

SCOPE OF WORK & TECHNICAL REQUIREMENTS

1. Name of Work

Scope of work consist of supply and replacement of structural steel Cable Gallery [OHE (Railway traction line) & Non OHE portion] and Pipe Cum Cable Gallery (OHE portion only) on EPC (Engineering, Procurement & Construction) basis including associated civil, foundation, fabrication, erection, testing, and handing over works in CHP area of NTPC Simhadri, including portions passing over existing “Railway Track & 25 kV OHE influence zone” and passing between CW duct, Cable duct, sewer lines and buildings and/or associated structures, .

The works includes:

- A. The “**Cable gallery**” length approximately 630 m. The total load including cable, cable trays & fixtures shall be considered approx. **840 kg/mtr.** (Supply of cables, cable trays and fixtures are excluded from the SOW)
- About 570 m cable gallery passing over ground (crossing roads and pipe cum cable gallery) including 180m passing between underground CW duct and the buildings (clear space between buildings and duct is approximately 13 m)
 - About 60 m cable gallery passing above existing railway tracks and live 25 kV OHE system.
- B. The “**Pipe cum Cable gallery**” of about 80 m length pass above existing railway tracks and live 25 kV OHE system. The total projected load of pipes and cable & cable trays to be considered approx. **1120Kg/m** (weight of pipes including water/LDO is about **580 kg/m**, and cable & cable trays with fitting is **540kg/m**) (supply of pipes and cable and cable trays are excluded from the SOW)

Agency is advised to **visit the site prior to bidding and get themselves acquaint to the scope of work, necessary statutory requirement and clearance and safety measures for safely execution** of the job . No request will entertain after awarding of the contract for any changing scope of work on the ground of incomplete information. In this regard, the decision of the EIC will be final.

Reference Document:

The following drawings/documents are provided for reference and tendering purposes only:

- Indicative routing of cable gallery and pipe cum cable gallery.
- Sectional details for proposed cable gallery
- Detailed drawings of Pipe cum cable gallery near OHE and track area zone.
- Existing pipe cum cable racks details at the vicinity of the proposed facilities.
- Wind Data
- Seismic-Criteria
- Preliminary Geotechnical data
- Civil Scope of work-Part-A
- Detailed Civil Specs-Part-B (Technical specification)
- Indicative reference QP & FQP

These drawings and data shall be treated as reference documents only.

Final drawings, calculations, and construction methodology shall be developed by the EPC contractor and get it approved by NTPC and statutory authorities prior to execution.

Note: For pipe cum cable gallery, If the sections designed based on the projected loading are found to be lighter than the existing gallery sections drawing (in terms of load-carrying capacity), agency must provide minimum sections as given in NTPC tender drawing (Existing reference structure). For termination with the existing galleries, agency has to develop the drawings and get it approved by NTPC

The services indicated below are only indicative and intended to outline the overall scope of work. For detailed technical requirements, specifications, procedures, and execution methodology, the approved Technical Data Sheets, detailed specifications, and Terms & Conditions of the contract shall prevail. In case of any discrepancy, the provisions of the Technical Data Sheets, specifications, and contractual Terms & Conditions shall supersede any other reference.

10.0 Supply of structural steel for galleries and trestle:

Supply of Structural Steel for Cable Gallery & Pipe Gallery including Trestles and Walkway Grating, handrails and earthing strips (for trestle and associated material)

The scope of work covers supply of structural steel materials for construction of Cable Gallery and Pipe Gallery, including trestles/support structures and GI grating walkways, complete in all respects as per approved drawings, specifications, and applicable IS codes.

Electro forged gratings (Galvanised), walkways and platforms shall be supplied as per approved drawings and provisions of technical specifications.

The scope includes :

- Shop-fabricated structural members, duly marked and identified, and
- Supply of raw structural steel materials for fabrication at site for completion of facility in all respect.

For minor site fabrication works, NTPC shall provide space and electrical power, while the agency shall arrange/ develop its own enclosed fabrication shed, tools, tackles, welding equipment, consumables, manpower, safety arrangements, and all associated infrastructure required for fabrication and painting within the enclosed space.

The scope further includes transportation of materials/fabricated members to site, unloading, internal shifting, proper stacking, and preservation of materials at site until erection, including protection against corrosion, moisture, and mechanical damage.

All materials shall be subject to inspection by NTPC, and the agency shall submit relevant mill test certificates, quality documents, and galvanization certificates as applicable or in Quality plan. Any damage during transportation or handling shall be made good by the agency at no extra cost.

20.0 Erection/installation works specification:

20.1 Survey, Testing, Engineering, Design and approval

- Detailed site survey including geotechnical survey, GPR survey, route verification, level confirmation, and interface identification.
- Development of complete engineering design and drawings, (as per relevant standard considering CX coastal environment, considering corrosion allowance) including:
 - GA drawings
 - Sectional drawings
 - Foundation drawings
 - Fabrication and erection drawings
 - Structural analysis and design
- Structural analysis and design calculation using STAAD/SAP 2000 models and/or computer work sheets or any other software model as mutually agreed with Owner.
- Submission of drawings and design calculations in AutoCAD / PDF / Excel formats for approval from NTPC.
- Preparation and submission of drawings, design calculations, erection methodology, and safety plans for complete works including CW duct area, building and railway track & OHE influence zone.
- Obtaining all statutory approvals / Railway clearances, wherever applicable, including approvals required for execution of works over/near existing railway track and energized OHE.
- Agency must follow the clause 4 and associated sub clause for “DESIGN CRITERIA AND GENERAL SPECIFICATION “ for design consideration of the cable gallery and associated civil work and corrosion protection under Technical Requirement in addition to cluse 5 and related subclause under general requirement
- Should comply with clause 6 and related subclause for material specification
- Agency should comply with clause 7 and associated sub clause for foundation system and geotechnical data
- In general agency should comply with all relevant clause and subclause in technical specification to meet the requirements for completion of facility in all respect.

20.2 Fabrication and Erection of cable gallery and Trestles (about 630 m)

The scope of work includes survey, fabrication, transportation, testing ,erection , alignment, and completion of a Cable Gallery (**single box type**) of approximately 630 m length (subject to final site survey), having a clear width of **minimum 1.8 m**, complete in all respects (including earthing of trestles) as per approved drawings, specifications, and applicable IS codes.

The Cable gallery as well as Pipe cum Cable Gallery shall be Structural Steel Superstructure with Steel Truss (Lattice Girder) having a general span of 12.0m/15.0m, however, the span may varies as per actual site conditions preferably adopting height up to bottom chords of gallery as 3.5 m, 8.5 m, and 11.3 m wherever required for crossing of existing gallery/trestles and approval from NTPC (tentative layout and drawing has been attached)

Structural Configuration

- 2-legged steel trestles for normal straight spans

- 4-legged steel trestles at elevated sections, change in direction, crossings, and other special locations

Alignment & Special Locations

- Approximately 570 m of cable gallery shall run over ground, including crossings over internal roads and existing pipe/cable gallery trestles, and about 180 m (including in aforesaid 570 m) passing between underground CW duct and adjacent buildings.
- Approximately 60 m of cable gallery shall pass above existing railway tracks and live 25 kV OHE system, requiring adoption of approved safety procedures, erection methodology, and statutory compliance during execution.

Environmental Conditions

- The structure shall be designed and protected for Coastal / Marine Industrial (CX) environment, including surface preparation and corrosion protection system as per approved specifications.

General Inclusions

- Fabrication of structural steel members as per approved quality plan/methodology)
- Transportation to site, unloading, internal shifting, and erection
- Bolting, welding, alignment, levelling, and finishing works
- Temporary supports, scaffolding, safety arrangements, and quality control
- Inspection, testing, and submission of required documentation

No payment for scrap generated due to fabrication, cutting etc. shall be made. Agency should bid taking consideration accordingly

20.3 Fabrication and Erection of Pipe-cum-Cable Gallery and trestles (~80 m) over Railway Track & Live 25 kV OHE

The scope of work includes fabrication, transportation, erection, alignment, connection termination and completion of a Pipe-cum-Cable Gallery of approximately 80 m length, passing above existing railway tracks and live 25 kV OHE system, complete in all respects (including earthing of trestles),

If the sections designed based on the projected loading are found to be lighter than the existing gallery sections drawing (in terms of load-carrying capacity), agency must provide minimum sections as given in NTPC tender drawing (Existing reference structure). For termination with the existing galleries, agency has to develop the drawings and get it approved by NTPC

The work shall cover structural steel pipe rack and support system, including beams, columns, bracings, purlins, walkways/handrails, gratings, connections, bolting/ welding, and all associated steel works required for the complete facility.

All activities in the railway influence zone and OHE corridor shall be executed with approved erection methodology, statutory safety compliance, and coordination with concerned authorities/ railways, including provision of temporary supports, protective shielding, scaffolding, and safety measures to prevent any risk to railway operations and OHE.

The structure shall be designed and protected for Coastal / Marine Industrial (CX) environment, including surface preparation and corrosion protection system as per approved specifications.

The scope includes fabrication (shop or site as approved), transportation to site, unloading, internal shifting, erection, alignment, levelling, finishing, inspection, testing, and documentation any temporary support for end termination with existing pipe trestle structure.

No payment for scrap generated due to fabrication, cutting etc. shall be made. Agency should bid taking consideration accordingly

20.4 Erection of Pipes in pipe trestle:

The work shall include termination and connection of pipelines on the pipe trestle portion. Supply of pipes shall be in the scope of NTPC, while the agency shall be responsible for handling, erection, positioning, alignment, and connection of the pipes, including all necessary supports, clamps, and fittings as per approved drawings.

Details of pipes to be fixed are as follows

- Fire Hydrant Header – 250 mm dia, heavy-duty MS pipe
- Sprinkler Header – 300 mm dia, heavy-duty MS pipe
- Service Water Pipeline – 150 mm dia, heavy-duty MS pipe
- LDO Pipeline – 6” dia, heavy-duty carbon steel pipe

Pipes shall be protected for Coastal / Marine Industrial (CX) environment, including surface reparation and corrosion protection system as per approved specifications.

20.5: Dismantling of Existing Pipe Gallery (Track & OHE Area)

This BOQ item covers dismantling of the existing Pipe Gallery portion located in railway track and OHE area, to be carried out only after successful completion of the new Pipe-cum-Cable Gallery and receipt of written clearance from NTPC.

The item shall be executed on lump-sum basis, inclusive of all activities, tools, plants, equipment, and safety arrangements required for completion of the work in all respects.

The scope of work includes safe dismantling, handling, and disposal of the existing Pipe Gallery structure located in the railway track and live 25 kV OHE influence zone, strictly as per approved methodology and directions of Engineer-in-Charge (EIC), NTPC.

Scope Includes

- Dismantling to be carried out only after commissioning of the new Pipe-cum-Cable Gallery and clearance from NTPC
- Cutting, dismantling, and removal of:
 - Structural steel members (pipe trestles, beams, columns, bracings, supports)
 - Existing pipelines mounted on the pipe gallery
- Deployment of all required cutting tools, tackles, cranes, lifting equipment, scaffolding, and manpower
- Safe lowering, handling, segregation, and stacking of dismantled materials
- Transportation of dismantled materials and scrap to NTPC-designated scrap yard
- Disposal and accounting of scrap as per instructions of EIC, NTPC
- Protection of railway tracks, OHE system, nearby structures, and utilities during execution
- Compliance with all safety procedures, statutory requirements, and NTPC safety guidelines, especially for work in railway and OHE zones

General Conditions

- Work shall be executed under restricted working conditions with due care to avoid disruption to railway operations and OHE
- Any damage to existing assets due to dismantling shall be rectified by the contractor at no extra cost
- All incidental activities required for safe and complete dismantling, whether specifically mentioned or not, shall be deemed included in the scope

30.0: Associated civil works including supply of material for open cast foundation and piling Foundation

The scope of work covers execution of civil works for pile (if required) and open-cast foundations, required for the Cable Gallery and associated structures, complete in all respects, in accordance with approved drawings, specifications, and approved **Field quality plan**.

The work shall broadly include survey, setting out, excavation, piling, concreting, and finishing of foundations, including foundations located in railway influence zones, CW duct areas, and other congested or restricted locations, as applicable.

General Scope Includes

- Excavation in all types of soil and strata, including dewatering if required
- Construction of pile foundations (if required; cast-in-situ or as specified), including pile caps
- Construction of open-cast / isolated foundations, pedestals, and tie beams where applicable
- Supply, placement, laying, compaction, finishing, and curing of RCC (M35 grade) and PCC
- Supply, cutting, bending, fixing of reinforcement steel as per approved drawings
- Formwork / shuttering and its removal
- Installation and grouting of anchor bolts, inserts, and embedded items

- Backfilling, compaction, disposal of surplus excavated material, and area restoration
- Protection of existing utilities, structures, and services during execution
- Any other civil work for completing the system requirement.

Quality Control & Testing

- All materials, workmanship, inspection, and testing shall be carried out as per the approved Technical Data Sheets (TDS), applicable IS codes, and NTPC specifications
- Mandatory tests for Civil work, and workmanship shall be conducted as specified in approved Field Quality Plan

General Requirements

- The contractor shall arrange all materials, labour, tools & plants, machinery, testing facilities, safety measures, and statutory compliances required to complete the work.
- The works shall be executed in a Coastal / Marine Industrial environment, and construction practices shall be suitable for such exposure conditions
- Any activity, material, or operation not specifically mentioned but required for safe, sound, and complete execution of the foundations shall be deemed included in the scope without any extra cost

Reference Clause

Detailed technical requirements, material specifications, workmanship standards, inspection & testing requirements shall be governed by the applicable Technical Data Sheets (TDS)/specification, which shall form an integral part of the contract.

40.0: Supply and Apply Painting / corrosion protection (CX system)

The scope of work covers supply, surface preparation, and application of painting / corrosion protection system for structural steel and associated metallic components of cable gallery, pipe gallery, trestles, supports, handrails, gratings, and other appurtenances, complete in all respects, suitable for Coastal / Marine Industrial (CX) environment, in accordance with approved drawings, Technical Data Sheets (TDS), and applicable standards.

General Scope Includes

- Supply of all paints, primers, intermediate and finish coats, thinners, and consumables as specified in the approved CX corrosion protection system
- Surface preparation by approved methods such as abrasive blasting / power tool cleaning / hand tool cleaning, as applicable and as specified in the TDS
- Application of multi-coat paint system (primer, intermediate, and topcoats) to achieve specified Dry Film Thickness (DFT)
- Touch-up painting at damaged areas, edges, welds, bolts, and erection marks
- Protection of adjacent structures, cables, equipment, and flooring during painting works
- Painting of newly fabricated as well as erected members, including repair of transit or erection-related damages

Quality Control & Testing

- All inspection and testing shall be carried out as per the approved TDS and relevant IS / ISO standards/ Field Quality plan including but not limited to:
 - Surface cleanliness verification
 - DFT measurement using calibrated gauges
 - Adhesion and holiday testing (where specified)

- Submission of paint manufacturer certificates, batch test certificates, and inspection records

Environmental & Safety Requirements

- Work shall be executed considering coastal / marine exposure, humidity, and ambient conditions as specified in the TDS/specifications.
- Compliance with all safety, health, and environmental (SHE) requirements, including ventilation, PPE, waste disposal, and fire safety

General

- The contractor shall arrange all materials, labour, tools & plants, scaffolding, access arrangements, testing instruments, and safety measures required to complete the work
- Any activity or material not specifically mentioned but required for complete and durable corrosion protection shall be deemed included in the scope
- The painted system shall meet the design life and performance criteria specified for CX environment

Reference Clause

Detailed technical requirements, surface preparation standards, coating system details, DFT requirements, inspection & testing procedures shall be governed by the approved Technical Data Sheets (TDS)/specification, which shall form an integral part of the contract.

Bidder to quote the rates in attached Bill of Quantities as per the following:

- (a) Supply of Structural steel: 20%-30% of total quoted rate of package
- (b) Erection/installation works: 35%-45% of total quoted rate of package
- (c) Civil works: 15%-25% of total quoted rate of package
- (d) Supply & apply of Painting (CX): 10%-20% of total quoted rate of package

Notes:

Erection/installation works: (a) In case the installation price is below the minimum percentage specified above, the amount by which it is lower shall be retained proportionally from the supply price of contract while releasing payments due on receipt of materials, and no interest shall be payable on the retained amount. The aforesaid retained amount shall be paid on pro-rata basis upon completion of installation of the respective material and its certification by the EIC.

(b) In case the installation price is above the maximum percentage specified above, the amount by which it is higher shall be retained while releasing progressive payments due on installation of material, and no interest shall be payable on the retained amount. The aforesaid retained amount shall be paid along with payment due on final acceptance of facilities.

Civil works: (a) In case the Civil works price is below the minimum percentage specified above, the amount by which it is lower shall be retained proportionally from the supply price of contract price while releasing payments due on receipt of materials, and no interest shall be payable on the retained amount. The aforesaid retained amount shall be paid on pro-rata basis upon completion of Civil works of the respective material and its certification by the EIC.

(b) In case the civil works price is above the maximum percentage specified above, the amount by which it is higher shall be retained while releasing progressive payments due on civil works of material, and no interest shall be payable on the retained amount. The aforesaid retained amount shall be paid along with payment due on final acceptance of facilities.

TERMS AND CONDITIONS:

Payment Terms: Progressive payment on Running Account Bill basis on submission of required documents and certification of EIC as per following:

Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication applicable to NTPC for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be reviewed by NTPC.

