed with the Employer or the Engineer-in-Charge, for the purpose of BIM review, scheduling, setting priorities, discussing comments, and other related coordination activities.
- (x) All architectural, structural, MEP, and other discipline-specific drawings shall be extracted from the BIM software and submitted along with corresponding BIM-related files as part of the overall submission. These shall be provided for the purpose of clash detection, coordination, and review to the Employer. These BIM models, upon issuance of approved drawings to Employer, would then be handed over to the contractors/ Engineer-in-charge for further updates during subsequent stages including CRD/ GFC stage, As-built stage, etc.
- (xi) The GC shall appoint qualified modellers, operators / BIM coordinators and BIM Manager, whose credentials and qualifications as per EQC shall be submitted to the Employer for their approval.
- (xii) The GC shall adopt the file sharing system i.e. Common Data Environment/ Electronic Document Management System, as provided by the Employer, into which all BIM model files and analysis information will be uploaded. The Employer will be given full access rights to this system. All the parties involved in the project should have "role-based" access to the latest approved model, along with modification history and changes that are being considered. BIM models built and analysis done will be handed over to and become the property of The Employer.
- (xiii) It is the GC responsibility to ensure that the information in the BIM model, 2D/3D drawings and other submittals and models, including any data in Geographic Information System, shall be spatially coordinated and have consistent versioning, consistent classification and naming of objects with one another.

**(E&M, Plumbing, ECS TVS, BMS and SCADA System Design)****7.1 Functional requirement of E & M, Plumbing Works, ECS, TVS, BMS and SCADA**

The scope of GC includes the provision of cable duct/ trenches for the 33 kV cable looped in and out at the ASS. The route includes the trench / conduit planned to carry 66/33/11 kV cable from station to the electric substation. Otherwise for lighting in circulation area, only 415/240 V power distribution is planned. Air conditioning requirements, Fire Detection and Suppression System need to be planned individually for each elevated, at-grade and Underground station, tunnel and in Viaduct buildings based on Employer/Employer's Representative's requirements.

2. Design of ELECTRICAL & MECHANICAL SERVICES shall include the followings but not limited to:

Design of Power and Control cables from LV Main Switchboard in the A.S.S. to the Sub main and other Distribution/ Sub Distribution Boards etc. This will include provision of Bus Trucking / Feeder Cables as required. Design of U.P.S. supply feeding all Emergency loads. Design of D.G. sets for feeding all Emergency, Essential and Semi Essential loads. Design of Interlocks and Protection Schemes for Power distribution, suiting to the desired operation, duly co-operated with high voltage side protections and protection of the individual equipment. GC shall also provide the relay settings including the relay coordination between HT and LT power supplies. Design of normal and emergency lighting arrangement & automatic operation in Station areas, tunnel, cable galleries, parking areas, sub way connecting entry/exit and other room. This includes external cabling and provision of lighting fixtures with lamps, ballast, control gear, etc. Design of Earthing System comprising of earth mats, earth electrodes and Main earth Bus in Auxiliary Sub Stations, Clean Earth System and bus, earthing arrangement in tunnels. Design of Control and small power supplies to various station equipment/ Panel. Design of Lightning Protection System. Design of tie bus Cables / bus trucking system for connection between A.S.S. Design of complete Fire- Detection & Alarm system including monitoring and control through a Fire Alarm Panel at Station Control Room and OCC through BMS / SCADA. Designs of Fire suppression system in the Station, Tunnels and Ancillary Building / other structures including Hydrants, Hose Reels, Sprinklers System, Fire Hose Cabinets, Fire Mains in the Tunnel, Portable Extinguishers, Gas Based Flooding System, pipeline network with control valves for sprinklers and hydrants.

3. Design of ECS and TVS Works shall include the followings but not limited to:

The ECS and TVS work requirement shall include the design of all building accommodation and architectural interfaces with ECS and TVS services in the civil structures in the station and tunnel. The scope of GC includes the provision of Environment Control System (ECS) and tunnel ventilation System (TVS) including all control centres, AHUs, ECS fans, Chillers, Cooling Towers, Dampers, Ducts, Tunnel ventilation Fans and Dampers, Electric Panels, Cables, switchgears etc. necessary to deliver the requirements of underground station. The system shall be designed in accordance with the provision of the Full height Platform Screen Doors in each underground station and Platform edge door for elevated stations.

4. Design of BMS and SCADA shall include the followings but not limited to:

The GC scope also includes the provision of design for Building Management System (BMS) (including TVS SCADA work) to fully integrate control, monitoring, and supervision Environmental Control Systems, Low Voltage Power & Distribution System, Fire Alarm System, Hydraulic System (Seepage, Sewage, Bore Well Pumps etc.), and other nominated Building Services Systems and interface with Tunnel Ventilation System SCADA at the station level as well as at the OCC level, including all PLC Equipment, CPU's, Modules, Sub Modules, Power Supplies, Local Control Panels, PC Work Stations, Printers, CPM, Local Area Network (LAN), Ethernet Hubs and Switches,

Cable containment and wiring systems, and other components as required whether or not specified necessary to deliver the requirements.

5. The scope of E&M (Electrical and mechanical) and plumbing services for elevated stations shall include the followings but not limited to

1. Preparation of Tender documents i.e outline design criteria, outline design specification in compliance to prevailing relevant standards and codes of practice, tender drawings, layouts (GAD including Slab and Wall cutouts drawings indicating the sizes of cutouts suitable for laying all required services i.e. duly integrated with all services with back up data to justify the sizes of cutouts) duly coordinated with architectural drawings etc. interface with the system-wide contractor for their requirement or arising out of concurrent works, cost estimates and other documents, as required and as approved by Employer and obtain approval from Employer for any necessary corrections and modifications.

The recommended specifications and design criteria shall cover aspects related to the methods of construction. The specifications shall also prescribe the tests and acceptance standards for various components of works.

2. The outline design criteria and outline design specification shall meet the project requirement at reasonable & optimized cost, without imposing any limitations in regard to competitive bidding. Employer intends to go green building and adopt international best practices in relation to harnessing renewable (solar, etc.) energy, rainwater harvesting, other initiatives (as required under law / statutory obligations) in line with government policies/ programmes and initiatives, etc. at stations, viaducts, and other Namu Bharat project components.
3. The GC shall prepare Testing, Commissioning and acceptance Criterion.
4. Prepare Documents – In the form of Data sheet.
5. Modify, update and supplement as necessary, the Namu Bharat Outline station Design & planning Criteria / General / Specifications as provided to suit the project requirement.
6. Requirement of Lifts, Escalators and Travellator: Preparation of layout drawings indicating the location of lifts, type of lift and Escalator(glass/ss), shaft, pit, machine room, floor levels, panel rooms, plinths, supports, anchors, system cable containment, power supplies, drainage connections and other provisions necessary for the installation of the lifts and escalators, travellators and associated systems.

In addition to above, the scope shall include the preparation of drawings, layouts, specifications, erection/ mounting details, interface with the system-wide contractor or arising out of concurrent works, cost estimates based on LARs/Market rates and other documents, as required. This shall include the incorporation of architectural co-ordination requirements with the requirements of other disciplines for the following services:

1. Structure provision for lifts & escalators & Travellators/moving walks for elevation and underground sections.
2. MEP support provisions.
3. Low voltage distribution.
4. Normal lighting; aesthetic lighting & façade lighting
5. Emergency lighting connected to UPS backed by DG set and normal supply
6. Essential lighting backed by DG set supply;
7. General purpose power;
8. Signalling and communications;
9. Stand-by generator;

10. Uninterruptible power supply system (UPS) for lighting loads & Control Circuit
11. Earthing (Earth Mat design with soil resistivity test report of the Earth Mat location planned by the GC and located in the Architectural Drawing) and bonding.
12. Lightning protection including mounting arrangement and routing of Lightning protection system in coordination with PEB design
13. Power factor correction at major loads; linear; short switching non-linear
14. Fire Prevention, Fire detection, Fire protection, Fire suppression for passenger amenities/ commercial development/ advertisements inside the stations as per latest NFPA 130 guidelines/ NBC code & local fire authorities; Fire Compartmentation drawings
15. BMS (Building Management System) SCADA System for underground, Elevated and At-Grade stations and associated OCC & BCC.
16. Space provision for Lift, Escalator & Moving Walk/Travellator and its Remote Monitoring System (RMS) for all the stations including associated OCC & BCC
17. Smoke Management report for all structures;
18. Water services; pumps and automatic control;
19. Drainage, storm water, plumbing and sewerage;
20. Lifting arrangement for equipment at plant rooms;
21. Lighting calculations, Lighting power distribution for parking areas, circulation area, station face lighting;
22. Provision of cable ducts, cable ways or trenches for all the cables including in coming 33 kV supply cable or cables supplied by all interfacing contractors. NCRTC is planning to take power supply directly from the DISCOM/state government at each station, therefore GC shall also submit the layout and design for LV services accordingly.
23. LT distribution and fire prevention measures for passenger amenities/commercial development/ advertisements inside station.
24. Building Management system for all the stations and all other Buildings ((i.e. Police Stations/Post, PD Areas, Barracks etc.); BMS Architecture and BMS IO Summary, Outline Design Specifications and Outline Construction Specifications, BOQ etc. as per requirements.
25. VAC systems
26. ECS Requirements
27. BMS and SCADA Requirements
28. Lighting calculations for different buildings, civil structures, stations, etc. as applicable. PABX system
29. Electrical & communication cable layout drawings,
30. Typical installation drawings of E&M and plumbing services
31. Conduit layout drawings;
32. Mode tables and other required logics for automation.
33. Mounting details of lighting fixtures and other fittings,
34. Load calculations for internal electrification, DB/ SDB details of different circuits for lighting fixtures, fans, exhaust fans, sockets, HVAC, Lift, Escalator and Moving walks etc.,