BOQ no	BOQ description	Payment Terms
10.10	Payment for Supply of Structural Steel (Cable Gallery & Pipe-cum-Cable Gallery)	<p>a) 70% upon receipt of materials/fabricated members at site, after inspection and acceptance by NTPC, along with submission of mill test certificates, galvanization certificates, and quality documents.</p> <p>b) 20% after pro-rata erection works, alignment, and bolting/welding of the respective structures.</p> <p>c) 10% after submission of material reconciliation statement, attending minor defects as noticed and final acceptance by EIC/EIC representative.</p> <p>Note: Payment shall be done based on approved drawings only. Any minor items like fasteners, cleats, pipe anchors etc. shall not be paid separately. Agency to quote the rates accordingly. In case of any dispute, NTPC weightment shall be applicable.</p>
20.10	Payment for Engineering, Survey, Design & Statutory Approvals	<p>a) 30% upon completion of detailed site survey, including geotechnical survey, GPR survey, route verification, and submission of survey reports.</p> <p>b) 30% upon submission and approval of General Arrangement (GA) drawings, foundation drawings, fabrication drawings, and associated engineering documents.</p> <p>c) 30% upon submission and approval of structural design calculations, erection methodology, safety plans (including Railway & OHE influence zone), and receipt of all statutory approvals/clearances wherever applicable.</p> <p>d) 10 % after completion of work in all respect</p> <p>Note: No payment shall be released without approval of documents by NTPC.</p>

		Engineering payment shall be independent of physical progress but linked strictly to document approval.
20.20	Payment for Fabrication & Erection of Cable Gallery (~630 m)	<p>a) 80% on progressive erection of cable gallery and certified by EIC.</p> <p>b) 10% upon completion of erection, alignment, leveling, bolting, and welding.</p> <p>c) 10% after inspection, submission of completion documents, and final acceptance by NTPC after complete cable gallery erection works.</p> <p>Work executed in Railway Track & 25 kV OHE influence zone shall be paid only after compliance with approved methodology & drawings and statutory safety requirements.</p>
20.30	Payment for Fabrication & Erection of Pipe-cum-Cable Gallery (~80 m) in Railway & OHE Area	<p>a) 70% on progressive erection of the pipe-cum-cable gallery in Railway/OHE zone, based on certified measurements.</p> <p>b) 20% upon completion of erection, terminations, alignment, and compliance with statutory safety requirements.</p> <p>c) 10% after inspection, submission of completion documents, and final acceptance by NTPC after complete gallery erection works.</p> <p>Note:</p> <ol style="list-style-type: none"> 1) No payment shall be made without written clearance from NTPC for works executed in Railway and energized OHE areas 2) Work executed in Railway Track & 25 kV OHE influence zone shall be paid only after compliance with approved methodology & drawings and statutory safety requirements.
20.40	Payment for Erection of NTPC-Supplied Pipes on Pipe Trestles	<p>Supply of pipes shall be in NTPC scope. Payment for handling and erection shall be made as follows:</p> <p>a) 90% on progressive erection, positioning, alignment, connection of pipelines, hydro test and painting as per approved drawings and FQP.</p> <p>b) 10% after verification, inspection, and acceptance by NTPC.</p>

20.50	Payment for Dismantling of Existing Pipe Gallery (Railway & OHE Area)	<p>Payment for dismantling shall be made as under:</p> <p>a) 80% after safe dismantling, lowering, stacking, and transportation of dismantled materials to NTPC-designated scrap yard.</p> <p>b) 20% after complete site clearance, disposal/accounting of scrap, and certification by EIC.</p> <p>Dismantling shall be carried out only after commissioning of the new Pipe-cum-Cable Gallery and written clearance from NTPC.</p> <p>Note: Weighment shall be done at NTPC Station.</p>
30.10	Payment for Civil Works – Pile Foundations & Open-Cast Foundations	<p>Payment for civil works shall be released progressively (based upon agreed BBU rate) as under:</p> <p>a) 90% of the contract value for Civil works shall be released upon completion of all civil works, duly certified by the Engineer-in-Charge.</p> <p>b) 10% of the contract value for Civil works shall be released upon submission of as-built drawings and final acceptance of all civil works by NTPC and completion of facility in all respect.</p> <p>c) All payments shall be subject to compliance with the approved Technical Data Sheets (TDS), Field Quality Plan (FQP), and other applicable contractual quality requirements.</p>
40.10	Payment for supply and Painting / Corrosion Protection System (CX Environment)	<p>Payment for painting and corrosion protection works shall be made Progressively as follows:</p> <p>a) 95% upon completed area on pro-rata basis in all respect including inspection, Dry Film Thickness (DFT) verification, and acceptance by NTPC.</p> <p>d) 5% shall be retained and to be released after successful completion of Defect Liability Period (DLP)</p>

General Terms and conditions:

1. Bid evaluation shall be done on the total quoted price (lump sum basis)
2. Security deposit and workman compensation policy shall be as per GCC.
3. Contract variation limits:

All the items/equipment/Erection works/civil works & other works as specified shall form part of the "LUMPSUM PORTION". All the items though not specifically mentioned in the Technical Specification but are required to make the system complete in all respects shall be deemed to be included in the LUMPSUM PORTION and the same shall be included within quoted price by the Bidder. Variation in contract price with respect to Contract price for the Lumpsum portion shall be admissible during the execution of the contract only in case there is any change in scope of work with respect to the scope of work identified in Technical Specification.


The variation in the total contract price due to variations shall be limited to GCC. When and if the total variation in contract price exceeds the limit as per GCC, the rates of items requiring revision shall be mutually decided by the Employer and the Contractor.


4. Safety retention@... of service portion of contract: 5%
5. Firm price contract
6. Boarding, lodging and local transportation of workers is in contractor's scope.
7. Contract period: 18 months
8. Defect liability period: As per GCC.
9. Bidder may manufacture the gallery structures as per approved drawings at their own works (shop fabricated) and site fabrication for completion of the facility.
10. The agency shall submit the materials re-conciliation statement monthly or along with RA bill.
11. **Third Party Liability Insurance Policy:**
Total/ Aggregate amount during the currency of Contract: Rs. 50.00 Lakhs or '110% of Contract value (Excluding GST)' whichever is lower
For any one occurrence: 50% of Total aggregate amount
12. Sources of Raw Material for STRUCTURAL STEEL shall be communicated to NTPC EIC before procurement.
13. Field quality checks through FQP, if any, shall be finalized by NTPC Site FQA with agency. Tentative FQPs are attached for bidder's reference purpose.
14. The final QA intervention (QP requirements & NTPC witnesses) shall be as per mutual agreement between NTPC EIC and the agency during detailed engineering, taking reference from the attached QA inputs.


Any other remarks / requirements regarding PDI / QP submission or approval / Routine & Acceptance tests TC submission / inspection reports specified elsewhere in tender documents /tech specs / attachments shall be ignored.


CLAUSE NO.	<div data-bbox="641 121 985 151" data-label="Section-Header">SCOPE OF SUPPLY & SERVICES</div> <div data-bbox="1279 96 1425 168" data-label="Image"> </div>		
1.00.00	<div data-bbox="406 197 891 224" data-label="Section-Header">SCOPE OF CIVIL AND STRUCTURAL WORKS</div> <p data-bbox="406 245 1399 877">The scope of civil and structural work shall include topographical survey, geotechnical investigation, site clearance, GPR survey, preparation of design documents and drawings and getting approval of the same from the Owner and Statutory Authorities, and construction of all civil, and structural works including supply of all construction materials for cable gallery and pipe & cable gallery structures including their foundations for the package. The nature of work generally involves earthwork in excavation in all types of soil and rock including mechanical means, de-watering, shoring, shuttering, sheet piling, backfilling around completed structures, disposal of surplus earth/rock/excavated material/dismantled material, concreting including reinforcement and form work, plastering, corrosion protection measures including painting, fabrication of all structures, pre assembly of fabricated structures , transportation of fabricated structures and erection of steel structures and miscellaneous steel works (i.e., cable supports, pipe supports, ladders, walkways, railing, grating etc.), painting of structures, grouting, dismantling of existing pipe & cable rack at crossings of railway lines & OHEL lines, final grading and site clearance before handing over and any other item of work required for completion of all systems under the scope of work complete.</p> <p data-bbox="406 905 1399 1213">The works covered under the scope of the bidder have to be executed in an existing power station. The bidder shall take all necessary precautions to protect the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to activities of the bidder on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be made - good by the bidder at his own cost to the satisfaction of the Owner. The bidder shall take all necessary safety measures to avoid any harm, injury to his workers/ staff from the equipment / facilities of the power station.</p> <p data-bbox="406 1241 1399 1350">The scope of Bidder for civil and structural as defined above shall include but not be limited to the following structures/ areas/ systems along with their foundations, super structures and finishes complete:</p> <ol data-bbox="440 1377 1399 1787" style="list-style-type: none"> 1. Topographical Survey . 2. Geotechnical Investigation (for additional data, if required by Bidder, beyond details as provided in the specifications). 3. Site clearance including removal and disposal of plants/vegetation. 4. Removal of drains, paving and roads for construction of foundations, temporary diversion of the same prior to removal and restoration of the same after construction. 5. Hard crusting in working area and preassembly area to facilitate movement of vehicles and erection equipment. 		
SIMHADRI SUPER THERMAL POWER PROJECT (4X500 MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATION PART-A	CIVIL WORKS	PAGE 1 OF 5


CLAUSE NO.	<div data-bbox="641 121 985 151" data-label="Section-Header">SCOPE OF SUPPLY & SERVICES</div> <div data-bbox="1279 96 1425 168" data-label="Image"> </div>			
1.00.02	<p>6. GPR survey (Ground Penetrating Radar Survey) at the vicinity of proposed routing of cable gallery and Pipe & cable gallery to identify the existing underground facilities.</p> <p>7. All Civil and Structural works including their foundations for entire area under Bidder's scope covering the following:</p> <p>All Civil & structural works including design, drawings and detailed engineering for</p> <ol style="list-style-type: none"> Cable gallery and its supporting trestles from terminal point near TP-5 to terminal point near TP-4. Pipe & cable gallery and its supporting trestles at crossing of railway lines & OHE lines. Grouting of underside of baseplates of trestles and encasement of baseplate assembly of trestles. Modification and strengthening of existing structures at terminal points. <p>8. Dismantling existing Pipe & cable gallery structure at railway line & OHE line crossings and disposal of material at location inside the plant premises identified by EIC after construction of new gallery and rerouting of cables & piping.</p> <p>9. Earthing mats & risers for all trestles under the bidder's scope.</p> <p>10. All civil and structural works including extension of cantilever related to interface locations at terminal points for cable gallery/Pipe & Cable gallery/ Trestles/ Connecting walkways, etc, as required during detailed engineering</p> <p>11. For steel structures, bidders has to fabricate at factory meeting all the quality and inspection requirements as defined elsewhere in the technical specifications.</p> <p>12. Agency shall visit site and prepare plan for foundation system open/ pile foundation as per space availability and safe execution of the work with stability of nearby structures and railway track .</p> <p>No additional land than what is mentioned in technical specifications, shall be provided by Owner for site fabrication. Bidder has to make all necessary arrangements of water, security, etc. on its own. No claim, whatsoever, regarding time extension and financial implication for site fabrication shall be entertained at any point of time.</p> <p>13. Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required.</p> <p>CORROSION PROTECTION</p> <p>The plant lies in the corrosive category CX as per ISO 12944-2. Protection measures shall be provided for the mentioned corrosivity category with very high durability as specified in Part-B of Technical Specifications.</p> <p>All CX painting system shall be finished with color shades approved by Owner.</p>			
SIMHADRI SUPER THERMAL POWER PROJECT (4X500 MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATION PART-A	CIVIL WORKS	PAGE 2 OF 5


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.03	Shifting of earth for backfilling, disposal of surplus earth/ debris/ rock etc in environmental friendly manner within plant premises and making payment of Seigniorage, royalty, levies, taxes and any other applicable charges etc. shall be in bidder's scope.			
1.00.04	THE SCOPE OF WORK OF THE SUCCESSFUL BIDDER INCLUDES: - (a) To interact, discuss with Owner the modalities, schedule, and design parameters, loading to be considered in line with the Owner's specifications. (b) To submit the drawings and design calculations as per the project schedule sequentially as per the sequence below. (c) Incorporate all the comments/observations/suggestions furnished by the Owner on the drawings and design documents. Sequence of submission of documents: - 1) Design basis which will include all design philosophy, seismic and wind criteria as per specification, foundation type along with bearing capacity as per Geotechnical Report, materials of construction, loading details, finishing schedule etc. 2) General Arrangement drawings including the elevations and cross sections. 3) Design calculation along with the STAAD/SAP 2000 models and/or computer work sheets or any other software model as mutually agreed with Owner. 4) Foundation drawings. 5) Superstructure drawings sequentially as per construction sequence or material projection, as applicable.			
2.00.00	Deleted			
2.01.00	Deleted			
2.02.00	CONSTRUCTION FACILITIES The following are in the Bidder's scope of work pertaining to construction facilities in this package. 1. Construction Water Construction water shall be the responsibility of Bidder during all stages of construction. 2. Construction Power Construction power shall be provided by the Owner at one point (Source). Necessary tapping arrangements like cablings, junction boxes, ELCB etc. from NTPC source is under the scope of contractor. 3. Construction of following temporary facilities of bidder: a) Construction office. b) Construction stores (covered) & open stores as per requirement. c) Workshops for maintenance of construction plant and equipment.			
SIMHADRI SUPER THERMAL POWER PROJECT (4X500 MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATION PART-A	CIVIL WORKS	PAGE 3 OF 5


CLAUSE NO.	<div style="text-align: center;"> SCOPE OF SUPPLY & SERVICES  </div>			
	<p>d) Material/field testing laboratory facilities (if required) and any other temporary building.</p> <p>e) Enclosed covered shed for site fabrication and painting, if applicable.</p> <p>4. Providing all necessary fire-fighting devices/equipment etc. required during the execution stage in project areas including laydown/pre-assembly yard area.</p> <p>5. Providing all tools and tackles, Equipment's required for the work.</p> <p>6. The Bidder shall arrange skilled/semiskilled/unskilled labour (from local source(s) as far as available) and supervisory staff for quality execution of all civil & structural works.</p> <p>7. Development of hard crusted / paved fabrication yard for onsite structural steel fabrication work where permitted. Surface preparation and painting shall be done in enclosed covered sheds.</p> <p>8. Area lighting at the construction / erection site, fabrication, pre-assembly and storage yard, office areas, etc.</p> <p>9. Providing first aid facilities at the construction / erection sites, workshops, laboratories, fabrication, pre-assembly & storage yard, Offices and other places of work as per the requirement.</p> <p>10. Repair & Maintenance Facilities by the Bidder: Bidder shall establish/set up at site suitable repair facilities for construction equipment and machinery (like cranes, hydra, forklifts, welding equipment, dumpers, rollers, etc.). Bidder shall also make arrangements /tie-up with manufacturers / suppliers of such construction plant, equipment & machinery, for periodic overhaul/ maintenance and for repair of major breakdown, if any. Bidder should also keep adequate stock of spares at site for various construction plants, equipment and machinery to meet day-to-day requirements as recommended by the manufacturer / suppliers or as instructed by the Owner. Bidder shall deploy dedicated qualified, full time mechanical / electrical foreman & supervisors for manning the repair facilities as specified above.</p> <p>11. Water sprinkling in construction area and roads, as per requirement/directions of Engineer-in-Charge, to arrest fugitive construction dust.</p> <p>12. Dewatering in construction area during construction period for any seepage water as well as accumulated rainwater is in the scope including all pumps and accessories.</p> <p>13. Housekeeping of all construction area and disposal of construction/demolition waste. This also includes cutting and removal of vegetation including dry vegetation to avoid fire hazard in the entire project construction area.</p> <p>2.03.00 DEVELOPMENT OF LAYDOWN AREA</p> <p>Inside the plant boundary, laydown area (about 2 acre) shall be provided by the NTPC inside the existing plant area as per the availability of space. In case area allocated by the NTPC is not adequate, Bidder to identify the laydown area outside the plant boundary in the areas owned by private owners. Also, development, fencing/boundary wall, security, etc. in the laydown area is in Bidder's scope.</p> <p>2.03.01 The contractor shall develop the following facilities in the laydown area</p> <p>a. Site clearance including cutting of trees/plants/vegetation.</p>			
SIMHADRI SUPER THERMAL POWER PROJECT (4X500 MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATION PART-A	CIVIL WORKS	PAGE 4 OF 5


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	<p>b. Laydown area will be provided within plant premises. Agency has to make own arrangement for material transportation. Further bidder to ensure measures to avoid noise and dust pollution to habitants during the contract period.</p> <p>c. Security of material shall be responsibility of the EPC Contractor, including gate control.</p> <p>d. Levelling, compaction backfilling, for purpose of laydown area surface preparation.</p> <p>e. Hard crusting of Laydown area, fabrication, and pre-assembly yard area has to be carried out. The extent of hard crusting shall be decided by the contractor based on their requirement. Material storage shall be as per guidelines covered elsewhere.</p>		
SIMHADRI SUPER THERMAL POWER PROJECT (4X500 MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATION PART-A	CIVIL WORKS	PAGE 5 OF 5


CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	GENERAL			
1.01.00	<p>This specification is to cover topographic survey, GPR survey, detailed geotechnical Investigation (for additional data, if required by Bidder, beyond details as provided in the specifications), design, preparation of general arrangement drawings, construction and fabrication drawings, supply of labour & materials and construction of all civil and structural works by the Bidder.</p> <p>Description of various items of work under this specification and nature of work in detail are given hereinafter. The complete work under this scope is referred to as civil works. The structures and facilities covered under the scope are given in Part-A(Scope of work) and herein.</p> <p>The work to be performed under this specification consists of design, engineering, fabrication, construction, testing, erection, painting and providing all labour, materials, consumables, equipment, temporary works, temporary fabrication & storage sheds, temporary site offices, constructional plants, fuel supply, transportation and all incidental items not shown or specified but reasonably implied or necessary for the completion and proper functioning of the system, all in strict accordance with the specifications including revisions and amendments thereto as may be required during the execution of work.</p> <p>All construction materials including cement, reinforcement steel, coarse & fine aggregate, structural steel etc., shall be arranged by the Bidder.</p> <p>The scope shall also include conducting all relevant tests as per FQP. Such tests shall be carried out by the Bidder either in a laboratory established by the Bidder in the field or through third-party laboratories approved by the Owner.</p> <p>The scope shall also include dismantling of existing pipe & cable gallery structures (about 80 m) over the railway tracks and OHE lines area as mentioned in the SOW after completion of erection and commissioning of cables and piping in new pipe & cable gallery and laying of pipes over the new pipe cum cable trestle at OHE portion is considered under the scope of bidder.</p> <p>Detailed geotechnical investigation in the proposed area shall be carried out by the Bidder if any additional data is required to the Bidder beyond the details provided in the technical specifications and shall be submitted to Owner for approval. For foundation system and geotechnical data, refer Clause 7.00.00.</p> <p>The work shall be carried out according to the design/drawings to be developed by the Bidder and approved by the Owner. For the proposed structures and facilities, necessary layout and details are to be developed by the Bidder keeping in view the statutory and functional requirements and providing enough space and access for operation, use and maintenance. The Bidder's work shall cover the complete requirements as per IS codes, fire safety norms, requirements of various statutory bodies, International Standards, best prevailing practices and to the complete satisfaction of the Owner.</p> <p>The Bidder shall make the layout and levels of all structures from the general grid of the plot and the nearest benchmark of NTPC Ltd as per the directions of the Owner. The Bidder shall be solely responsible for the correctness of the layout and levels and shall also provide necessary instruments, materials, access to works, etc., to the Owner for general checking of the correctness of the civil works.</p>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30


CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to.</p> <p>The Bidder shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site-specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications.</p> <p>In case of any conflict between stipulations in various portions of the specification, most stringent stipulation would be applicable for implementation by the Bidder without any extra cost to the Owner.</p> <p>Bidder or his agencies engaged as detailer for fabrication drawings should have experience of detailing for steel structures.</p>			
1.02.00	<p>SCOPE OF WORK</p> <p>The scope of work for the contractor shall include the analysis, design, construction, testing, erection & painting of all civil and structural works and all other items mentioned in Part-A of this Specification.</p>			
1.02.01	<p>Construction Facilities</p> <p>For details of construction facilities refer to Part-A of this specification.</p>			
1.02.02	<p>Exclusions & Terminal points:</p> <p>Exclusions: Dismantling of existing Pipe & Cable gallery foundations and dismantling of existing cable gallery structure (other than pipe cum cable gallery) at crossings of Railway lines & OHE Lines</p> <p>Terminal Points: Terminal Points as marked in GLP and other tender drawings.</p>			
1.03.00	<p>SUBMISSIONS</p>			
1.03.01	<p>The drawings included in the Bidding Document provide a general idea about the work to be performed under the scope of this contract. These are preliminary drawings for bidding purposes only and are by no means the final drawings or show the full range of the work under the scope. Work has to be executed according to drawings prepared by the contractor. The following documents and drawing shall be submitted and got approved before commencement of detailed engineering. The list given below is not exhaustive but indicative only.</p> <div><div>a)</div><div>Design criteria which shall cover all design aspects, design parameters, material of construction and its specifications, structural idealization including framing system for gravity loads and lateral loads (wind and seismic), load cases, load combinations, assumptions, references, basis of analysis & design.</div></div> <div><div>b)</div><div>Survey drawings indicating coordinates and levels of existing facilities at the vicinity of structures covered in the scope of work.</div></div> <div><div>c)</div><div>GPR survey report.</div></div>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30


CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div><div>d)</div><div>Geotechnical Investigation report including foundation system recommendations, if any geotechnical investigation is carried out by the Bidder.</div></div> <div><div>e)</div><div>Typical design of pile, if applicable, in terms of type, rated capacity, length, diameter and the termination criteria to locate the founding level.</div></div> <div><div>f)</div><div>Scheme for initial and routine load test of Pile foundation high strain dynamic load test and pile integrity test methodology, if applicable.</div></div> <div><div>g)</div><div>Details of corrosion protection measures for all structures, foundations etc.</div></div>			
1.03.02	Detailed construction drawings and design calculations for all civil works for static as well as dynamic analysis shall be submitted for approval prior to undertaking construction work.			
1.03.03	Design calculations shall be done in M.S. Office (latest version) and Drawings shall be prepared in Auto Cad (latest version). The analysis shall be done by using STAAD PRO / SAP2000 (latest version). However, design may be carried out manually, using computer work sheets or by using suitable software programs, as mutually agreed by the Owner. Final calculations and drawings shall be submitted as mentioned in General technical Requirements Chapter.			
1.03.04	Structural steel fabrication drawings to be prepared by the contractor will not be approved by the Owner. However, the Contractor shall submit all fabrication drawings for Owner's reference. Copy of detailed bar bending schedule as prepared by contractor shall also be submitted to Engineer in charge for the reference.			
1.03.05	Approval of construction drawings prepared by the contractor shall not relieve the Contractor of his responsibility regarding the safety and adequacy of design and correctness of the drawing.			
1.03.06	<div>"As-built" drawings in AutoCad & PDF format shall be prepared and submitted to owner by the Contractor after completion of construction / erection, incorporating changes, if any.</div> <div>Final executed quantities of RCC and structural Steel shall be incorporated in the As-Built drawing.</div>			
1.03.07	Bidder shall provide tentative Bill of Quantities of RCC, Reinforcement and Structure steel in all the Civil/structural drawings as per scope of respective drawing.			
1.04.00	Inspection, Testing and Quality Control			
1.04.01	<div>Sampling and testing of major items of civil works viz. earthwork, filling, concreting, structural steel work (including welding) & painting shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified, relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used.</div> <div>The Bidder shall submit and finalize a detailed field Quality Assurance Program before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing</div>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30


CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Owner. The Bidder shall furnish the test certificate from the manufacturers of various materials to be used in the construction.</p>			
1.04.02	<p>Workmanship and dimensional tolerances shall be checked as stipulated elsewhere in the specification.</p>			
1.05.00	<p>Statutory Requirements</p> <p>Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules, Water Act for pollution control, Explosives Act, etc.</p> <p>Provisions of safety, health and welfare according to Factories Act shall be complied with.</p> <p>Statutory clearances and norms of State Pollution Control Board shall be followed.</p> <p>Bidder shall obtain approval of Civil and structural drawings from concerned authorities before taking up the construction work at Railway lines and OHE lines crossings.</p>			
2.00.00	<p>GENERAL LAYOUT AND SURVEY</p>			
2.01.00	<p>The preliminary layout plan proposed for the work is shown in the drawing titled "Coordinates marking in General Layout Plan (GLP) for new cable gallery".</p> <p>It shall form the basis for further elaboration by the Bidder for the structures and facilities, which are in his scope. Area identified for facilities remain same as indicated in GLP/above drawings, however, minor modification in routing of cable galleries and pipe& cable galleries may be done to optimize layout.</p> <p>Bidder shall prepare the detailed layout of the structures and facilities which are in his scope and shall submit the same for Owner's approval.</p> <p>While preparing the detailed layout, planning his facilities and deciding upon the transportation and erection strategy, Bidder shall ensure all statutory requirements including safe distances from existing facilities as per applicable rules/acts/laws including local bye-laws.</p>			
2.03.00	<p>Survey, Excavation and Backfilling</p>			
2.03.01	<p>Bidder shall carry out the topographical survey and GPR survey before he commences detailed design. This survey shall cover the area at the vicinity of Bidder's scope of work. Based on field observations, the Bidder shall prepare and submit the survey drawing and report on existing underground and overground facilities along the routing of cable gallery and Pipe & cable gallery.</p> <p>The excavation shall be in all types of soils or rock or a mixture of these. The bidder should assess and satisfy himself about the actual nature of soil present at site, before submitting his bid.</p> <p>The excavated material can be used for backfilling. The surplus material shall be taken and stacked at places(s) within the plant boundary as directed by the Owner. If any additional suitable earth is required for backfilling, the same shall be arranged by the Bidder from the area within the plant boundary.</p>			
2.03.02	<p>All existing drains/channels at the vicinity of proposed facilities shall be suitably diverted by the Bidder before taking up any construction. These diversions shall be so designed as to</p>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.03.03	ensure effective disposal of water without any accumulation or flooding in adjoining areas. For detailed specifications regarding excavation and backfilling, refer Cl. 7.03.00.			
3.00.00	DESIGN BASIS OF PIPE AND CABLE GALLERIES Salient Features The Cable gallery as well as Pipe cum Cable Gallery shall be Structural Steel Superstructure with Steel Truss (Lattice Girder) having a general span of 12.0m/15.0m, however, the span may varies as per actual site conditions. The steel truss shall be supported on 2 legged/ 4 legged trestles the arrangement of which shall be developed by the Bidder. Trestles for galleries shall also be of structural steel. The width of the Gallery shall be provided as per Tender drawings. For pipe & cable gallery near crossing of railway lines & OHE lines, minimum size of structural steel sections shall be the sizes mentioned in the Tender drawings and maximum span shall be to 25m however as per site condition may be extended subject to the approval of NTPC. A walkway of minimum width 600mm shall be provided along the Cable Trays supporting floor as well as piping supporting floor of the galleries. The walkway shall comprise 40mm thick galvanized MS electroforged grating and 1.0m high handrail made of 32NB galvanized MS pipes. Plan bracings shall be provided at all chord levels of the cable gallery truss. Minimum gusset plate thickness shall be 8mm for all connections. The level of the bottom chord (bottom of steel) of the gallery shall be at least 3.0m above the finished paving/ground level in general. However, at all road/rail crossings (including railway traction line), the level of bottom of steel of the gallery shall be at least 8.0m/11.3 m (as per the existing elevation of cable/pipe gallery at crossings) from the top of road surface and 8.5 m from top of rail track. Wherever the galleries crosses existing pipe & cable galleries, a minimum clearance of 300mm shall be maintained above/below existing pipe & cable galleries. The galvanized Caged structural steel ladder shall be provided at an interval of 100m for access to the Pipe-Cable Gallery Walkway, however, adequate numbers of caged ladders shall be provided to ensure access to walkways at all levels. At the inter-connection of galleries with existing galleries at terminal points, existing galleries shall be suitably modified/strengthened, if required, with prior approval of the Owner. The foundation for Pipe-Cable gallery trestles shall be open foundation or pile foundation depending upon bearing capacity requirements. Design Concept The pipe/cable structure shall be designed as a 3-dimensional space frame for all the relevant load cases mentioned in the design criteria chapter. The gallery being an unclad building, wind load shall be evaluated based on the projected frontal area of the structural members and cable tray/piping depth. The end portals shall be designed as rigid frames hinged (pinned support) at the base plate level (on top of the trestle column). The gallery vertical truss shall be designed as simply supported girders on trestles and detailing of end portals shall be done accordingly.			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>Suitable expansion gap shall be provided in the gallery structure by providing twin two-legged trestles at the expansion gap. The expansion gap shall be provided at an interval of 100 to 120m.</p>			
4.00.00	DESIGN CRITERIA AND GENERAL SPECIFICATION			
4.01.01	General			
	<p>The design criteria given herein is applicable for all sub-structure, super-structure works of cable galleries and pipe & cable galleries included in the scope of the Bidder.</p>			
4.01.02	<p>Structures shall be designed for the most critical combinations of dead loads, imposed loads, piping loads (static, friction and dynamic), cable tray loads, earth pressure & surcharge loads, wind loads, seismic loads and temperature loads. In addition, Erection loads shall also be considered.</p>			
4.01.03	<p>Cable galleries and Pipe& cable Galleries including their supporting trestles shall have structural steel framed super structure.</p>			
	<p>All 2-legged structural steel trestles shall be completely braced in the vertical plane. All 4-legged structural steel trestles shall be completely braced in all four vertical planes. In addition, specified horizontal planes shall be completely braced to provide stiffness against torsional sway.</p>			
	<p>The bottom of base plates of trestles shall be kept at 300mm above finished ground level.</p>			
4.02.00	Loading			
	<p>For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed.</p>			
4.02.01	Dead loads			
	<p>Dead loads shall include the weight of structure complete with finishes and fixtures shall be taken as per IS: 875 (Part-I).</p>			
	<p>For Structural steel analysis & design, Self weight factor of minimum 1.15 shall be applied in structural model to account for elements such as stiffener plates, gussets, lip sections, etc.</p>			
4.02.02	Imposed loads			
	<p>Imposed loads shall include live loads, piping loads, cable tray loads and erection loads.</p>			
	<p>For consideration of imposed loads on structures, IS:875 (Part-2) "Code of practice for design loads (other than earthquake) for buildings and structures" shall be followed.</p>			
	<p>For walkways of galleries, live load of 0.40 Ton/ Sq.M shall be considered.</p>			
	<p>If erection load is higher than the specified imposed loads on any floor or part thereof, then the erection loads are to be considered for the design.</p>			
4.02.03	Piping, cable and associated loads			
	<p>Piping, cable and associated loads furnished by Owner shall be considered over and above the imposed loads. For pipe supporting structures, frictional loads shall be considered in addition to piping load.</p>			
4.02.04	Seismic load			
	<p>For design of all structures, the site specific seismic design criteria as attached in Annexure-A</p>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30


CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.02.05	shall be followed.			
	Wind load			
	For design of all structures, the wind loads shall be taken as per the site specific wind data specified in Annexure–B of this specification.			
	4.02.06	Temperature Load		
		For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation. This load shall be considered on all the structural elements.		
	Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS 800 for steel structures. In Limit state design, the partial safety factor for temperature load in load combinations shall be taken same as specified for dead load (DL) in Table 4 of IS 800: 2007 for steel structures.			
	4.03.00 Civil Design Concepts			
	4.03.01	Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.,		
	4.03.02	The different load combinations shall be taken as per IS: 875 (Part-5) and other relevant IS Codes.		
	<div><div>a)</div><div>Wind and seismic forces shall not be considered to act simultaneously.</div></div> <div><div>b)</div><div>Permissible limit states for different load combinations shall be taken as per relevant IS and IRS codes.</div></div> <div><div>c)</div><div>Wherever pipe cable trestle is routed through filled up area, soil overburden weight to be accounted from natural ground level to finished grade level in foundation design as in other structures.</div></div> <div><div>d)</div><div>Frictional forces between the pipes and supporting structure in longitudinal direction need not be considered along with seismic or wind forces.</div></div> <div><div>e)</div><div>For checking against uplift / tension case, 90% of Dead Loads with no Imposed Loads shall be considered along with other Loads. However, Seismic loads used in such combinations shall be estimated using imposed loads also in addition to all other loads.</div></div> <div><div>f)</div><div>The Structures shall be Designed for most unfavourable Combination of Dead Loads, Imposed Loads, Piping loads, Cables Loads, Wind / Seismic Loads, Temperature Loads, and other applicable Loads without exceeding the Permissible limit states.</div></div> <div><div>g)</div><div>No reduction in piping loads shall be considered for calculation of seismic weight of the structures and for load combinations thereof.</div></div> <div><div>h)</div><div>In all Loading Combinations, the Loads that have reduction effect on design condition shall not be taken into account in the Combination concerned.</div></div> <div><div>i)</div><div>In all Load Combinations, temperature loads (with reversible effects) are to be considered</div></div> <div><div>j)</div><div>Foundations shall be designed for all the load combinations for which Structure has been designed in addition to the load combinations mentioned in respective codal provisions.</div></div>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30


CLAUSE NO.	TECHNICAL REQUIREMENTS																			
4.03.03	Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards including National Building Code (2016).																			
4.03.04	<p>Shop connections and connections in fabrication yard will be welded type. All field connections will be either welded or bolted. Field permanent bolts wherever provided will be high tensile bolts of property class 8.8(min) as per 1367 for all major connections. However, nominal connections in the field will be done by means of M.S. black bolts of grade 4.6 conforming to IS-1367. The bolted joints will be designed for friction grip or bearing type. For friction grip type connections, bolts will be tightened to develop the required pretension during their installation.</p> <p>For bolted Connection, IS 4000, IS: 3757, IS: 6623 and IS: 6649 shall be followed. IS 814, IS 816, IS: 1024, IS 4353 and IS: 9595 shall be followed for welding of structures.</p>																			
4.03.05	All structures close to railway line shall have clearances conforming to Railway norms.																			
4.03.06	The minimum concrete clear cover to reinforcement bars in all RCC structures shall be as per IS:456. The durability of concrete shall conform to “very severe” exposure conditions as per Table-3 of IS 456.																			
4.03.07	<p>Factor of safety against overturning and sliding</p> <p>The structure shall be checked for minimum factor of safety of 1.5 against overturning conditions (ratio of stabilizing moment to overturning moment) and 1.4 against sliding conditions as per IS: 456.</p>																			
4.03.08	For detailing of Reinforcement IS 5525, IS 13920, IS 4326 and SP 34 shall be followed.																			
4.03.09	Two layers of reinforcement (on both faces) shall be provided for RCC sections having thickness of 150 mm and above.																			
4.03.10	<p>Minimum diameter of main and distribution Reinforcement bars in different structural elements shall be as follows:</p> <table><thead><tr><th>Sl. No.</th><th>Structural Element</th><th>Main Reinforcement</th><th>Distribution Reinforcement / Stirrups/ ties/ Anchor Bars</th></tr></thead><tbody><tr><td>a)</td><td>Foundation</td><td>12 mm</td><td>10 mm</td></tr><tr><td>b)</td><td>Beams</td><td>12 mm</td><td>8 mm</td></tr><tr><td>c)</td><td>Columns</td><td>12 mm</td><td>8mm</td></tr></tbody></table>				Sl. No.	Structural Element	Main Reinforcement	Distribution Reinforcement / Stirrups/ ties/ Anchor Bars	a)	Foundation	12 mm	10 mm	b)	Beams	12 mm	8 mm	c)	Columns	12 mm	8mm
Sl. No.	Structural Element	Main Reinforcement	Distribution Reinforcement / Stirrups/ ties/ Anchor Bars																	
a)	Foundation	12 mm	10 mm																	
b)	Beams	12 mm	8 mm																	
c)	Columns	12 mm	8mm																	
4.03.11	The sizing of foundation, design criteria & clear cover shall conform to IS:1904, IS:456 and other relevant Indian codes. However, minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.																			
4.03.12	Minimum thickness of foundation slab / raft shall not be less than 250 mm.																			
4.03.13	<p>Horizontal Deflection criteria</p> <p>The maximum horizontal deflection for trestles and galleries shall not exceed Height/325 and the maximum vertical deflection of galleries shall not exceed Span/325.</p> <p>However, the maximum vertical deflection of Grating shall be limited to 6mm.</p>																			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30																


CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>Note: Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.</p> <p>Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.</p>			
4.03.14	<p>a) Dispersion of load in any direction through soil shall be as per IS 8009 (relevant part).</p> <p>b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.</p>			
4.03.15	<p>A minimum clearance (clear headroom) of 8m/11.3 m (as per site) shall be kept for all over-ground pipe/cable galleries for all road crossings and 8.5m shall be kept for rail crossings. For other areas, the requirement of trestle height is specified elsewhere in the specifications. All trestles shall be provided with continuous walkway of minimum 600mm width with handrails and toe-guards all along the length of the trestle along with approach ladders near roads, passageways, etc.</p>			
4.03.16	<p>Footings shall be so proportioned to as to minimize the differential settlement.</p>			
4.03.17	<p>Joints/Connections in steel structures:</p> <p>Steel structures shall be detailed and connection and joints provided as per the provisions of IS 800, IS 816, IS 9595, IS 1367, and IS 9178 and as per following requirements.</p> <p>a) Connections to be designed as per IS 800.</p> <p>b) All butt welds shall be full penetration butt welds.</p> <p>c) Connection of base plate and associated stiffeners with the columns shall be designed considering the total load transferred through welds. However, minimum weld size (double fillet) shall not be less than 0.6 times the thickness of stiffeners.</p> <p>e) Splicing: All work shall be full strength. Field splicing shall be done with web and flange cover plates for full strength. Shop splicing for all sections other than rolled shall be carried out by full penetration butt welds with no cover plates. Splicing for all rolled sections shall be carried out using web and flange cover plate.</p>			
4.04.00	<p>Design Criteria for Foundation</p> <p>The founding depth / cut off level of piles shall be decided based on functional requirement.</p> <p>Wherever structural steel columns are envisaged, the bottom of the base plate shall be kept 300mm above finished ground level. Further the gusset plate and foundation bolts are to be encased with RCC up to the top gusset plates by providing skin reinforcement of 8mm dia at 100mm c/c on all faces (Minimum 400mm anchorage of vertical skin reinforcement into the Pedestal shall be provided).</p> <p>a) OPEN Foundations</p> <p>For foundations, the minimum founding depth and the minimum size of foundation shall be as per foundation system and geotechnical data specified in the foundation chapter included hereafter in this specification.</p>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30


CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																				
4.05.00 4.05.01	<p>For open foundations, the total permissible settlement shall be as per the criteria furnished under the foundation system specified elsewhere in this specification.</p> <p>The sizing of foundation, design criteria & clear cover shall conform to IS:1904, IS:456 and other relevant Indian codes. However, minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement both in case of bottom face and also for tension face of foundation shall be same as that stipulated for beam as per IS:456.</p> <p>b) PILE Foundations (As required)</p> <p>Minimum centre to centre spacing of the piles shall be as per IS: 2911. In case single piles are used, these piles are to be interconnected with tie beams along both orthogonal directions perpendicular to each other.</p> <p>Minimum penetration of piles into Pile cap shall be 75 mm and clear cover to the main reinforcement at the bottom face of the pile cap shall be 100 mm. Structural design of pile cap and reinforcement shall conform to IS:2911 and IS:456. However minimum 0.12% of cross section of the pile cap shall be provided on the top face of the pile cap along two orthogonal directions and minimum percentage of reinforcement at bottom face of pile cap shall be same as that stipulated for beam as per IS:456.</p> <p>Detailed requirement of open and pile foundation has been presented in the foundation chapter in this specification.</p>																							
	CORROSION PROTECTION																							
	General																							
	(a) All Steel structures shall be provided with painting system as mentioned below in this specification for the Corrosivity category CX.																							
	Painting system for steel surfaces embedded in Concrete is given separately.																							
	(b) All Painting shall be done as per Technical Specification. Painting scheme shall submitted by the Bidder.																							
	(c) All steel structures shall be designed by following basic design considerations in ISO 12944 Part 3. Where steel is fully accessible for cleaning and repainting and where it is feasible to follow design criteria given in ISO 12944 part 3, minimum thicknesses of structural members shall be as follows:																							
	<table><tr><th>Structural Sections</th><th>Minimum thickness (mm)</th><th>Minimum Flange thickness (mm)</th><th>Minimum Web thickness (mm)</th></tr><tr><td>Plates</td><td>6</td><td></td><td></td></tr><tr><td>Built up Sections</td><td></td><td>6</td><td>6</td></tr><tr><td>Angle sections</td><td>6</td><td></td><td></td></tr><tr><td>ISMB /ISM C</td><td></td><td>6</td><td>4.5</td></tr></table>				Structural Sections	Minimum thickness (mm)	Minimum Flange thickness (mm)	Minimum Web thickness (mm)	Plates	6			Built up Sections		6	6	Angle sections	6			ISMB /ISM C		6	4.5
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CLAUSE NO.	TECHNICAL REQUIREMENTS				<div>एन टी पी सी NTPC</div>								
4.05.02	NPB/ WPB		6	4.5									
	<p>Where steel surfaces are inaccessible for cleaning and repainting (such as back-to-back sections, lap joints etc.) or where it is not feasible to follow design criteria given in ISO 12944 part 3, corrosion allowance of 1.5 mm shall be kept in thickness (over the design thickness or minimum thickness specified above, whichever is more). The minimum thickness consideration shall apply for both web and flange.</p> <p>However minimum gusset plate thicknesses shall be followed as mentioned elsewhere in the specification and minimum angle section to be used is ISA 50x50x6. Ends of box sections to be effectively sealed at both ends. Also, tubular handrail thicknesses will be as governed by mentioned clauses in the spec. Tubular sections are not allowed for structural members other than handrails.</p>												
	<p>Painting of Steel Surfaces Embedded in Concrete</p> <p>a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT).</p> <p>b) All threaded and other surfaces of foundation bolts and its materials, anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.</p>												
4.05.03	<p>Painting of Steel Surfaces (Other Than Those Embedded In Concrete)</p> <p>Following painting system corresponding to corrosion category CX.</p> <table><tr><th>CORROSSIVITY CATEGORY (as per ISO 12944-2)</th><th>PRIMER COAT</th><th>INTERMEDIATE COAT</th><th>FINAL COAT</th></tr><tr><td>CX</td><td>All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer/Zinc rich epoxy coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 125 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface</td><td>Primer coat shall be followed with the application of Intermediate coat of low solvent two component amine cured, glass flake reinforced, abrasion resistant epoxy coating with high solids, high build product for better protection in very harsh environment. with solid content of 90 +/-2 % (VS%) (min) of minimum 250-micron DFT. This coat shall be</td><td>Intermediate coat shall be followed with the application of finish coat of twopack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0</td></tr></table>					CORROSSIVITY CATEGORY (as per ISO 12944-2)	PRIMER COAT	INTERMEDIATE COAT	FINAL COAT	CX	All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer/Zinc rich epoxy coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 125 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface	Primer coat shall be followed with the application of Intermediate coat of low solvent two component amine cured, glass flake reinforced, abrasion resistant epoxy coating with high solids, high build product for better protection in very harsh environment. with solid content of 90 +/-2 % (VS%) (min) of minimum 250-micron DFT. This coat shall be	Intermediate coat shall be followed with the application of finish coat of twopack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0
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SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B		CIVIL WORKS	PAGE 1 OF 30								


CLAUSE NO.	<div style="text-align: center;"> TECHNICAL REQUIREMENTS  </div>			
		profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.	applied in shop after an interval of minimum 24 hours from the application of primer coat by airless spray technique.	ΔE) and minimum 75micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months from the completion of Intermediate coat. Colour and shade of the coat shall be as mentioned in the colour coding approved by Owner.
<p>Notes:</p> <ol style="list-style-type: none"> For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically, it should be used when coating bare steel surface for first time. The most frequent problem associated when top coating Primer is bubbling/pinholes especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (125 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme. <p>4.05.04 Gratings</p> <p>All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 900 g/sqm.</p> <p>4.05.05 Hand Railings and Ladders</p> <p>All Mild steel (MS) handrails and ladders shall be galvanized at the rate of 900 g/sqm as per IS 4736.</p> <p>4.05.06 Painting of Structural bolts, nuts and washers (MS / HS / HT/ HSFG bolting for bolted connection):</p>				
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATIONS Part-B		CIVIL WORKS	PAGE 1 OF 30


CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.05.06	<p>All structural bolts (+ nuts + washers) should be coated with Zinc flakes as per ISO: 10683 (latest version), to provide salt spray resistance suitable as per C5 corrosive category with high durability.</p> <p>For reinforced concrete work.</p> <p>i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts.</p> <p>ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion.</p> <p>This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc.</p> <p>Bituminous painting shall be provided for RCC foundations.</p>			
5.00.00	GENERAL REQUIREMENTS			
5.01.00	JOINTS IN CONCRETE STRUCTURES			
	Construction Joints			
	All horizontal construction joints shall be provided with a groove (shear key) for transfer of shear force.			
5.02.00	Miscellaneous General Requirements			
	<div><div>1.</div><div>All steel sections and fabricated structures, which are required to be transported on sea, shall be provided with anti-corrosive paint before shipment to take care of sea worthiness.</div></div> <div><div>2.</div><div>Detailed scheme for dewatering shall be prepared, wherever required, before starting of deep excavation work. IS 9758 shall be followed as general guidance for dewatering.</div></div> <div><div>3.</div><div>Non-shrink flowable grout shall be used for under-pinning work below base plate of columns. Nominal thickness of grout shall be 50 mm. Non-shrink cum plasticizer admixture shall be added in the grout. Crushing strength of the grout shall generally be one grade higher than that of the base concrete. Minimum grade of grout shall be M-40.</div></div> <div><div>4.</div><div>Unless specified all sand filling shall be compacted to minimum 80% of the relative density and backfilled earth shall be compacted to minimum 90% of the Standard proctor density at OMC.</div></div> <div><div>5.</div><div>40mm Diameter MS rods as earthing mat, placed at a distance of 1.0m away and at depths between 0.60m and 1.00m shall be supplied and laid all around the periphery of structures as per approved drawings. Riser of 40mm Dia. MS rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Bidder as per the approved drawings. Raiser shall be laid up to a height of 300 mm above the local Ground level, at columns of the trestles. The Contractor shall also supply and lay necessary number of 3.0 m deep 40 mm diameter MS rods Earthing electrodes and connect electrodes to the Earthing mat, as per the approved drawings and supplying and laying of 40 mm Dia. MS rods for connecting the 's earthing mat with the Owner's earthing mat separately.</div></div>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30


CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.03.00	CONCRETE a) Concrete work shall be of grade as per IS 456. Mix design concrete shall be used for all areas other than lean concrete work and plain cement concrete where nominal/volume mix can be permitted. Design mix shall be carried out as per IS10262. Specific approval of the Owner shall be obtained regarding degree of quality control to be adopted for design mix. b) Minimum grade of reinforced cement concrete for all foundations shall be M35. c) Higher grade of concrete than specified above may be used at the discretion of the Bidder. d) Unless otherwise specified, 20mm and down aggregates shall be used for all structural concrete works. However, 40mm and down aggregates may also be used under special conditions for mass concreting in foundation. e) Minimum 75mm thick lean concrete M-10 shall be provided below all other foundations, pilecaps etc., to provide a base for construction. f) All structural(reinforced) concrete production shall be done at automated batching plant of suitable capacity, conforming to IS:4925., situated within the area allocated to the contractor. The batching plant shall have facility of digitised recording of the materials added along with quantity of concrete produced in each batch and printout of the same. Batch-wise report for each shift shall be submitted to the Owner.			
5.04.00	PIPE AND CABLE RACKS ACROSS RAIL TRACKS Design of any structure crossing the Railway tracks shall be as per Railways/ RDSO guidelines. The Bidder shall obtain necessary approvals from Railways before start of construction work. Construction of these structures is to be done as per Railways guidelines. Any statutory and codal charges payable to Railways/ RDSO for approval & execution of the above crossings shall be borne by the Bidder. Engagement of approved Railway Consultant for the above work by the bidder would be at his own cost. The levels/clearances of the above crossings are to be finalized by the bidder as per Railway standards and shall be subject to approval of Owner/Owner's Consultant. However, for design of the crossings above rail track, the following minimum clearance from Rail track shall be maintained: A. Horizontal clearance: A minimum clearance of 3.5m shall be maintained between centre line of the Railway track to face of the crossing structure. B. Vertical clearance: A minimum vertical clearance of 8.5m shall be maintained between Rail top level and bottom of structure. Bidder has to submit to the Owner two sets of railway approved drawings and two sets of (hard & soft copies) as built drawings.			
5.05.00	GRATING All gratings shall be electroforged types. Minimum thickness of the grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30


<p>CLAUSE NO.</p>	<p>TECHNICAL REQUIREMENTS</p>			
<p>5.06.00</p>	<p>bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be hot dip galvanised at the rate of 900 g/sqm after surface preparation by means of shot blasting or cleaned by acid pickling.</p>			
	<p>FABRICATION & ERECTION OF STEEL STRUCTURES</p> <p>The fabrication shall be done as per fabrication drawing which would clearly indicate various details of joints to be welded, type of weld, length and size of weld.</p> <p>All steel fabrication and painting work shall be carried out at shop in enclosed and covered sheds.</p> <p>All steelwork before and after manufacturing shall be smooth, straight and free of deformations, cracks, twists and burrs. All steelwork shall be cut and fabricated to a tolerance of ± 1.5 mm in its length and location of matching bolt holes for field connections (if applicable).</p>			
<p>5.06.01</p>	<p>Welding</p> <p>Sequence of Welding</p> <ol style="list-style-type: none"> The sequence of welding shall be carefully chosen to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed. The distortion should be effectively controlled either by a counter effect or by a counter distortion. The direction of welding should be away from the point of restraint and towards the point of maximum freedom. Each case shall be carefully studied before finally following a particular sequence of welding. Butt weld in flange plates and/or web plates shall be completed before the flanges and webs are welded together. The beam and column stiffeners shall preferably be welded to the webs before the web and flanges are assembled unless the web and flanges to the beam or column are assembled by automatic welding process. All welds shall be finished full and made with correct number of runs, the weld being kept free from slag and other inclusions, all adhering slag being removed. Current shall be appropriate for the type of electrode used. To ensure complete fusion, the weaving procedure should go proper and rate of arc advancement should not be so rapid as to leave the edges unmelted. Pudding shall be sufficient to enable the gases to escape from the molten metal before it solidifies. Non-uniform heating and cooling should be avoided to ensure that excessive stresses are not locked up resulting ultimately in cracks. The ends of butt welds shall have full throat thickness. This shall be obtained on all main butt welds by the use of run off and run on pieces adequately secured on either side of main plates. The width of these pieces shall not be less than the thickness of the thicker part joined. Additional metal remaining after the removal of extension pieces shall be removed by grinding or by other approval means and the ends and surface of the welds shall be smoothly finished. Where the abutting parts are thinner than 20mm the extension pieces may be omitted but the end be welded to provide the ends with the required reinforcement. 			
<p>SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS Part-B</p>	<p>CIVIL WORKS</p>	<p>PAGE 1 OF 30</p>	

CLAUSE NO.	TECHNICAL REQUIREMENTS				
5.06.02	j)	The fusion faces shall be carefully aligned. Angle shrinkage shall be controlled by presetting. Correct gap and alignment shall be maintained during the welding operation.			
	k)	All main butt welds shall have complete penetration and back surface of the weld being gouged out clean before first run of the weld is given from the back. However, partial penetration butt weld shall be permitted, when specifically shown in the design drawings.			
	l)	Intermittent welds shall be permitted only when shown in the design drawings.			
	m)	The welding shrinkage shall be minimised by adopting the correct welding procedure and method. In long and slender member extra length should be provided at the time of fabrication for shrinkage.			
5.06.02	Painting				
5.06.03	a)	Surface treatment and painting before and after delivery to site shall be in accordance with Clause no. 4.05.00 above. All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance in thickness(over the design thickness) of structural steel members shall be kept.			
	b)	For parts to be bolted, the surfaces in contact shall be provided with ethyl Zinc silicate primer as specified in clause 6.4.3 (a) and shall be free of oil, dirt, loose rust, burrs and other defects, which would prevent proper seating of the parts. For design of friction type bolted joints slip factor for surfaces with ethyl zinc silicate primer as given in IS 4000 shall be considered.			
	c)	Surfaces inaccessible after shop assembly shall receive the full-specified protective treatment before assembly.			
5.06.03	Bolting				
5.06.04	The threaded portion of each bolt shall project through the nut by at least one thread. High strength friction grip bolts, preferably the type with indicated load, shall be used where specified and shall be tightened strictly in accordance with the manufacturer's instructions and the relevant regulations. When connections are made using high strength friction grip bolts, relevant standards shall be observed.				
	Erection of Structures				
	All erection work shall be done with the help of cranes, use of derrick is not envisaged.				
	Erection Marks				
5.06.04	a)	Erection marks in accordance with fabrication drawing shall be clearly painted on the fabricated steelwork. Each piece shall be marked in at least on two places. Each piece shall also have its weight marked thereon.			
	g)	The centre lines of all columns, elevations and girder bearings shall be marked on the sections to ensure proper alignment and assembly of the pieces at site.			
5.06.04	Erection Scheme				
	a)	The Erection Scheme for the erection of all major structures shall be furnished. The erectability of the structure shall be checked by the Bidder before commencement of			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B		CIVIL WORKS	PAGE 1 OF 30

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>fabrication work to avoid future modification. The erection scheme shall indicate the approximate weight of the structural members, position of lifting hook, crane boom length, crane capacity at different boom length and at different boom inclination, etc.,</p> <p>b) The erection scheme shall also give details of the method of handling, transport, hoisting, including false work/staging, temporary, bracing, guying, temporary strengthening, etc., It will also give the complete details of the number and capacity of the various erection equipment that will be used such as cranes, winches, etc., along with disposition at the time of erection of columns, trusses, etc.</p> <p>c) The erection of columns, trusses, trestles, portals, etc., shall be carried out in one single piece as far as practicable. No column shall be fabricated and erected in more than 3 pieces. Galleries shall generally be erected as box i.e. the bottom chord and bracings, top chord and bracings, side vertical posts and bracings, end portals and roof-trusses shall be completely welded prior to erection and if required temporary strengthening during erection shall be made.</p>			
6.00.00	MATERIAL SPECIFICATION			
6.01.00	<p>Cement, Aggregates, Bricks, Water etc:</p> <p>Ordinary Portland Cement with C3A content from 5 to 8 percent conforming to IS 269/ Portland slag cement conforming to IS 455 shall be used for all areas.</p> <p>Coarse aggregate shall meet the requirements of IS 383. Fine aggregate in concrete shall conform to IS 383.</p> <p>For plaster, it shall conform to IS 1542.</p> <p>Potable water shall generally be considered satisfactory for all masonry and concrete works, including curing.</p> <p>All materials brought for incorporation in works shall be as per IS unless specified otherwise.</p>			
6.02.00	<p>Reinforcement Steel</p> <p>Reinforcement steel shall be of corrosion resistant grade high strength deformed TMT steel bars of grade Fe-415/ Fe-500/ Fe500D/ Fe550D and shall conform to IS 1786 and IS 13920. However, minimum elongation shall be 14.5%.</p>			
6.03.00	<p>Structural Steel</p> <p>Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.</p>			
6.03.01	<p>Mild Steel</p> <p>a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p> <p>b) Pipes shall conform to IS: 1161.</p>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B		CIVIL WORKS
				PAGE 1 OF 30