35. Cable sizing details, cable schedule.
36. Details of protection switch gear, calculation of breaking capacity of upstream tripping, assessment of requirement of residual current circuit breaker and other special requirement of switch gear for scientific equipment along with specific requirement of zero halogen fire retardant and flame proof cables and switchgear.
37. Power generation through solar panels and other renewable energy source and use of energy efficient fixtures.
38. External Electrification: Design of electrical distribution system and recommendation of capacity of electrical substation, tapping points for pumps, systems, MEP systems etc., Layout of cable, feeder pillars,
39. lighting system etc. complete in all respects.
40. Access Control System & CCTV system, Local Area Networking for building services
41. Any other requirements as applicable to comply with applicable norms of concerned authorities.

All individual components should be readily accessible for maintenance and repair.

The power supply to essential and 'semi-essential' services shall be backed by a DG set and the power supply to emergency services shall be backed up by UPS.

Load estimation and optimization, design of system/ equipment, selection, description, preparation of technical specifications, supporting calculations, BOQ in line of architectural drawings, SLD, schematics, recommended vendors for E&M and plumbing items with their data sheet, rate analysis (with back up offers), cost estimates, assist in obtaining clearances and certificates from statutory authorities wherever required.

**7.2 E&M, Plumbing, ECS, TVS, BMS & SCADA services for underground station and associated tunnel section, the GC shall prepare the following but not limited to:**

- Preliminary Design and Tender Drawings, BOQ, Estimate, Rate Analysis, Milestone, Material and Workmanship Specifications, Outline Design Specification and Outline Construction Specification, Special Conditions of Contract, for Electrical and Mechanical Works (E&M), ECS, TVS, Fire Fighting and Fire Detection, BMS& SCADA System
- Layout of the Plant Rooms.
- The GC shall prepare Testing, Commissioning and acceptance Criterion
- Modify, update and supplement as necessary, the Namu Bharat Outline station Design & planning Criteria / General / Material and Workmanship Specifications /Outline Design Specifications and Outline Construction Specifications based on the inputs/comments from Employer..
- Review & facilitate necessary Technical Document, Presentation and assist the Employer to obtain necessary approvals for E&M Systems including Fire Detection and Suppression System from the Approving/ Statutory Authorities such as Fire Service.
- Plan, Design, Detail, Control, Co-Ordinate, and Execute the design phase of the Works for Production of Drawings, Documents and Reports to meet the Key Schedule Dates included in the Agreement and as directed by the Employer.
- Preliminary Design of Earthing System comprising of Earth Mats, earth electrodes and Main earth Bus in Auxiliary Sub Stations, Clean Earth System and bus, earthing arrangement in station, tunnels, Mid Ventilation Buildings/Shafts.

### 7.3 Functional requirement of Mechanical & Plumbing works

Preliminary Design and preparation of system/ equipment description, technical specifications, BOQ, General Arrangement & Layout drawings, data sheets and calculation ensuring compliance with the latest IS codes/ standards/NBC norms etc. as applicable, including the following works:

#### **Plumbing works (Water supply and sewage disposal)**

- a. Plumbing works shall include all of the work associated with the design of piping, fixtures and appliances in connection with drinking water supply, non-drinking water supply and drainage systems, which flow in and out of buildings and between given connection points to points of use and/or disposal.
- b. Water pump installations shall be designed for unmanned operation, controlled through liquid level controllers, capable of pumping the requisite amount of water to the utility or to the ground / overhead tanks/ tanks.
- c. The pumping installation shall withstand the corrosive effects of normal water supply, seepage water and sewage and serve for the anticipated life of the equipment.

**Drinking water supplies or non-drinking water supplies:** Preliminary design and designate the installation, of any pipes, fittings, appliances or other items that directly or indirectly involve the supply of drinking water and non-drinking water, including fire services from a given connection point, or onsite supply source to a point of use within a property.

**Sanitary disposal system:** Preliminary design and designate for the installation of any drains, fittings, pipes, fixtures, appliances or other items involved in the collection, conveyance, disposal or treatment of sewage, trade waste or grey water that is above ground.

**Drainage:** Preliminary Design and designate the installation of any below ground drains, pipes, fittings, appliances or other items involved in the collection, conveyance, disposal or reuse of sewage, trade waste or stormwater that is . Inspection pits and inspection chambers.

**Roof drainage systems:** design and designate roof gutters, flashings, piping, sheeting, roof covering or other above ground items involved in the collection, conveyance, disposal, treatment, storage or reuse of rainwater.

**Mechanical services:** Preliminary design and designate the installation of any valves, regulators, registers, pipes, ducts, flues, tanks, heating and cooling lines or surfaces, cooling towers, boilers, burners, solid fuel heaters, coils or other items involved in heating, cooling or ventilating a building by mechanical means.

**Plumbing Fixtures**—The Plumbing Engineer coordinates the appropriate type of fixtures in the different areas of the building. Close coordination is required for code requirements, number and placement of the plumbing fixtures. Looking at the domestic water system and sewer system with the whole building approach the Plumbing Engineer realizes that low flow fixtures reduce water and sewer consumption. In a municipal system, reducing the amount of municipal sewer and domestic water taken from and placed into the local fresh water supply, depends on more buildings using a water conservation approach to water supply and disposal.

**Sanitary Sewer Systems**—Water flowing from plumbing fixtures collects in the building sewer system. The Plumbing Engineer designs this system to a point it connects to a municipal sewer system or to an on-site disposal or containment system. Some facilities require a separation between waste streams and/or treatment of special waste systems before they enter a common building waste system. For example, the grease waste from a kitchen can damage the sewer piping system. As a result, a grease trap is installed to capture the grease before it enters the common building system.

**Storm Water Systems**— During a rain or storm event rain water falls on building roofs, parking lots, and green spaces. In northern climates snow falls on a site in the same places. The water from the rain or snow is collected in the storm water system. The

question of what to do with this water is becoming a debated topic and requires different approaches in different locations. The traditional way to manage storm water was to remove it from the building and site as quickly as possible. In some growing communities this approach resulted in devastating results by creating flooding and contaminating fresh water supplies downstream of the buildings. Options on methods to handle storm water should be discussed early in the design process.

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**CHAPTER 8**

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**POWER SUPPLY & TRACTION SYSTEM**

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**8.1 DETAILED SCOPE OF WORK:**

The scope of work for GC under this contract includes the following, but not limited to

- (1) The GC shall conduct simulation studies (by using software approved by Employer) as under:
  - i. Traction Power Simulation considering (n-1) scenario at various levels.
  - ii. HV & LV load flow studies including Voltage drop calculations of control and power cables, Power Factor & Harmonics studies and shall submit an integrated comprehensive scheme for control and correction of power factor and mitigation of harmonics as per relevant regulations/standards for complete power supply network.
- (2) GC shall be responsible for preparation of typical method statements, required tools and plants/machinery, checklists for installation, testing and commissioning of OHE system to be incorporated in bid documents for construction contracts with references of such implementations outside India as per the international practices for similar operating speed as of Namo Bharat corridors.
- (3) Preparation of typical method statements, required tools and plants/machinery, checklists for installation, testing and commissioning of power supply system for incorporation in bid documents.
- (4) For energization of OHE and Cable system, clearances are required from DOT (Department of Telecommunication) & PTCC (Power Telecom Coordination Committee) for which fees shall be paid by Employer and GC shall coordinate and associate for joint surveys with DOT and PTCC for obtaining requisite certification. Efforts shall be made for mitigating the requirement of booster transformers for OHE system.
- (5) Preparation of typical earthing and bonding schemes of Power Supply and Traction systems for bidding documents of PST tenders and providing input to the civil contractor.
- (6) Preparation of typical arrangements/layouts of different switching stations in elevated and underground sections, specification of switching equipment, recommending suitable switchgears, e.g. LBS, Isolator etc. for feeding posts/isolation of 25 kV cable from ROCS. Switching station room size shall be optimized for underground sections.
- (7) Before mobilization of PST Contractors, GC shall provide all required inputs for civil bidding documents / civil contractors such as pegging plans, earthing & bonding requirements, typical PST structure loads such as OHE structures/Power Supply equipment/cables etc. with sizing & fixing/supporting arrangements, cutouts, track crossings, typical cable layouts, specification and fixing arrangement, space requirements etc., requirement of neutral section in tunnel with preference for bored tunnel etc.
- (8) Typical arrangements of OHE structures, arrangement of OHE and RC/OPC at Stations, OHE conductor sizing and specification such as Contact, catenary, RC, OPC, BEC, dropper, Jumper, feeder, bus bar, typical, maximum span calculation, OHE U-bolt design, method statement/checklist for the checking of U bolt before and after casting of parapet, Jumper connector and PG Clamp size suitable for Jumpers and OHE Conductors etc.
- (9) EHV and HV Cable route survey and preparation of cable laying plans for bid documents.
- (10) Preparation of typical Power Supply diagram for 33 kV network, including SLDs, typical ASS layouts for room sizing, requirements of loading deck, ASS Transformer