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240 and minimum thickness shall be 4 mm..</p> <p>d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.</p>			
6.03.02	<p>Medium and High Tensile Steel</p> <p>Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS: 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p>			
6.04.00	<p>Foundation Bolts</p> <p>Material and details of foundation bolts shall conform to IS: 5624. Mild steel bars used for the fabrication of bolt assembly shall conform to grade 1 of IS: 432 and/ or grade A of IS: 2062. Hexagonal nuts and lock nuts shall conform to IS: 1363 & IS: 1364 upto M36 diameter and IS: 5624 for M42 to M150 diameter.</p>			
6.05.00	<p>Chemical Admixtures</p> <p>All Chemical Admixtures shall conform to IS 456. Any special admixtures shall conform to either IS 9103 or ASTM C-494. Admixtures shall be used in liquid form only, quantity of which shall be as per manufacturer's recommendation and approved mix design.</p>			
6.05.01	<p>Chemical Admixtures for workability</p> <p>PCE type Super-plasticizers shall only be used in concrete mix, wherever required.</p>			
6.05.02	<p>Chemical Admixtures for corrosion inhibition</p> <p>Corrosion inhibiting admixture (Organic Bipolar concrete penetrating admixture type) shall be used in concrete for corrosion inhibition and same shall conform to tests specified in RDSO specification number M&C/PCN/126.</p>			
6.05.03	<p>Chemical Admixtures for waterproofing</p> <p>Integral Crystalline admixture, if used in concrete, for waterproofing treatment to Concrete shall comply with CPWD specification 2019, clause 22.14.</p>			
6.09.00	<p>Bitumen</p> <p>For painting of foundation and surfaces of substructure coming in contact with earth, minimum two coats of hot bitumen of Industrial grade 85/25, confirming to IS:702(latest), mixed with 1% anti-stripping compound at the rate of 1.7 Kg/Sq.m(for sum of all coats) shall be used.</p>			
7.00.00	<p>FOUNDATION SYSTEM AND GEOTECHNICAL DATA</p>			
7.01.00	<p>Geotechnical data and foundation system for the respective project are enclosed at Annexure-I. The corresponding bore logs are enclosed at Annexure-II.</p> <p>The geotechnical investigation report comprising of Boreholes, Laboratory tests, Chemical analysis, etc for the sub-strata prevailing at site would be made available for the Bidder's study at the Owner's office, if required. The onus of correct assessment / interpretation and</p>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>understanding of the existing substrata profile / data lies with the Bidder. In case, bidder feels that the available data is inadequate, he may carry out his own geotechnical investigation at no cost to Owner. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.05.00. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. Net allowable bearing pressure shall be limited to Table-1 of Annexure-I. The report shall be submitted for Owner's approval prior to commencement of design of foundation.</p> <p>As per the available Bore log data, NGL varies from RL (+)5.0m to RL (+)5.9m in pipe and cable gallery corridor.</p>			
7.01.01	<p>The borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Substrata profiles in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between Substrata profiles collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be Payable.</p>			
7.02.00	<p>Foundation System</p> <p>The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.</p>			
7.02.01	<p>General Requirements</p> <p>a) All structures shall be supported on suitable open foundations (isolated, combined, raft) with ground improvement depending on type of structures/facilities, sub-strata, topography etc.</p> <p>b) The roads, trenches, pipe pedestals (except thrust blocks), channels/drain and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil.</p> <p>c) No other foundation (other than as mentioned in (b) above shall rest on the filled up ground / soil.</p> <p>d) No foundation shall rest on the black cotton soil.</p> <p>e) Before execution of work, the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines, cable ducts, CW ducts etc. Any such damage and remedial/ rectification measures shall be at the contractors cost. Shoring/Strutting/Sheeting along with dewatering or any other method suitable shall be adopted by bidder to safeguard the structures.</p> <p>f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations. Bidder shall carry out GPR survey to locate existing underground facilities at no extra cost to owner.</p>			
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30

CLAUSE NO.	TECHNICAL REQUIREMENTS	
<p>7.02.02</p> <p>7.03.00</p> <p>7.03.01</p> <p>7.03.02</p> <p>7.03.03</p> <p>7.03.04</p> <p>7.03.05</p> <p>7.04.00</p>	<p>g) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.</p> <p>h) The water table for design purpose shall be considered at Finished Ground Level.</p> <p>Open Foundations</p> <p>In case open foundations are adopted, following shall be adhered to.</p> <p>a) The minimum width of foundation shall be 2.0 m.</p> <p>b) The minimum founding level shall be 1.0m below Finished ground level (FGL) or, 1.0m below Natural ground level (NGL) whichever is lower.</p> <p>c) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC M7.5 up to designed foundation level.</p> <p>d) The last layer of about 300 mm before reaching the founding level shall be excavated carefully by such equipment so that soil at the required level will be left in its natural condition.</p> <p>Excavation, Filling and Dewatering</p> <p>For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.</p> <p>Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.</p> <p>Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non cohesive soils.</p> <p>Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.</p> <p>The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides.</p> <p>Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.</p> <p>Sheeting & Shoring</p> <p>The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Owner.</p>	
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS PAGE 1 OF 30

CLAUSE NO.	TECHNICAL REQUIREMENTS				<div>एनटीपीसी NTPC</div>
7.05.00	Geotechnical investigation work shall be got executed by the Contractor through the following agencies				
	1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata				
	2. Cengrs Geotechnica Pvt. Ltd, New Delhi				
	3. KCT Consultancy Services, Ahemdabad				
	4. M.K. Soil Testing Laboratory, Ahemdabad				
	5. MNEC Consultant Pvt Ltd, Nagpur				
	6. Soil Engineering Consultants, New Delhi				
	7. CEG Test House and Research Centre Private Limited, Jaipur				
	8. Arun Soil Lab Private Limited, Lucknow				
	9. Geo Designs and Research P. Ltd, Vadodara				
10. Techpro Engineers Pvt. Ltd., Kanpur					
Annexure-I					
SOIL DATA AND FOUNDATION SYSTEM					
a)	The minimum founding level and the corresponding net allowable bearing pressure shall be as given in Table – 1 below				
Table-1					
Zone		Founding RL	Net Allowable Bearing Pressure T/m2		
			Isolated and combined footings		Rafts (width > 6m)
			Width upto 3.0m	Width > 3.0m upto 6m	
Zone-I (600N to 740N)		RL (+) 3.0M	18	15	16
		RL (+) 2.5M	20	20	20
Zone-II (740N to 970N)		RL (+) 4.0M	18	15	16
		RL (+) 3.5M	20	20	20
Zone-III (970N to 1120N)		RL (+) 4.5M	18	15	16
		RL (+) 4.0M	20	20	20
Zone-IV (1120N to 1150N & 2130W to 2210W)		RL (+) 4.0M	18	15	16
		RL (+) 3.5M	20	20	20
For Finished ground level (FGL) refer General layout plan (GLP).					
In case any loose/soft pockets is encountered at founding level, the same shall be removed completely upto the hard strata and filled up with PCC M7.5.					
The net allowable bearing pressure higher than above-mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.					
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B		CIVIL WORKS	PAGE 1 OF 30

For open foundations, the total permissible settlement shall be governed by IS: 1904 / IS: 13063 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:


Isolated & Strip	40 mm
Raft	75 mm
Foundations in Weathered rock / rock	12 mm

In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with the Owner.

b) Special Requirements:

The chemicals in ground water are more than permissible limits. In view of the presence of chemicals following shall be adopted for all foundations and sub-structures.

- Minimum grade of concrete shall be M35.
- Minimum cement content shall be 370 kg/m³ and maximum free water-cement ratio shall be 0.45 for foundation works.
- Cover to reinforcement shall be provided considering “**Very Severe**” exposure condition as per IS 456.
- All foundations and surfaces of substructures coming in contact with earth shall be applied with Minimum two coats of hot bitumen of Industrial grade 85/25, conforming to IS: 702 (latest), mixed with 1% anti-stripping compound at the rate 1.7 Kg/Sq.m (for sum of all coats).


CLAUSE NO.	<div style="text-align: center;"> TECHNICAL REQUIREMENTS  </div>		
	<p style="text-align: center;"><u>ANNEXURE-A</u></p> <p style="text-align: center;">CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES, FOUNDATIONS AND EQUIPMENT</p> <p>All structures, foundations and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893.</p> <p>A Site specific seismic study has been conducted for the project site. The design earthquake zone factor for different return periods for the project site, and the site specific normalized horizontal spectral acceleration coefficients (in units of gravity acceleration 'g') for the various damping values for evaluating the design acceleration spectra are as given at Appendix-I.</p> <p>Vertical acceleration spectral values shall be taken as 0.67 of the corresponding horizontal values for time period greater than 0.1 Sec. For time period 0.0 sec to 0.1 sec, value shall be linearly interpolated between 0.85 and 0.67.</p> <p>The site specific normalized horizontal spectral acceleration shall be used in place of the acceleration spectra given in IS1893. The site specific normalized horizontal spectral acceleration in Appendix-I includes the effect of the seismic environment of the site. The importance factor and the response reduction factor shall be applied as per IS 1893 based on category of structure and framing system respectively.</p> <p>Design Horizontal acceleration coefficient (A_{HD}) should be calculated as</p> $A_{HD} = Z \times \frac{I}{R} \times A_{NH}$ <p>Design Vertical acceleration coefficient (A_{VD}) should be calculated as</p> $A_{VD} = Z \times I \times A_{NV}$ <p>However, for design of equipment and structures where inelastic action is not relevant or not permitted, Design Horizontal acceleration coefficient (A_{HD}) should be calculated as</p> $A_{HD} = Z \times A_{NH}$ <p>A_{HD} = Design Horizontal acceleration coefficient</p> <p>A_{NH} = Normalized Horizontal Spectral acceleration coefficient provided in Appendix-I</p> <p>A_{VD} = Design Vertical acceleration coefficient</p> <p>A_{NV} = Normalized Vertical Spectral acceleration coefficient</p> <p>I = Importance factor to be considered as per Table 6 of IS 1893 Part-5</p> <p>R = Response Reduction factor to be considered as per Table 4 of IS 1893 Part-4</p> <p>Z = Design Earthquake Zone Factor provided in Appendix-I</p>		
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनडीपीसी NTPC</div>																
	<div>Damping in Structures</div> <p>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <table><tr><td>a)</td><td>Steel structures</td><td>:</td><td>2%</td></tr><tr><td>b)</td><td>Reinforced Concrete Structures</td><td>:</td><td>5%</td></tr><tr><td>c)</td><td>Reinforced Concrete Stacks / RCC Pylons</td><td>:</td><td>3%</td></tr><tr><td>d)</td><td>Steel stacks</td><td>:</td><td>2%</td></tr></table> <div>Method of Analysis</div> <p>Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The model used in such dynamic analysis must capture all the elements contributing to stiffness of the structure. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).</p> <p>In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS1893 Part 1 as per basic load combinations. For design of structural systems including foundations, additional load combinations as per IS 1893 Part 5 shall also be considered. For basic seismic load combinations, allowable bearing capacities / Pile capacities may be increased by 25%.</p> <p>The normalized spectral acceleration coefficient shall get restricted to the peak normalized spectral value if the fundamental natural period of the structure falls to the left of the peak in the normalized spectral acceleration curve.</p> <p>For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear (\bar{V}_B) computed using the approximate fundamental period (T_a) given in IS:1893:Part 5 and using site specific acceleration spectra, the response quantities (e.g. stress resultants, member forces, storey shear forces and base reactions) shall be enhanced in the ratio of \bar{V}_B/ V_B. However, for base shear enhancement in steel braced frames of MPH/ CCR, Boiler, and Mill Bunker Building, the approximate fundamental period may be determined using the specialist references cited in the foreword of IS 1893: Part 1. Further, no reduction is permitted if \bar{V}_B is less than V_B.</p> <div>Design/Detailing for Ductility for Structures</div> <p>Structures shall be engineered and detailed in accordance with relevant Indian/ International standards to achieve ductility.</p>				a)	Steel structures	:	2%	b)	Reinforced Concrete Structures	:	5%	c)	Reinforced Concrete Stacks / RCC Pylons	:	3%	d)	Steel stacks	:	2%
a)	Steel structures	:	2%																	
b)	Reinforced Concrete Structures	:	5%																	
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SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE		TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30																

NORMALIZED HORIZONTAL SPECTRAL ACCELERATION COEFFICIENTS
In units of 'g' for Simhadri TPP

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	5%	3%
0.00	1.00	1.00	1.00
0.05	1.67	1.50	1.52
0.06	1.97	1.69	1.77
0.07	2.24	1.83	2.00
0.08	2.51	1.99	2.21
0.09	2.73	2.22	2.39
0.10	2.95	2.38	2.59
0.12	3.36	2.60	2.91
0.14	3.66	2.85	3.16
0.16	3.98	3.01	3.39
0.18	4.23	3.08	3.61
0.20	4.38	3.14	3.75
0.22	4.45	3.18	3.84
0.24	4.50	3.19	3.9
0.26	4.50	3.16	3.92
0.28	4.47	3.11	3.88
0.30	4.39	3.03	3.79
0.40	3.60	2.48	3.04
0.50	2.81	2.01	2.41
0.60	2.25	1.68	1.97
0.70	1.87	1.48	1.66
0.80	1.66	1.33	1.48
0.90	1.52	1.21	1.36
1.0	1.40	1.09	1.24
1.1	1.30	0.99	1.14
1.2	1.21	0.90	1.05
1.3	1.14	0.83	0.96
1.4	1.06	0.77	0.89
1.5	0.99	0.72	0.84
1.6	0.91	0.68	0.78
1.7	0.84	0.63	0.72
1.8	0.77	0.59	0.67
1.9	0.70	0.56	0.62
2.0	0.64	0.54	0.57
2.1	0.58	0.48	0.53
2.2	0.54	0.45	0.49

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div><div>एनटीपीसी</div><div>NTPC</div></div>																			
	<div>APPENDIX-I</div> <div>NORMALIZED HORIZONTAL SPECTRAL ACCELERATION COEFFICIENTS</div> <div>In units of 'g' for Simhadri TPP</div> <div><table><tr><th rowspan="2">Time Period (Sec)</th><th colspan="3">Damping Factor (as a percentage of critical damping)</th></tr><tr><th>2%</th><th>5%</th><th>3%</th></tr><tr><td>2.3</td><td>0.50</td><td>0.43</td><td>0.45</td></tr><tr><td>2.4</td><td>0.47</td><td>0.39</td><td>0.42</td></tr><tr><td>3.0</td><td>0.47</td><td>0.39</td><td>0.42</td></tr></table></div>				Time Period (Sec)	Damping Factor (as a percentage of critical damping)			2%	5%	3%	2.3	0.50	0.43	0.45	2.4	0.47	0.39	0.42	3.0	0.47	0.39	0.42
Time Period (Sec)	Damping Factor (as a percentage of critical damping)																						
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SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30																				

CLAUSE NO.	<div data-bbox="646 121 1039 153" data-label="Page-Header">TECHNICAL REQUIREMENTS</div> <div data-bbox="1276 92 1425 163" data-label="Page-Header">  </div>		
	<div data-bbox="800 176 1006 210" data-label="Section-Header"><u>ANNEXURE-B</u></div> <div data-bbox="388 273 1422 304" data-label="Section-Header"><u>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</u></div> <p data-bbox="388 340 1422 407">All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – III for site specific information.</p> <p data-bbox="388 443 1422 510">Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.</p> <p data-bbox="388 546 1422 720">Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.</p> <p data-bbox="388 756 1422 861">Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.</p> <p data-bbox="388 896 1422 1001">Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.</p> <p data-bbox="388 1037 1422 1173">It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.</p> <div data-bbox="388 1209 686 1241" data-label="Section-Header">Damping in Structures</div> <p data-bbox="388 1276 1422 1341">The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <div data-bbox="399 1409 1398 1686" data-label="List-Group"> <ul style="list-style-type: none"> a) Welded steel structures : 1.0% b) Bolted steel structures/RCC structures : 2.0% c) Prestressed concrete structures : 1.6% d) Steel stacks : As per IS:6533 & CICIND Model Code whichever is more critical. </div>		
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30

CLAUSE NO.	<div> <div>TECHNICAL REQUIREMENTS</div> <div>एन टी पी सी NTPC</div> </div>		
	<div>ANNEXURE-III</div> <div><u>SITE SPECIFIC DESIGN PARAMETERS</u></div> <div>The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:</div> <div> <div>a) The basic wind speed “V_b” at ten meters above the mean ground level</div> <div>:</div> <div>50 meters/second</div> <div>b) The Risk Coefficient “K₁”</div> <div>:</div> <div>1.08</div> <div>c) Category of terrain</div> <div>:</div> <div>Category-2</div> <div>d) Importance factor for cyclonic region “K₄”</div> <div>:</div> <div>1.15</div> </div>		
SIMHADRI SUPER THERMAL POWER PROJECT(4X500MW) PIPE AND CABLE GALLERY PACKAGE	TECHNICAL SPECIFICATIONS Part-B	CIVIL WORKS	PAGE 1 OF 30

Simhadri STPP



BORELOG DATA SHEET OF BH-151

Location: CHP & Cooling Tower Co-ordinate: N-1025/ W-2100 Ground R.L. (m): 5.905

Type of boring: Shell & Auger Diameter of boring: 150 mm Casing provided: upto

Inclination: Vertical Soil sampler used: Open drive Total depth of: 10.00
boring

Commenced on: 17.01.98 Completed on: 19.01.98

Description of strata	Soil classification	Log	Thickness of stratum	Depth from ground surface	R.L. of lower contact	Samples			N-value	Ground water level, m
						Type	No.	Depth		
Very stiff to hard grey to brownish clayey silt mixed with nodules and sand	CI		4.00	4.00	1.905	D	956	0.50	48	2.00
						P	957	1.50 - 1.95		
						U	958	3.10 - 3.45		
Very dense light reddish brown medium grained silty sand with kankars and weathered rock pieces	CI		6.00	10.00	-4.095	P	959	4.50 - 4.61	>100	
						P	960	6.00 - 6.09		
						P	961	7.50 - 7.56		
						P	962	9.00 - 9.05		
						P	963	10.00 - 10.0		

D - Disturbed Sample
 U - Undisturbed Sample
 DC - Disturbed Sample from cutting shoe
 P - Standard Penetration Test