- sizing/rating calculation etc., for bidding documents of PST tenders and providing input to the civil contractor.
- (11) To prepare typical equipment layout, preliminary building layouts and other drawings & specification pertaining to RSSs (with AIS type & GIS type), preparation and submission of techno-economical analysis of AIS vs GIS to Employer.
  - (12) Sizing and specification of Power Cables (EHV, HV, LT) and Control cables, lightning arresters, isolators, bus bar arrangement, circuit breakers, CT's, PT's, metering panels and any other equipment/material at each RSS & ASS for bid documents.
  - (13) Preparation and analysis of typical protection and interlocking scheme of RSS, OHE, ASS with different options.
  - (14) Typical architecture, drawing & specification of SCADA system of power supply & traction system including but not limited to RSS, ASS, Switching Stations, OCC, BCC, giving due consideration to requirements of integration with SCADA systems of interconnected NCRTC corridors. Preparation of typical I/O lists of the complete PST system.
  - (15) Preparation of specifications for procurement of power from GSS to RSS through Open Access in accordance with relevant regulations of states and incorporation of the same in bidding documents with the approval of Employer.
  - (16) Recommendation for introduction of new technologies for the improvement of system & equipment such as digital twin, digital substations, Cyber Security, AI-based condition monitoring and predictive maintenance for power supply & traction system, energy management etc. supported by proven-ness considering local conditions, life cycle cost etc.
  - (17) Preparation of technical specifications and drawings, cost schedules/bill of quantities, cost estimate along with basis/analysis of rates, interface documents for bidding documents for Power Supply & Traction system including SCADA, viaduct lighting & power sockets.
  - (18) Liasoning, interfacing & coordination with Power Supply Authorities and other agencies, obtaining estimate for direct power supply connections at all stations. Employer will provide requisite assistance including payment of fees to the authorities (if any). Based on the estimate of direct supply vs. 33kv Ring Main system, a detailed techno-economical analysis with report to be prepared and submitted to Employer.

## CHAPTER 9

### OPERATIONS & SECURITY REQUIREMENTS FOR GC SCOPE:

#### 1. GENERAL

The GC (DC) shall ensure that all civil, architectural, structural, and MEP designs for stations (elevated, at-grade and underground), tunnels, viaducts and associated structures comprehensively incorporate necessary provisions for 'Operations & Security' as detailed in Employer's requirements and interface matrices. All provisions shall be coordinated closely with the O&M Operator and clearly reflected in deliverables.

#### 2. SPECIFIC REQUIREMENTS

##### 2.1 Space Planning and Rooms for Operations

- Allocate and clearly indicate all required rooms/spaces for Operation and Security but not limited to AM/SM Room, Mess Room, House Keeping Room, Security Room, Utilities such as Washrooms (Male/Female/Differently abled) & Drinking Water, Male/Female Changing Room, Store for Operation, Document room, Technical Staff Room, Cleaning machine and chemical room etc. The arrangements for power sockets along with Air Conditioning shall also be planned on requirement basis.
- Room sizing, access, and utility provisions shall strictly follow Operations and Security requirements.
- Clearly indicate the requirement of air conditioning/ventilation in rooms for Operations and security.
- The layout of the SCR should emulate the mini-Operations Control Centre (OCC) design, with all workstations stacked along a single wall, to maximize space utilization and ensure optimal visibility and access for the Station Controller.



- Clearly indicate the signages in the station area providing clear information regarding utilities, adjoining areas, platform access etc. in such a manner that passengers may be able to access the station without requirement of any aid from the station staff.
- **Crew Control Room:** Provide comprehensive designs for Crew Control at the terminal station connecting station with following facilities but not limited to:
  - Crew Management Room
  - Rest Room (Male/Female)

- Locker Room (Male/Female)
- Mess Room & Washrooms (Male/Female) etc.
- Recreation Room
- Counselling Room
- Meeting Room etc.

Provision for **multiple standalone Crew Control facilities** should be made at the interchange stations of the Namo Bharat. Since different lines will be managed by separate operators and trains are expected to transition between lines due to interoperability, it becomes necessary to enable **crew changes at these interchange stations**.

- **Lost & Found and Help Desk:** One dedicated room for Lost & Found and Help desk at any station preferably middle of the line shall be planned.
- Provide clear designs indicating First Aid/Nursing room at the interchange stations or high ridership stations. Also, provide signages required at interchange stations.
- Provide comprehensive design clearly indicating Parking spaces, EV charging station, Halt and Go Lanes, CCTV Masts, Vehicular movement plan, Boom barriers at entry/exit of parking with separate entry and exit points & enclosed parking spaces to reduce disputes, pedestrian paths etc in the circulating area of the station at ground level. Parking's shall be designed with booth for the parking operator with power sockets and proper provision for ventilation.
- Provide water connection (tap) and power sockets for Housekeeping Activities at each level of the station at every 50-80 meters at various location like concourse paid and unpaid, platform, near stairs and entry gate. Waste water drainage pits at various locations for Housekeeping.
- Provide Ramps where there is grade separation.
- Provide meeting room at prominent stations in each District for meeting with civic/law enforcement agencies on each corridor.
- Provide comprehensive designs for the Emergency Evacuation Staircases/Shfts, Emergency Exit & Firemen Staircase at the underground stations with appropriate latching/opening arrangements with proper CCTV coverage and access control measures.
- Provide comprehensive designs for SCR in such a way that no pillar obstructs the view of the SCR and EFO with proper ventilation. At least one EFO may be merged with SCR for efficient utilization of the manpower.
- Provide comprehensive designs for seamless integration with other modes of transport including metro systems with paid-to-paid connections.
- Provide comprehensive designs of the station paid concourse area in such a way that the utilities such as washrooms & drinking water are centrally located, easily accessible and at easily sight-able location.
- The station façade at concourse shall be so designed that there shall be no rainwater ingress in the areas where Escalators, lifts and security equipment are provided.

## 2.2 Space Planning and Rooms for Security

- **Frisking & Checking Point at Stations:** Clearly indicate the security check point ahead of the AFC entry Gates array with appropriate provision for Male/Female DFMDs, X-Bis Machines, BP Morcha and Desk for Security Supervisor. Necessary arrangements for power connection, LAN Connectivity and ventilation for security equipment and security staff shall be provided.

- Provide room for Security Cluster Officer for group of every 4 station.
- Provide Police post at every station at suitable location preferably at ground level in the circulating area with minimum two rooms, washroom and pantry facility in it. And provide Police Station Building in each District as per norms specified for police stations and police posts.
- Provide Security Room and Guard post at each RSS.
- Provide comprehensive design for mini security control room for every 8 stations. At these stations separate security control room will not be required. Provide comprehensive design for Joint Security Command Control Centre at OCC for each line.
- Provide comprehensive design for Barrack Accommodation for each state SSF (State Security Force) as per norms specified by SSF.



**CHAPTER 10****Signalling & Telecommunication (S&T), Platform Screen Door (PSD) and AFC Requirements for GC Scope****1.0 GENERAL**

Signalling & Telecommunication (S&T) includes Signalling and Train Control (LTE and/or wi-fi) and Telecom systems. The GC (DC) shall ensure that all civil, architectural, structural, and MEP designs for stations (elevated, at-grade and underground), tunnels, viaducts and associated structures comprehensively incorporate necessary provisions for Signalling & Telecommunication (S&T) Platform Screen Door (PSD) and AFC systems as detailed in Employer's requirements and interface matrices. All provisions shall be coordinated closely with the system contractors and clearly reflected in deliverables.

**2.0 SPECIFIC REQUIREMENTS****2.1 Space Planning and Technical Rooms**

- Allocate and clearly indicate all required rooms/spaces for Signalling, Telecom, and PSD systems, including but not limited to SER, TER, SMR, SCR, Niches, PSD, AFC panel/control rooms/TOMs/niches at platform/concourse levels, ensuring compliance with interface matrices.
- Room sizing, access, and utility. provisions shall strictly follow system contractor requirements.
- Ensure rooms are designed without windows, free from water/dust ingress, and not located beneath expansion joints, staircases, lift or escalators
- Design all platforms (elevated, underground, at-grade) to accommodate S&T, PSD, AFC installations, including structural provisions for hanger walls, beams, supports, mounting loads, and access as specified, and any additional requirements indicated later.
- Include Street level detailing with parking area and entry / exit mentioning. Detailing of number of floors of station like PD area etc., availability of electric light boom and other necessary arrangement if any.