Location:	C.H.P & Cooling Tower	Co-ordinate:	N-925/ W-2100	Ground R.L. (m):	5.020
Type of boring:	Shell & Auger	Diameter of boring:	150 mm	Casing provided: upto	
Inclination:	Vertical	Soil sampler used:	Open drive	Total depth of: boring (m)	7.50
Commenced on:	18.12.97			Completed on:	19.12.97

[illegible]

D - Disturbed Sample
U - Undisturbed Sample
DC - Disturbed Sample from cutting shoe
P - Standard Penetration Test

GEOLOGICAL LOG OF DRILL HOLE NO. BH-154 (N)

Location: CHP & Cooling Tower Co-ordinate: N-925/W-2100 Ground R.L. (m): 5.020
 Depth of soil boring: 7.50 Angle with horizon: 90° Total depth (m): 40.02
 Size of hole: NX Casing provided: upto Type of core: Double tube barrel
 Water level (m): 1.20 Commenced on: 19.12.97 Completed on: 22.12.97

Elevation (m)	Run	Description	Log	Size of core pcs (mm)	Structural condition	Recovery (%)	Type of bit	R.Q.D.	Drilling water loss	Fract. freq. per m	Penetration rate, mm/min
7.50	7.50 - 9.00	Highly weathered highly fractured brownish grey		<100	Highly fractured	19	Diamond	Nil	Partial	>15	
	9.00 - 10.50	fine to medium grained		"	"	20	"	Nil	"	>15	
	10.50 - 12.00	very weak to weak khondolite		"	"	21	"	Nil	"	>15	
	12.00 - 13.50	khondolite		"	"	20	"	Nil	"	>15	
15.00	13.50 - 15.00			"	"	22	"	Nil	"	>15	
15.20	15.00 - 16.50	Moderately weathered moderately fractured reddish brown fine to medium grained		<100	Mod. fractured	212	Diamond	Nil	Partial	15 - 8	
	16.50 - 18.00	weak to moderately weak khondolite		"	"	23	"	Nil	"	15 - 8	
	18.00 - 19.50			75 - 150	"	25	"	13	"	15 - 8	
	19.50 - 21.00			"	"	28	"	8	"	15 - 8	
	21.00 - 22.50			"	"	27	"	13	"	15 - 8	
	22.50 - 24.00			<100	"	25	"	Nil	"	8 - 5	
	24.00 - 25.50			75 - 150	"	33	"	15	"	8 - 5	
27.00	25.50 - 27.00			"	"	31	"	7	"	8 - 5	
27.30	27.00 - 28.50	Slightly weathered slightly fractured brownish grey fine to medium grained		75 - 150	Slightly fractured	37	Diamond	22	Partial	8 - 5	
	28.50 - 30.00	moderately weak to moderately strong khondolite		"	"	35	"	7	"	8 - 5	
	30.00 - 31.50			"	"	43	"	13	"	8 - 5	
	31.50 - 33.00			"	"	42	"	9	"	8 - 5	
	33.00 - 34.50			"	"	43	"	7	"	5 - 1	
	34.50 - 36.00			"	"	51	"	29	"	5 - 1	
	36.00 - 37.50			"	"	44	"	19	"	5 - 1	
	37.50 - 39.00			"	"	51	"	29	"	5 - 1	
40.02	39.00 - 40.02			"	"	50	"	47	"	5 - 1	

N denotes Value of Standard Penetration Test.



BORELOG DATA SHEET OF BH-152

Location: C.H.P & Cooling Tower Co-ordinate: N-800/
W-2100 Ground R.L. (m): 5.085

Type of boring: Shell & Auger Diameter of boring: 150 mm Casing provided:
upto

Inclination: Vertical Soil sampler used: Open drive Total depth of:
boring (m) 7.05

Commenced on: 22.12.97 Completed on: 23.12.97

Description of strata	Soil classification	Log	Thickness of stratum	Depth from ground surface	R.L. of lower contact	Samples			N-value	Ground water level, m
						Type	No.	Depth		
Very stiff gray to blackish clayey silt mixed with low percentage of calcareous nodules and kankars.	CI		4.80	4.80	0.285	D	1477	0.50	31	0.94
						U	1478	1.20 - 1.60		
						P	1479	1.75 - 2.20		
Hard yellowish brown clayey silt mixed with fine to medium grain sand and weathered rock fragments.	CI		2.25	7.05	-1.965	P	1480	3.50 - 3.95	65	
						P	1481	5.00 - 5.12	>100	
						P	1482	6.50 - 6.56	>100	
						P	1483	7.05 - 7.09	>100	

D - Disturbed Sample
U - Undisturbed Sample
DC - Disturbed Sample from cutting shoe
P - Standard Penetration Test



GEOLOGICAL LOG OF DRILL HOLE NO. BH-152

CHP & Cooling

























Tower

Location: Co-ordinate: N-800/W-2100 Ground R.L. (m): 5.085

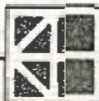
Depth of soil boring: 7.05 Angle with horizon: 90° Total depth (m): 40.05

Size of hole: NX Casing provided: upto Type of core: Double tube barrel

Water level (m): 0.94 Commenced on: 23.12.97 Completed on: 25.12.97

Elevation (m)	Run	Description	Log	Size of core pcs (mm)	Structural condition	Recovery (%)	Type of bit	R.Q.D.	Drilling water loss	Fract. freq. per m	Penetration rate, mm/min
7.05	7.05 - 8.55	Highly weathered		<100	Highly fractured	20	Diamond	Nil	Partial	>15	
	8.55 - 10.05	highly fractured reddish brown fine to medium grained very weak to weak khondolite		"	"	21	"	Nil	"	>15	
10.05											
10.15	10.05 - 11.55	Moderately weathered		<100	Mod. fractured	20	Diamond	Nil	Partial	15 - 8	
	11.55 - 13.05	moderately fractured		"	"	21	"	Nil	"	15 - 8	
	13.05 - 14.55	reddish brown fine to medium grained		"	"	22	"	Nil	"	15 - 8	
	14.55 - 16.05	weak to moderately		"	"	23	"	Nil	"	15 - 8	
	16.05 - 17.55	weak khondolite.		"	"	26	"	Nil	"	8 - 5	
	17.55 - 19.05	Intrusion of ferrous materials and quartz vein observed		75 - 150	"	27	"	8	"	8 - 5	
	19.05 - 20.55			"	"	33	"	7	"	8 - 5	
	20.55 - 22.05			"	"	31	"	16	"	8 - 5	
	22.05 - 23.55			<100	"	33	"	Nil	"	8 - 5	
	23.55 - 25.05			75 - 150	"	33	"	7	"	8 - 5	
	25.05 - 26.55			<100	"	28	"	Nil	"	8 - 5	
	26.55 - 28.05			75 - 150	"	35	"	8	"	8 - 5	
	28.05 - 29.55			"	"	36	"	9	"	8 - 5	
	29.55 - 31.05			<100	"	37	"	Nil	"	8 - 5	
32.55	31.05 - 32.55			75 - 150	"	41	"	24	"	8 - 5	
											
32.60	32.55 - 34.05	Moderately becoming		75 - 150	Slightly fractured	43	Diamond	17	Partial	8 - 5	
	34.05 - 35.55	slightly weathered		"	"	47	"	13	"	8 - 5	
	35.55 - 37.05	slightly fractured		"	"	49	"	14	"	8 - 5	
	37.05 - 38.55	brownish grey fine		"	"	43	"	17	"	8 - 5	
	38.55 - 40.05	moderately weak to moderately strong khondolite intrusion of quartz vein observed		"	"	52	"	13	"	8 - 5	

N denotes Value of Standard Penetration Test.



BORELOG DATA SHEET OF BH-187

Location: CHP & Cooling Tower Co-ordinate: N-600/
W-2200 Ground R.L. (m): 3.915

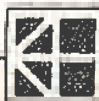
Type of boring: Shell & Auger Diameter of boring: 150 mm Casing provided: upto

Inclination: Vertical Soil sampler used: Open drive Total depth of: 12.60
boring

Commenced on: 20.01.98 Completed on: 21.01.98

Description of strata	Soil classification	Log	Thickness of stratum	Depth from ground surface	R.L. of lower contact	Samples			N-value	Ground water level, m
						Type	No.	Depth		
Medium dense to grey to brownish fine to medium grained silty sand mixed with kankars	SM		4.00	4.00	-0.085	D	1101	0.50		0.72
						P	1102	1.50 - 1.90	33	
						P	1103	3.25 - 3.70	44	
Very dense brownish to reddish medium grained silty sand mixed with kankars	SM		8.60	12.60	-8.685	P	1104	4.50 - 4.95	84	
						P	1105	6.00 - 6.18	>100	
						P	1106	7.50 - 7.56	>100	
						P	1107	9.00 - 9.03	>100	
						P	1108	10.50 - 10.5	>100	
						P	1109	12.00 - 12.0	>100	
						P	1110	12.60 - 12.6	>100	

D - Disturbed Sample
 U - Undisturbed Sample
 DC - Disturbed Sample from cutting shoe
 P - Standard Penetration Test

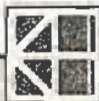


GEOLOGICAL LOG OF DRILL HOLE NO. BH-187

CHP & Cooling
 Location: Tower Co-ordinate: N-600/W-2200 Ground R.L. (m): 3.915
 Depth of soil boring: 12.60 Angle with horizon: 90° Total depth (m): 25.00
 Size of hole: NX Casing provided: upto Type of core: Double tube barrel
 Water level (m): 0.72 Commenced on: 20.01.98 Completed on: 20.01.98

Elevation (m)	Run	Description	Log	Size of core pcs (mm)	Structural condition	Recovery (%)	Type of bit	R.O.D.	Drilling water loss	Fract. freq. per m	Penetration rate, mm/min
12.60	12.60 - 14.10	Highly weathered		<100	Highly fractured	13	Diamond	Nil	Partial	>15	
	14.10 - 14.12	highly fractured		"	"	-	"	Nil	"	>15	
	12.15 - 15.60	fine to medium grained		"	"	14	"	Nil	"	>15	
	15.60 - 15.82	reddish brown very weak		"	"	-	"	Nil	"	>15	
	13.65 - 17.10	khondolite		"	"	14	"	Nil	"	>15	
	15.15 - 17.12			"	"	-	"	Nil	"	>15	
	15.15 - 18.60			"	"	25	"	Nil	"	>15	
	18.60 - 20.10			"	"	27	"	Nil	"	>15	
21.60	16.65 - 21.60			"	"	29	"	Nil	"	>15	
21.60	21.60 - 23.10	Highly weathered highly		<100	Highly weathered	31	Diamond	Nil	Partial	15-8	
	23.10 - 24.10	becoming fractured		"	"	37	"	Nil	"	15-8	
25.00	24.10 - 25.00	greyish white to brownish fine to medium grained weak khondolite.		"	"	44	"	Nil	"	15-8	

N denotes Value of Standard Penetration Test.



Sinhadhri STEP

Details of Boreholes in CHP & Cooling Tower

Borehole No.	Ground R.L. (m)	Co-ordinate (m)	Depth below G.L. (m)		Rock Drilling Depth (m)	Standing water level below G.L. (m)	No. of samples collected			Core
			G.L. (m)	Soil Boring Depth (m)			UDS	SPT	Disturbed	
BH-151	5.835	N-1025/W-2100	10.00	G.L. - 10.00	No Drilling	2.00	1	6	7	-
BH-152	5.885	N-800/W-2100	40.05	GL-7.05	7.05 - 40.05	0.94	1	5	6	-
BH-153	4.650	N-875/W-2050	50.07	G.L. - 6.40	5.40 - 50.07	0.95	1	3	5	-
BH-154(N)	5.020	N-825/W-2100	40.02	G.L. - 7.50	7.50 - 40.02	1.20	1	4	5	-
BH-155	5.650	N-853/W-1975	40.00	G.L. - 13.25	13.25 - 40.00	0.95	1	8	9	-
BH-156	5.415	N-900/W-1975	40.00	G.L. - 6.25	6.25 - 40.00	1.40	1	4	5	-
BH-157	5.045	N-875/W-1900	50.06	G.L. - 9.15	9.15 - 50.06	1.95	2	4	7	-
BH-158	3.895	N-800/W-1740	40.00	GL-7.50	7.50 - 40.00	1.40	1	4	5	-
BH-159	6.820	N-933/W-1775	27.50	G.L. - 6.50	6.50 - 27.50	2.85	-	5	6	-
BH-160	6.465	N-1150/W-2100	15.00	GL - 10.50	10.50 - 15.00	1.92	-	7	8	-
BH-161	8.560	N-1205/W-2000	15.00	GL - 8.90	8.90 - 15.00	2.10	-	6	7	-
BH-162(N)	7.500	N-1275/W-2125	15.00	GL - 6.70	6.70 - 15.00	1.55	1	4	6	-
BH-163	8.880	N-1275/W-2088	15.00	GL - 8.35	8.35 - 15.00	4.50	-	6	7	-
BH-164	9.110	N-1263/W-2000	20.00	GL - 5.25	5.25 - 20.00	4.62	-	4	5	-
BH-165	9.560	N-1325/W-1938	20.00	GL - 7.90	7.90 - 20.00	5.35	1	5	6	-
BH-166	8.550	N-1325/W-2075	20.00	GL - 8.50	8.50 - 20.00	4.22	-	6	7	-
BH-167	8.115	N-1325/W-2125	15.00	GL - 7.10	7.10 - 15.00	1.45	1	5	6	-
BH-168	7.355	N-1072/W-2000	15.00	G.L. - 6.50	6.50 - 15.00	2.55	-	5	6	-
BH-169(N)	2.350	N-100/W-1800	20.00	G.L. - 10.80	10.80 - 20.00	2.75	1	6	8	-
BH-170	2.445	N-125/W-1100	20.00	G.L. - 10.70	10.70 - 20.00	1.39	1	7	8	-
BH-171	3.48	N-300/W-2000	15.00	GL - 10.20	10.20 - 15.00	0.95	-	7	8	-
BH-173	3.545	N-325/W-2000	25.00	GL - 7.40	7.40 - 25.00	1.30	1	4	6	-
BH-174	2.515	N-25/W-1392	30.00	GL - 13.75	13.75 - 30.00	1.35	-	10	11	-
BH-175	2.525	N-25/W-1492	30.00	GL - 13.20	13.20 - 30.00	1.14	-	9	10	-
BH-176	2.21	N-03/W-1640	30.00	GL - 11.40	11.40 - 30.00	1.00	-	8	9	-
BH-177	2.555	N-29/W-1855	25.00	GL - 11.20	11.20 - 25.00	0.79	-	8	9	-
BH-178	4.045	N-250/W-1975	25.05	GL - 11.15	11.15 - 25.05	0.83	2	6	9	-
BH-179	3.11	N-250/W-1700	20.00	GL - 11.10	11.10 - 20.00	0.79	1	7	8	-
BH-180	2.665	N-250/W-1295	25.00	GL - 10.75	10.75 - 25.00	0.89	2	5	6	-
BH-181	2.805	N-340/W-1400	20.00	GL - 11.65	11.65 - 20.00	0.98	2	6	7	-



Simhadri STPP

Details of Boreholes in CHP & Cooling Tower(Cont'd)

Borehole No.	Ground R.L. (m)	Co-ordinate (m)	Depth below G.L. (m)	Soil Boring Depth (m)	Rock Drilling Depth (m)	Standing water level below G.L. (m)	No. of samples collected			Core
							UDS	SPT	Disturbed Water	
BH - 182	3.515	N-340 / W-1600	20.00	GL - 10.80	10.80 - 20.00	1.65	2	5	6	6
BH - 183	4.36	N-400 / W-1875	25.00	GL - 10.20	10.20 - 25.00	2.74	1	3	7	10
BH - 184	3.53	N-400 / W-1700	20.00	GL - 10.20	10.20 - 20.00	2.51	1	6	7	7
BH - 185	2.645	N-400 / W-1500	20.00	GL - 11.30	11.30 - 20.00	1.30	2	6	7	6
BH - 186	2.9	N-400 / W-1500	25.00	GL - 10.65	10.65 - 25.00	1.35	2	5	6	10
BH - 187	3.915	N-600 / W-2200	25.00	GL - 12.60	12.60 - 25.00	0.72	-	9	10	9
BH - 188	4.035	N-600 / W-1875	25.05	GL - 8.50	8.50 - 25.05	2.55	1	5	6	11
BH - 188(A)	3.855	N-500 / W-1875	25.00	GL - 8.10	8.10 - 25.00	2.45	-	5	7	12
BH - 189	3.325	N-500 / W-1600	20.00	GL - 11.25	11.25 - 20.00	1.05	1	7	8	8
BH - 190(A)	2.875	N-479 / W-1320	25.00	GL - 19.25	19.25 - 25.00	1.30	2	10	12	1
BH - 190(B)	3.03	S-139 / W-1750	25.00	GL - 9.10	9.10 - 25.00	0.90	1	6	7	11
BH - 190(C)	1.2	S-275 / W-500	15.00	GL - 15.00	No Drilling	1.32	2	8	9	

Old Locations of CHP & Cooling Tower

Borehole No.	Ground R.L. (m)	Co-ordinate (m)	Depth below G.L. (m)	Soil Boring Depth (m)	Rock Drilling Depth (m)	Standing water level below G.L. (m)	moles collected			Water	Core
							UDS	SPT	Disturbed		
BH - 154	6.419	N-992 / W-1980	12.00	GL - 5.90	5.90 - 12.00	1.31	1	3	4	-	4
BH - 162	6.720	N-925 / W-1825	10.75	GL - 7.25	7.25 - 10.75	1.27	1	4	5	-	3
BH - 168	4.460	N-825 / W-1900	15.00	GL - 6.20	6.20 - 15.00	1.00	1	3	5	-	6
BH - 169	5.840	N-925 / W-1900	15.00	GL - 6.65	6.65 - 15.00	1.34	1	3	6	-	6