**2.2 Cable Routing, Containment, and Embedded Provisions**

- Provide comprehensive designs for cable trays, hangers, ducts, risers, sleeves, shafts, hume pipes, trenches, pull-pits, containment structures, etc. required for routing S&T PSD and AFC cables.
- Clearly indicate routing paths, ensuring EMC compliance, ease of maintenance, and allowances for future upgrades at stations (elevated, at-grade and underground), viaducts, tunnels.
- Coordinate and include necessary structural cut-outs, embedded conduits, trenches, and penetrations within civil/structural designs according to S&T, PSD and AFC requirements.

**2.3 Structural Supports and Mounting Provisions**

- Detail comprehensive structural supports, hangers, trays, brackets, mounting bases, chainages for signal, antenna and equipment installation and any other necessary provisions required for installation of S&T, PSD and AFC equipment including but not limited to signals, antennas, point machines, wayside boxes, telecom towers, CCTV, clocks, and PA speakers at stations (elevated, at-grade and underground), viaducts, tunnels.

**2.4 Power, Earthing, and MEP Interfaces**

- Design and clearly specify all power supply provisions for S&T, PSD and AFC systems, including but not limited to DG sets, UPS systems, socket outlets, MCB ratings and main/clean earthing arrangements, integrated with electrical and MEP layouts.

- Indicate earthing bars, busbars, power distribution points, and other related electrical infrastructure comprehensively in accordance with system contractor specifications.

## **2.5 Fire, HVAC, and Safety Provisions**

- Coordinate and integrate all necessary fire detection, suppression systems, HVAC, illumination, and other safety provisions specifically for S&T, PSD and AFC spaces, including but not limited to technical rooms and cable routing areas.

## **2.6 Signage and Visibility**

- Ensure station and platform signage, clocks, Passenger Information Display Systems (PIDS), and public area fittings do not obstruct or interfere with the visibility or functioning of S&T, PSD and AFC devices.

## **2.7 Drawings, BIM, and Deliverables**

- Clearly document all S&T, PSD and AFC provisions within General Arrangement (GA) drawings, GAD including Slab and Wall cutouts drawings indicating the sizes of cutouts suitable for laying all required services i.e. duly integrated with all services with back up data to justify the sizes of cutouts, BIM models, room layouts, schedules, and any other necessary documentation.
- Regularly update all design documentation to reflect the latest input and feedback from the GC and system contractors throughout each design stage.

## **2.8 Interface and Coordination with GC**

- Continuously interface and proactively coordinate with the GC and relevant system contractors to effectively incorporate all technical requirements related to S&T, PSD and AFC systems into civil, structural, and MEP designs.
- Actively participate in coordination and interface meetings, promptly respond to review comments, and integrate all feedback from GC into design submissions.
- Note: Below is list of some specific points which are to be taken into consideration while detailing:
- Trenches may be provided in place of Utility Gallery in Depots.
- SMR, UPS, SCR, etc. may be planned nearby SERs/TERs (within 50 m).
- False floor of 450 mm height (recommended) for all S&T technical rooms (SER/TER/CER) in place of tile floor.
- All S&T (SER/TER/CER/Lab/Server) technical rooms should not be on the ground floor or in basement. Also all S&T Technical Rooms should not be located near to ASS, Mess room etc.
- There should be no pillars inside any equipment room (SER, CER, or similar) to avoid obstruction.
- Cut out in the rooms for cable connectivity should be provided in such a way that there is no possibility of water ingress through these cutouts.
- Platform shall be designed to cater the load of PSD and core cutting in the platform edge for PSD installation (GC shall interface with GC/PSD contractor for load and other PSG requirements).
- The distance between one of platform edge and the SER should be approximately 70-80 meters.
- In underground stations, no infringement should be there within 1 metre of PSD header box.
- All drawings prepared must have coordinates for centre of track, start and end of platform area i.e. NSP of train.

- Cable routing should not pass through other rooms, route should be clear to access.

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**CHAPTER 11**

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**DESIGN DOCUMENT SUBMISSION REQUIREMENTS**

(DESIGN DELIVERABLES)

**11.1 Submission of Documents & Designs**

The design, including conceptual and preliminary drawings, 3-D renderings, BIM Models, all necessary reports/documents/analysis/calculations and the final Bill of Quantities with cost analysis and specifications substantially developed to define the Works, including, but not limited to, locations, shapes and sizes shall be submitted to the Employer/Employer's Representative for the Review, approval and further tendering purposes.

The GC shall maintain records showing design calculation and data supporting design review activities. The Employer reserves the right to inspect and audit these documents at any time to verify the effectiveness of design reviews.