Sinhadh STPP

Details of Boreholes in Ash Disposal Area

Borehole No.	Ground R.L. (m)	Co-ordinate (m)	Depth below G.L. (m)	Soil Boring Depth (m)	Rock Drilling Depth (m)	Standing water level below G.L. (m)	No. of samples collected			
							UDS	SPT	Disturbed	Water Core
BH-200	6.627	N-700/E-1000	15.00	GL-9.00	9.00-15.00	1.70	2	3	5	-
BH-201	3.085	S-200/E-1500	15.00	GL-0.85	6.85-15.00	0.59	1	3	5	-
BH-202	1.510	N-450/E-650	15.00	GL-15.00	No Drilling	2.24	2	3	9	-
BH-203	2.825	S-200/E-1500	15.00	GL-7.05	7.05-15.00	1.05	1	3	5	-
BH-212	4.887	N-650/E-650	25.00	GL-10.80	10.80-25.00	1.61	1	5	7	-
BH-213	3.367	N-250/E-650	15.00	GL-9.00	9.00-15.00	1.63	1	4	6	-
BH-214	2.275	S-115/E-650	15.00	GL-10.85	10.85-15.00	2.02	2	5	8	-
BH-215	1.405	S-600/E-650	25.00	GL-15.45	15.45-25.00	1.11	2	8	9	-
BH-216	1.765	S-650/E-950	15.00	GL-15.00	No Drilling	1.42	1	9	10	-
BH-217	1.675	S-700/E-1250	15.00	GL-15.00	No Drilling	1.01	2	8	9	-
BH-218	1.525	S-700/E-1500	25.00	GL-11.40	11.40-25.00	0.46	1	6	8	-
BH-219	1.710	S-750/E-2000	15.00	GL-6.80	6.80-15.00	1.50	2	2	4	-
BH-220	2.856	S-400/E-1500	15.00	GL-15.00	No Drilling	1.21	2	8	9	-



Sinhadri STPP

Details of Boreholes in Reservoir Area

Borehole No.	Ground R.L. (m)	Co-ordinate (m)	Depth below G.L. (m)	Soft Boring Depth (m)	Rock Drilling Depth (m)	Standing water level below G.L. (m)	No. of samples collected		
							UDS	SPT	Disturbed Water Core
BH-191	1.205	N-200/W-200	15.00	GL-13.75	13.75-15.00	2.00	1	8	11
BH-192	2.780	N-600/W-165	15.00	GL-7.50	7.50-15.00	1.90	1	4	6
BH-193	2.320	S-200/E-020	15.00	GL-15.00	No Drilling	2.05	2	8	9
BH-194	2.932	N-200/E-400	15.00	GL-11.45	11.45-15.00	4.05	1	6	9
BH-195	3.475	N-785/W-460	25.00	GL-13.75	13.75-25.00	2.32	2	8	11
BH-196	2.820	N-770/W-350	25.00	GL-12.80	12.80-25.00	1.47	1	7	10
BH-197	3.145	N-770/W-265	25.00	GL-13.40	13.40-25.00	1.66	1	7	9
BH-198	1.520	S-200/E-400	15.00	GL-15.00	No Drilling	1.85	1	9	10
BH-199	4.247	N-668/E-400	15.00	GL-5.80	5.80-15.00	1.60	1	3	5



Sinbadri STPP

Details of Boreholes in Sea Makeup Water Pump House

Borehole No.	Ground R.L. (m)	Co-ordinate (m)	Depth below		Soil Boring Depth (m)	Rock Drilling Depth (m)	Standing water level below G.L. (m)	No. of samples collected			Core	
			G.L. (m)					UDS	SPT	Disturbed		Water
W-1	3.807	S-3680/W-50	20.00		GL-12.20	12.20-20.00	1.20	1	7	8	-	6
W-2	3.632	S-3670/W-130	25.00		GL-12.50	12.50-25.00	1.00	1	8	9	-	9
W-3	4.052	S-3752/W-40	25.00		GL-12.50	12.50-25.00	1.35	1	8	9	-	9
W-4	3.412	S-3730/W-112	30.00		GL-13.55	13.55-30.00	0.90	1	9	10	-	11
W-5	4.042	S-3720/W-184	25.00		GL-14.15	14.15-25.00	1.40	-	10	11	-	8
W-6	3.352	S-3732/W-150	25.00		GL-12.00	12.00-25.00	0.20	1	7	8	-	9
W-7	3.167	S-3788/W-180	30.00		GL-12.50	12.50-30.00	0.50	1	8	9	-	12
W-8	5.317	S-3770/W-250	25.00		GL-16.00	16.00-25.00	2.70	1	10	11	-	6
W-9	4.222	S-3856/W-176	25.00		GL-12.70	12.70-25.00	1.50	1	9	10	-	9
W-10	7.642	S-4000/W-70	25.00		GL-15.10	15.10-25.00	5.25	-	10	11	-	7
W-11	10.967	S-4232/E-15	25.00		GL-18.20	18.20-25.00	8.30	-	14	15	-	5
W-12	8.132	S-4342/E-60	25.00		GL-15.50	15.50-25.00	5.50	-	11	12	-	7
W-13	3.992	S-4475/E-112	30.00		GL-18.15	18.15-30.00	1.40	-	13	14	-	8



Simhadri STP

Details of Boreholes in Sweet Water Pump House

Borehole No.	Ground R.L. (m)	Co-ordinate (m)	Depth below G.L. (m)	Soil Boring Depth (m)	Rock Drilling Depth (m)	Standing water level below G.L. (m)	No. of samples collected				
							UDS	SPT	Disturbed	Water Core	
PH-1	24.345	On the line of 24/3 pillar	20.00	GL-14.20	14.20 - 20.00	2.95	-	10	11	-	4
PH-2	24.470	On the line of 24/3 pillar	20.00	GL-18.00	18.00 - 20.00	2.50	1	11	12	-	2
PH-3	24.510	On the line of 24/3 pillar	20.00	GL-17.50	17.50 - 20.00	0.65	1	11	12	-	2
PH-4	27.504	On the line of 24/4 pillar	18.30	GL-15.60	15.80 - 18.30	3.30	1	10	11	-	2
PH-5	26.819	On the line of 24/4 pillar	17.50	GL-14.50	14.50 - 17.50	2.60	-	10	11	-	3
PH-6	25.744	On the line of 24/4 pillar	16.20	GL-13.70	13.70 - 16.20	1.60	-	10	11	-	2
PH-7	28.594	On the line of 24/5 pillar	28.58	GL-16.00	16.00 - 19.00	4.40	1	10	11	-	3
PH-8	27.159	On the line of 24/5 pillar	16.00	GL-13.00	13.00 - 16.00	3.02	1	8	9	-	3
PH-9	27.099	On the line of 24/5 pillar	16.50	GL-13.50	13.50 - 16.50	2.96	1	8	9	-	3





Sir Ramulu V
RAMALAYA
సార్ రామలయ
వారి రామలయ



Unit-1
2700 1

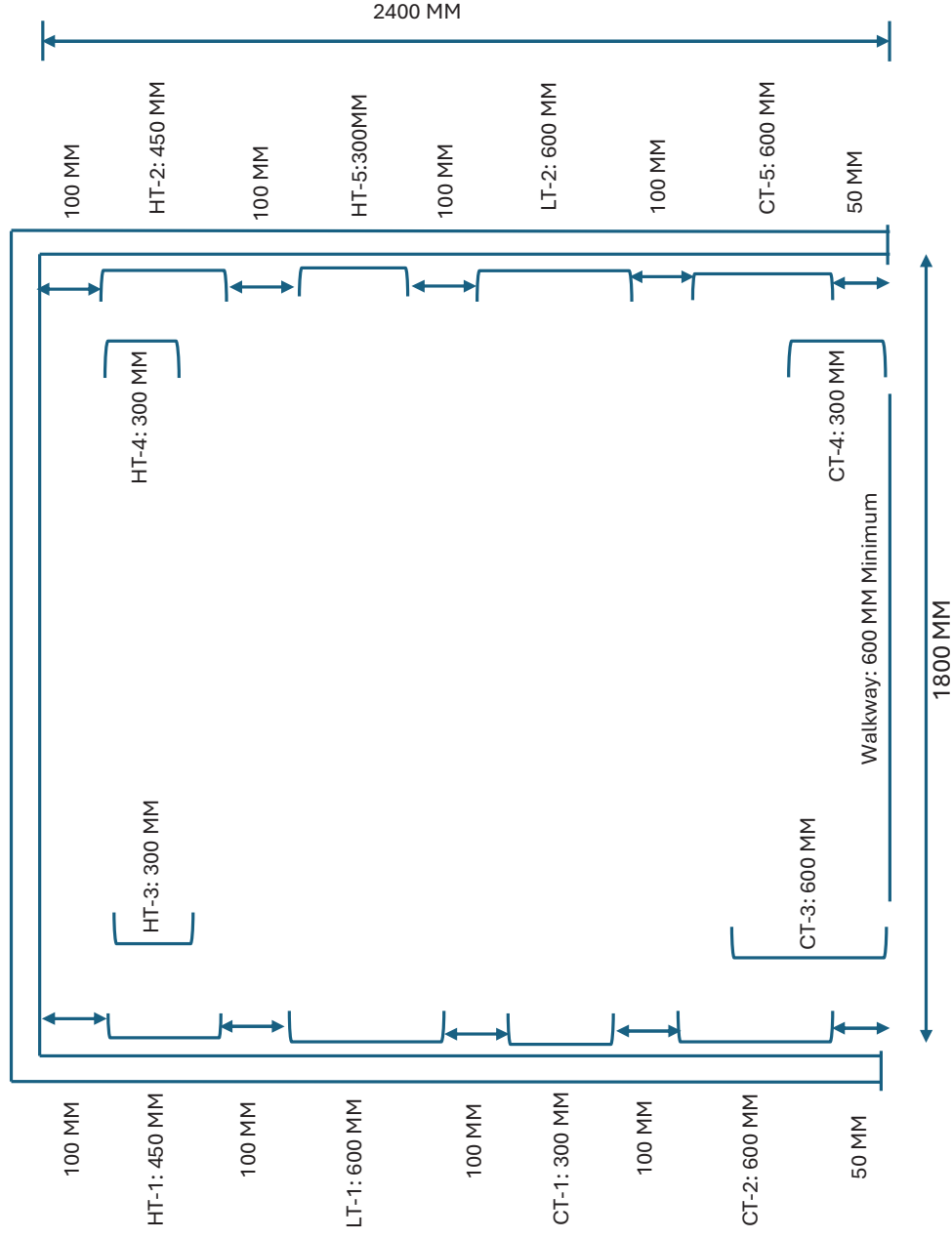
MCC-4

Proposed Cable gallery

Existing Underground CW ducts
(02 nos)

Proposed Pipe cum Cable
gallery Portion

CABLE TRAY ARRANGEMENT



1. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for road crossings where it shall be at 8.0M above grade level as per Site condition.
2. For rail crossing, the routing shall be as per RDSO guidelines.
3. The cable trestle shall have a minimum 600 mm clear walk-way and shall have maintenance platforms as required.
4. Power/Control cables associated with one Stream/Stage shall be segregated from cables of other Stream/Stage. (Segregation means physical isolation to prevent fire jumping)
5. Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire.
6. No joint is advisable in trip circuits, protection circuits and CT/PT circuits.
7. Control Cable tray depth considered: 150mm
8. Cabling shall be as per Statutory guidelines.



Approved
SUNIL
MALANI
(Sunil Malani)

P 1/2

SQP NO:	CPG-Q
Rev.	00

SQP NO.:	
Rev.	

**Item: - ELECTROFORGED
GRATING (GALVANISED /
PAINTED)**



SL. NO.	COMPONENT / OPERATION	CHARAC-TERISTICS	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS	
			M	N				D	M		N

\mathcal{A}	Raw Material/Bought Out Item Check
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1.	Raw Material	Chemical Composition & Mechanical Properties	1/Heat		Tender/PO Specs/NTPC approved DRG/DS	TC/IR	Y	P	V
2.		Dimensional check, Straightness, Surface Finish	100%	1%	Tender/PO Specs/NTPC approved DRG/DS	IR	Y	P	V




<i>B</i>	<i>Process/Assembly Check</i>
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1.	For Electro forging						
	Fusion (Cross bar projection) and Pitch	100%	1%	Tender/PO Specs/NTPC approved DRG/DS	IR	P	V
2.	For Fabrication						
	Diagonal, Fit up of frame bar, Finishing	100%	1%	Tender/PO Specs/NTPC approved DRG/DS	IR	P	V

<i>C</i>	<i>Finished Product/Final Inspection</i>
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1.	Hot Dip Galvanizing (For Galvanized Electro forged Gratings)									
		Mass, Uniformity, Thickness of Zinc Coating, Adhesion Test	5%	1%	Tender/PO Specs/NTPC approved DRG/DS/IS2629/IS 4759/IS 6745/IS 2633	IR / TC	Y	P	W	
2.	Painting (For Painted Electro forged Gratings)									
		Surface preparation, Thickness of Primer, Thickness of Intermediate Coat,	5%	1%	Tender/PO Specs/NTPC approved DRG/DS/BS4232	IR	Y	P	V/W*	*Final coat thickness

STANDARD QUALITY PLAN

	Item: - ELECTROFORGED GRATING (GALVANISED / PAINTED)	SQP NO:		CPG-QA-SQP- M052	P 2/2	Prepared  GANPATI JHA (Ganpati Jha)	Approved  SUNIL MALANI (Sunil Malani)
				Rev.	00	Date	26.09.2022

SL. NO.	COMPONENT/ OPERATION	CHARAC- TERISTICS	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
								M	N	
		Thickness of Final Coat								
3.	Deflection	Deflection Test	One for each loading per lot		Tender/PO Specs/NTPC approved DRG/DS/BS4592		IR	Y	P	W
4	Pull Test	Pull Test	One for each loading per lot		1.2 X allowable strength	Tender/PO Specs/NTPC approved DRG/DS	IR	Y	P	W

Notes:-

1. Y mark in Column 'D' means such document shall be furnished by the manufacturer / supplier.
2. Calibrated equipments required for performing the tests in presence of NTPC or authorized representative, shall be arranged by the supplier without any extra cost.
3. Witness by NTPC/authorized representative (wherever applicable) shall be on randomly chosen sample/s. NTPC shall review Mfrs test report for balance quantity.
4. A) Reference and Acceptance norms shall be derived from following in the same sequence 1) NTPC Approved drawing / data sheet; 2) NTPC tech specs; 3) Purchase Order; 4) Relevant national standard. 5) Relevant International standard; 6) Manufacturer's standard 7) Good Engineering practices

Abbreviations: -

M	Manufacturer	P	Perform	IR	Inspection Record / Report
N	NTPC Ltd or authorized representative	W	Witness	TC	Test Certificate
DRG	Drawing	V	Review of records	DS/PO	Data Sheet/Purchase Order

STANDARD QUALITY PLAN


	Item: FABRICATED STRUCTURES (for Single Piece Tonnage>10MT) (Non-Boiler/Turbine/Bunker/ESP/CHP Appln)			SQP No:	CPG-QA-SQP-M-338	P 1/2		Approved
	Rev.	00	Date	06.03.2026				

SL. NO.	COMPONENT/ OPERATION	CHARACTERISTICS	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
			M	N				M	N	

A RAW MATERIAL										
1	Plates, Pipes for Structural, Structural Steel Sections, Hollow (Square/ Rectangle), Chequered plate, Rolled /Forged Bar	a.Chemical & Mechanical Properties b.UT of plates >40mm thick (shall be degassed and furnace normalized) c.Forged/Rolled Bar Dia>50mm	100%		(a)As per NTPC PO, Tech Spec, SoW, Construction Drawing/Material Std (b) ASTM A578 Level B-S2 © ASTM A388M		MTC/TC	✓	P	V
B INPROCESS ACTIVITY										
1	Fillet Welds	a.LPI b. # Macro Etching (#for T>32mm per one Column one Test for "+.7/T" Column buildup beam)	100%	a. 10 % V /b. 5%W			IR	✓	P	V / W
2	NDT for Edge Preparation [EPI Area]	UT in EP area +50mm Heat Affected Zone ONLY for Thk>40mm	100%	100%	ASME Sec V/ASME E165 /AWS D1.1		IR	-	P	-
3	Butt Weld & Full Penetration Branch Weld Quality	a.Butt Weld Soundness for Plate Thickness =>32mm RT/UT b.Butt soundness for 10mm <Plate Thickness<32mm; RT/UT c.Full penetration weld (other than butt weld); UT	100%	100%			TR	✓	P	V
4	PH/PWHT/PFHT -as applicable	Time-Temperature Chart	100%	100%	ASME Sec V/ AWS D1.1		TR	✓	P	V
5	PTC coupon	Mechanical Test on PTC	1 per every 50 MT		As per WPS & Tech spec		IR/Time-Temp chart	✓	P	V
C FINISHED PRODUCT/FINAL INSPECTION										
1	Final Inspection	Dimension/Camber/Sweep/Match Marking / Level Marking / OLV / WL / Diagonal & pitch distance of holes/Pin Gauge Check for holes: Individual / Trial Assy	100%	@10% / 10%	Tech Spec/SoW/Construction Drawings/relevant IS Std/ASME Sec-V/AWS D1.1		IR	✓	P	W
2		Visual Inspection of loose items supplied like Steel Plates/Sheet / Foundation Bolt / Fasteners	100%	10%			IR	✓	P	W
3		LPI for fillet weld & MPI Groove weld and butt joints <32mm	100%	10%			IR	-	P	W
4		Surface Preparation and Painting-Shade, DFT	100%	-			IR	-	P	-

@ 10% of individual built-up columns/beams and 10% of Trial Assembly at Random

STANDARD QUALITY PLAN

	Item: FABRICATED STRUCTURES (for Single Piece Tonnage > 10MT) (Non-Boiler/Turbine/Bunker/ESP/CHP Appln)				SQP No:	CPG-QA-SQP-M-338	P 2/2	
	Rev.	00	Date	06.03.2026	Prepared	Reviewed	Approved	

SL. NO.	COMPONENT/ OPERATION	CHARACTERISTICS	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
			M	N				M	N	
								D		

NOTE:-

1. 'Y' / ✓ mark in Column 'D' means such document shall be furnished by the manufacturer / supplier.
2. Calibrated equipment required for performing the tests in the presence of NTPC/authorized representative, shall be arranged by the supplier without any extra cost.
3. Witness by NTPC/authorized representative (wherever applicable) shall be on randomly chosen sample/s. NTPC shall review Mfrs test report for balance quantity.
4. Reference and Acceptance norms shall be derived from following in the same sequence i) NTPC Approved drawing / data sheet; ii) NTPC tech specs; iii) Purchase Order; iv) Relevant national standard. v) Relevant International standard; vi) Manufacturer's standard vii) Good Engineering practices.
5. In case of failure/defect in any weld in RT/UT, the percentage of RT or UT shall be doubled wrt originally proposed percentage. If RT is not feasible, UT shall be carried out. All joints which are Radiographed/UT Test shall be suitably numbered using hard punch/engraving for easy identification/traceability and correlation with RT/UT reports.
6. Plates Thickness beyond 12mm and upto 40mm shall be Normalized Rolled.
7. Mechanical Test on Production Test Coupon [PTC] for built-up column Butt Welded Joints of highest plate thickness available in the offered lot (from NABL accredited lab or any third-party lab accredited as per ISO / IEC 17025) shall be witnessed by NTPC: One Sample for every 50MT fabrication shall be offered for NTPC Sample identification & NTPC RIO Inspector Seal Transfer and followed by Test witness at Laboratory.