The GC shall deliver all the drawings and documents produced / prepared in connection with this contract. They will be packaged as directed by the Employer/Employer's Representative.

The GC shall prepare and present drawings describing the civil, structural, architectural, Tracks, MEP, VAC design which shall, at a minimum, include, but not be limited to:

1. Land Plan
2. Site plans;
3. Street level Plan
4. Plans at each station & Building level;
5. Area Schedule
6. Roofing and Facade System along with lighting
7. Landscape and Grading Plan
8. Surface drainage design and storm water management Plan
9. Sections and elevations;
10. All critical and relevant typical details
11. Multi Modal Integration Plans
12. Complete Signage Design & Layout (Internal & External)
13. Schedule of Finishes and Colour Scheme
14. Necessary reports/documents/analysis/calculation/simulation/ methodology;
15. Alignment drawing & Track Plans
16. RSI study reports for standard spans and for longest non-standard spans.
17. Construction sequence drawings;
18. Plans, sections, elevation and sketch design studies of all typical features. Typical repetitive conditions to be noted as such and located.
19. Traffic management plan and report
20. Design calculations to reflect the definition of the Works;
21. Bill of Quantities along with cost analysis and sufficient specification for all the works in sufficient accuracy to be able to proceed to Tender for, structural, Architectural finishes and MEP works etc.
22. Technical specifications in sufficient detail of materials and workmanship to permit tenderers to bid for the work;

23. A design brief for MEP services covering the basis/ principles/ norms followed for various activities. Drawing for all design to be submitted for tendering purposes.
24. A draft description of assumed construction methods.
25. Comments, if any, on the documents supplied by the Employer/Employer's Representative.
26. Any other documents that may have been requested by the employer/Employer's Representative.

All drawings shall be submitted in legible copies of the appropriate size.

**The GC shall provide the following Design Deliverables (common for all disciplines) to the Employer/Employer's Representative for review and notice:**

#### **Tender Drawings Submission**

GC shall provide sufficient designs, drawings, specifications, BOQs, milestones, rate analysis and any other documents as required, so that employer can go for "Design and Built contract & Part Design and Built" for all the components covered in this scope.

Preparation BOQ and specifications of various items, assistance in pre-bid meeting, Preparation of documents (BOQ and specifications) for:

- All works related to civil, E&M, Plumbing, Fire Detection and Fire Suppression, ECS, TVS, BMS and SCADA including stations and Tunnel etc etc
- Any other tender documents as required by employers.

- 11.2** The GC shall submit all the drawings and documents for each discipline (Civil, structural, architectural, **Track supporting structure within station, track alignment and design in Viaduct** and tunnel MEP, ECS, TVS, BMS, SCADA and VAC as applicable) produced / prepared in connection with this contract and tentatively as detailed **below .3** sets of drawings (A1 & A3), documents, reports etc. as required by Employer along with two sets of soft copies in the form of CD/DVDs. They will be packaged as directed by the Employer/ Employer's representative.

| Submittal  | No. of Paper Copies |    |    | No. of electronic copies | Reference |
|--|---------------------|----|----|--------------------------|-----------|
|  | A1                  | A3 | A4 |                          |           |
| Initial Services Programme and Design Submission Programme with Supporting Information and Narrative |                     | 3  |    | 2                        |           |
| Monthly Programme Update   |                     | 3  |    | 2                        |           |
| One Month's Design Rolling Programme   |                     | 3  |    | 2                        |           |
| Monthly Progress Report  |                     |    | 3  | 2                        |           |
| Preliminary Designs  | 3                   | 3  |    | 2                        |           |
| Report And Documents As Applicable   |                     |    | 3  | 2                        |           |

| <b>Submittal</b>   | <b>No. of Paper Copies</b> |           |           | <b>No. of electronic copies</b> | <b>Reference</b> |
|--|----------------------------|-----------|-----------|---------------------------------|------------------|
|  | <b>A1</b>                  | <b>A3</b> | <b>A4</b> |                                 |                  |
| GADs, For Each Contract Package As Decided By Employer/Employer's Representative | 3                          | 3         |           | 2                               |                  |
| Design Quality Assurance plan  |                            |           | 3         | 2                               |                  |
| Final Completion Report  |                            |           | 3         | 2                               |                  |
| Traffic Management Plan  | 3                          | 3         |           | 2                               |                  |
| Investigation, PDA, EBS and Other Survey reports.                                |                            |           | 3         | 2                               |                  |
| Any Other Submittals Required By the Employer                                    | 3                          | 3         | 3         | 2                               | As Applicable    |