Abbreviation:

M/Mfr	Manufacturer	P	Perform	IR	Inspection Record / Report
N	NTPC Ltd or Authorized representative	W	Witness	TC/TR	Test Certificate / Test Report
PO	Purchase Order	V	Review of records	DS/MTC	Data Sheet / Mill Test Certificate
LPT	Liquid Penetrant Test	PH/PW/HT	Pre-Heat / Post Weld Heat Treatment	MPT	Magnetic Particle Test
VT	Visual Test	PEHT	Post Forming Heat Treatment	UT	Ultrasonic Test
WPS	Welding Procedure Specification	PQR	Procedure Qualification Record	HTC/HTR	Heat Treatment Chart/Record
PTC	Production Test Coupon	OLV	Overall Length Variation	WL	Water Level

STANDARD QUALITY PLAN

	Item: - Steel Plates / Rods / Bars (Plate thickness > 12mm; Rod / Bar Dia >40mm)	SQP NO:		CPG-QA-SQP-M-053		P 1 / 1	Prepared GANPATI JHA (Ganpati Jha)	Approved SUNIL MALANI (Sunil Malani)			
		Rev.		01					Date		07.03.2026

SL. NO.	COMPONENT / OPERATION	CHARAC-TERISTICS	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	D	AGENCY	REMARKS
1.0	<i>Raw Material / Bought Out Items Check</i>								
	Raw Material	Chemical composition and Physical properties	Sampling as per Mtl Std	Tender/PO Specs/NTPC approved DRG/DS	TC/IR			P	V
2.0	<i>Process / Assembly Check</i>								
	Heat treatment	Time and temperature	100%	Tender/PO Specs/NTPC approved DRG/DS	HT charts/ HT reports			P	V
3.0	<i>Finished Product / Final Inspection</i>								
	Finished product	a)Physical properties (TS, YS, Elongation)	1 sample / Heat / Size	Tender/PO Specs/NTPC approved DRG/DS	TC / IR	Y		P	W
		b)UT (for plate thickness>40mm ; rod dia >=50mm)	100%	ASTM 578 Level B S2 /A388	TC/IR	Y		P	W
		c)Dimension	100%	Tender/PO Specs/NTPC approved DRG/DS	IR			P	W
		d)PMI test	100%	-do-	IR			P	W
		e)Surface defects	100%	No visual surface defects	IR			P	W

Notes :-



- 'Y' mark in Column 'D' means such document shall be furnished by the manufacturer / supplier.
- Calibrated equipments required for performing the tests in presence of NTPC or authorized representative, shall be arranged by the supplier without any extra cost.
- Witness by NTPC/authorized representative (wherever applicable) shall be on randomly chosen sample/s. NTPC shall review Mfrs test report for balance quantity.
- Reference and Acceptance norms shall be derived from following in the same sequence-
 - NTPC Approved drawing / data sheet b) NTPC tech specs c) Purchase Order d) Relevant national standard e) Relevant International standard f) Manufacturer's standard g) Good Engineering practices
 - When Back Wall Echo (BWE) set to 100% Full Screen Height (FSH) in sound area of the material , a defect echo > 20% FSH is not acceptable. Also loss of BWE > 20% is not acceptable.

Abbreviations :-

M /Mfr	Manufacturer	P	Perform	IR	Inspection Record / Report
N	NTPC Ltd or authorized representative	W	Witness	PO	Purchase Order
DRG /DS	Drawing /Data Sheet	V	Review of records	TC	Test Certificate

NOTE: For Killing Status & Impact requirement, Normalizing in Furnace & Normalized Rolling & Degassing - please refer SoW/PO Tech Spec.
For UT std ASTM A435 or ASTM A578 Level B S2 or any std - shall be strictly as per SoW / PO Tech Spec.

STANDARD TC / INSPECTION REPORT REQUIREMENT

	ITEM: Chequered Plate			STCR NO:	CPG-QA-STC-M-097		Prepared by	Approved by		
				Rev.	00	Date				31-08-2023



PDI by NTPC is not envisaged. Vendor, along with material, shall submit test certificates / internal inspection reports for following-

Sl no.	Attribute / Test	Reference / Acceptance Norms	Remarks
A) Raw Material / Bought Out Items Checks			
1	Chemical Composition	Tender/PO specs/NTPC approved Drg/DS/relevant standard / Manufacturer's Standard	
B) Process / Assembly Checks			
1	Not Applicable		
C) Finished Product / Final Inspection / Testing			
1	Tensile Test & Bend Test	Tender/PO specs/NTPC approved Drg/DS/relevant standard / Manufacturer's Standard	
2	Dimension Test	Tender/PO specs/NTPC approved Drg/DS/relevant standard / Manufacturer's Standard	

Notes :-

1. TC / IR shall be from manufacturer's own lab or a NABL accredited lab or any third-party lab accredited as per ISO / IEC 17025.

STANDARD TC / INSPECTION REPORT REQUIREMENT

	ITEM: Earth Flat / Rod / Conductor		STCR NO: CPG-QA-STC-E-146	Prepared by		Approved by	
				Rev. 01	Date 03/01/2025		

Pre dispatch inspection (PDI) by NTPC is not envisaged. Vendor, along with material, shall submit test certificates / internal inspection reports for following-

Sl no.	Attribute / Test	Reference / Acceptance Norms	Remarks
A) Raw Material / Bought Out Items Checks			
1	NA		
B) Process / Assembly Checks			
1	NA		
C) Finished Product / Final Inspection / Testing			
1	Dimensions, Resistance, Material Chemical composition & Physical properties (as applicable),	Tender/PO specs/NTPC approved Drg/DS/relevant standard/Manufacturer's standard.	
2	Checks for galvanization(Uniformity & Mass of coating) (as applicable)	Tender/PO specs/NTPC approved Drg/DS/relevant standard/Manufacturer's standard.	


Notes:-

1. TC / IR shall be from manufacturer's own lab or a NABL accredited lab or any third-party lab accredited as per ISO / IEC 17025.

Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	10
2.2	Coarse Aggregate									
i		Moisture content	IS:2386	B	Physical	To be done every day before start of work	IS : 456/IS : 383/IS: 2386 Part-III/Tech Spec		SRLB	✓ During monsoon, frequency may be increased and accordingly water content in concrete will be adjusted.
ii		Sieve analysis, flakiness index, elongation index	IS:2386	B	Physical	One per 100 cum. or part thereof	IS: 2386 Part-I, IS:383 / Tech Spec		SR/LB/TR	✓
iii		Specific gravity, Soundness, Water absorption, Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale, Total of % of all deleterious materials),	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS: 2386 Part-II, IS: 2386 Part-I, IS:456, IS:383/Tech Spec		SR/LB/ TR	✓ During Design mix, these tests to be carried out as per clause no. 4.2 (i)
iv		Crushing value, Abrasion value and Impact Value	IS:2386	A	Physical	Once for each source & for every change of source	IS:383,IS:2386 Part IV/Tech Spec		SR/LB/ TR	
2.3	Fine Aggregate									
i		Moisture content	IS:2386	B	Physical	To be done every day before start of work	IS : 456/IS : 383/IS: 2386 Part-III/Tech Spec		SRLB	✓ During monsoon, frequency may be increased and accordingly water content in concrete will be adjusted.
ii		Sieve analysis, Silt content (% finer than 75 micron)	As agreed / required	B	Physical	One per 100 cum. or part thereof	Tech Spec/ IS 2386 / IS 456/ IS 383		SR/LB/ TR	✓
iii		Specific gravity, Soundness, Water absorption, Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale, Total of % of all deleterious materials (excluded mica as well as included mica content)), organic impurities	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS: 2386 Part-II, IS: 2386 Part-I, IS:456, IS:383/Tech Spec		SR/LB/ TR	✓ During Design mix, these tests to be carried out as per clause no. 4.2 (i)
2.4	Water	Complete Testing as per IS:456-2000	As per IS:456	B	Testing	Once for each source and thereafter yearly in case of borewell. If water is used from open source like river, stream, canal etc., then water testing is to be done quarterly.	IS:456-2000/ Tech. spec.		TR	✓
2.5	Admixtures for Concrete	Material/Type of admixture and its suitability	As per IS:9103	A	Review of MTC/ test reports	For each lot received at site	As per Designed mix and IS:9103/ Tech. Spec.		Test Report/ MTC	✓ Random sample may be send to Owner acceptable third party testing lab. for testing requirements as per TS and IS codes. Frequency of check may be decided by EIC/Head FQA based on quantity, requirement and Relevant IS code.
3	CONCRETING (MIXING, CONVEYING, PLACEMENT, COMPACTION, CURING & TESTING)									
3.1	Batching Plant (if installed)									
i		Calibration of Batching Plant		A	Physical	After initial setting up of batching plant, calibration by OEM / NABL accredited agency must be done before use of batching plant for production of concrete.	Review of calibration chart/ Certificate/IS 4925		Calibration Certificate	✓ Additionally, Batching Plant shall be calibrated regularly at least once in a 3 months in-house. The weights for batching plant calibration to be calibrated once in year by NPL/NABL accredited lab./Weights & Measures Dept.
3.2	CONCRETE									Load cells to be jointly signed (Agency, NTPC Execution & FQA) and sealed.
i		Design Mix.	As per IS 456	A	Physical	Design mix shall be carried out at the start of the work and in case of change of source of concrete ingredients	Tech. Spec., IS 456		TR	✓

Sl. No	Activity and operation	Characteristics / instruments	Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3	4	5	6	7	8	9	10
ii		4 Trial mixes to ascertain the workability and cube strength	A	Physical	4 trial mix. for each mix proportion as per IS 10262	Tech. Spec., IS 456/IS 10262		SR/LB	✓
iii		Concrete Cube strength Test	A	Physical	As per IS 456 clause 15.2.2	IS:516, IS:456, Tech. Spec.		SR/LB/ TR	✓ 1. For 7-day one sample/ 50 m3 or part thereof. 2. For 28 days sampling rate shall be as per IS 456 clause 15.2.2 Three test specimens shall be made for each sample
iv		Workability - slump test	B	Physical	At the time of concrete pouring at site every two hrs.	IS:456/Tech. Spec.		SR/LB/ TR	✓
4	REINFORCEMENT STEEL AND ITS PLACEMENT								
i	Material	Physical/Mechanical and chemical properties as per relevant IS codes and Tech spec.	A	Review of MTC	Each batch/lot of delivery	As per IS 1786, IS 432, IS 1566, IS 13920 , Tech spec and cont. drawing		MTC	✓ To be procured from Owner approved source.
	Coupler	Physical/Mechanical and chemical properties as per relevant IS codes and Tech spec.	A	Review of MTC	Each batch/lot of delivery	IS 16172, Tech spec and cont. drawing		MTC	✓ MTC shall contain all the parameters specified in the technical specifications
ii		Freedom from cracks surface flaws, Lamination & excessive rust.	B	Visual	Random minimum 10% in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings		SR	To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.
iii		Bar bending schedule with necessary lap, Spacers & Chairs	B	Physical & Measurement	100%	Approved Drawings, Tech Specs and Const. Drawings, IS:2502		SR	✓
5	FOUNDATION SYSTEM								
i		Foundation casting - Layout, Shape, Reinforcement, concreting, curing etc.	B	Physical	Each foundation	As per technical specifications and construction drawings		SR	✓ lines and levels to be checked. Concrete Grade to be checked as per Mix Design
ii		All Foundations/Footings to be painted with bitumen paint/Moisture resistance paint before backfilling.	B	Physical	Each foundation	As per technical specifications and construction drawings		SR	
6	STAGING AND FORMS								
i		Materials and accessories	B	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings		SR	
ii		Soundness of staging, shuttering and scaffolding including application of mould oil / release agent	B	Visual	Once before start of work	As per manufacturer's spec and as per 3696:4014, 4990, Tech Specs and Const. Drawings		SR	
iii		Acceptance of formwork before start of concreting : disposition w.r.t. reference axes, size, etc.	B	Physical / visual	Before start of concreting	As per provisions and tolerances in IS 456, Tech Specs and Const. Drawings		SR	✓
7	EMBEDDED PARTS (INCLUDING LAYING OF RAILS & ANCHOR FASTENERS) - if Applicable.								
i		Material	B	Review of MTC/ test reports	Each batch/lot of delivery	As per Tech Specs and Const. Drawings		SR/MTC	✓
ii		Position / alignment / levels of embedded parts / bolt hole / pipe sleeves / rails / PVC pipes / etc. as per IS and construction Drg.	B	Physical/ measurement	100%	As per Tech Specs and Const. Drawings		SR/ Protocol	✓ Exposed surface of the embedded parts other than holding down bolts are to be painted with as per technical specifications.
iii		Welding / tying of embedment to reinforcement	B	Physical/ measurement	Random minimum 10% in each shift	As per Tech Specs and Const. Drawings		SR	

Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	10
8	GROUTING (If applicable)				Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings		SR/MTC	✓
i		Material	As agreed / required	A	Physical	Random minimum 10%	Tech Specs and Const. Drawings		SR/LB/ TR	✓
ii		Compressive strength of cubes after grouting.	As agreed / required	A	Physical	Each grout section	Tech Specs and Const. Drawings		SR	✓
iii		Acceptance of the grouts : Mixing, placement, application and grout pressure (as applicable)	As agreed / required	B	Physical					
9	PILING WORK (If Applicable)									
9.1	Execution									
i		Borehole diameter	As required	B	Physical	100%	As per appd. Drawings and technical specification		SR/LB	✓
ii		Pile layout	Total station	B	Measurement	100%	As per appd. Drawings and technical specification		SR/LB	✓
iii		Recording ground level and pile termination level	As required	B	Measurement	Random minimum 10%	As per appd. Drawings and technical specification		SR/LB	✓
iv		Cleaning/Flushing of pile bore	As required	B	Measurement	Each pile	IS 2911/ Tech. Specs.		SR/LB	✓
v		Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.(If applicable)	As required	B	Measurement	100%	As per appd. Drawings and technical specification		SR/LB	✓
vi		Reinforcement cage/ alignment/ cover etc and pouring of concrete above cut off level.	As required	B	Measurement	100%	As per appd. Drawings and technical specification		SR/LB	✓
9.2	Testing									
i		Bentonite	IS:2720	A	Physical / Test report	Once per lot	As per IS:2720 IS 2911/ tech. Specs.		MTC/TR	✓ One sample from each (brand/manufacturer) to be tested at Owner acceptable third party lab.
ii		Density check on sample of mud collected from pile bore bottom	IS 2911	B	Physical	Each pile/ Randomly 1 in 10 piles (Le. 10%)	IS 2911/ Tech. Specs./approved PILING METHODOLOGY		SR/LB	✓ Tests to be done before placing of concrete.
iii		Slump test of concrete	IS:1199	B	Physical	Every 2 hrs at pouring point of concrete	IS:2911. As per appd. Drawings and technical specification		SR/LB/TR	✓
iv		Concrete Cube strength Test	IS:456	A	Physical	Frequency as per 4.2 (ii) above	IS:2911 IS:516, IS:456, As per appd. Drawings and technical specification		SR/LB/TR	✓
v		Initial Pile Load Tests - Vertical (Compression), Lateral (Horizontal) and Pull-Out (Tension).	IS:2911 / as required	A	Testing	As per Technical Specification/IS standard	IS:2911. As per appd. Drawings and technical specification		SR/LB/TR	✓
vi		Routine Pile Tests - Vertical Load Test (Compression) and Lateral Load Test (Horizontal)	IS:2911 / as required	A	Testing	As per Technical Specification/IS standard	IS:2911. As per appd. Drawings and technical specification		SR/LB/TR	✓
10	GEOTECHNICAL INVESTIGATION WORK									
i		Deployment of Owner approved Geotechnical Investigation Agency . Equipment, Manpower etc.	As required / agreed	B	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes		SR	✓
v		Submission of Owner approved Final Geotechnical investigation report along with recommendations.	As required / agreed	B	Physical	After completion of investigation work	As per technical specifications and relevant IS Codes		-	✓
		LEGENDS : * Records identified with tick (✓) shall be essentially included by supplier in QA documentation.					For Owner Use	Owner DOC NO. :		

Sl. No	Activity and operation	Characteristics / instruments	Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3	4	5	6	7	8	9	10
		<p># Class A : Critical, Class B : Major, Class C : Minor. Class 'A' checks shall be witnessed by Owner FQA and Execution Engineer, Class 'B' checks shall be witnessed by Owner Execution Engineer, Class 'C' checks shall be witnessed by Main contractor engineer. SR - Site Register, TR- Test Report, LB-Log Book, IR - Inspection Report, MTC - Manufacturer's Test Certificate. Surveillance of Class 'A' checks shall be performed By Owner Head (FOA), Class 'B' by Owner FQA Engineer and for class 'C' Another Executing Engineer authorised by Head (Executing Deptt). Tests having no inhouse facility, to be done at any NABL /NTPC Approved laboratory.</p> <p>Note: Any non conformity/ deviation to the Quality plan must be brought to notice of NTPC/Owner. Dispositioning authority shall be the authorised representative of NTPC/Owner as per NTPC FQA system manual.</p>							
	Main-supplier						REVIEWED BY	APPROVED BY	APPROVAL SEAL

FIELD QUALITY PLAN										
ITEM : FQP For ERECTION of STRUCTURAL STEEL				OP NO.:		PROJECT:				
				REV. NO.:		PACKAGE: Proposed Cable Trestle Woks				
S L. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF MISCELLANEOUS STRUCTURAL STEEL WORKS	DATE:		CONTRACT NO.:				
				TYPE OF CHECK	QUANT UM OF	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	REMARKS	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
1	MATERIAL	Physical condition of material Identification, correlation with inspection report	B	Visual	100%	MDCC *		Log Book	✓	*For Supply of Shop fabricated structure . If fabrication is to be done at site then separate FQP for "STRUCTURAL STEEL FABRICATION WORK " to be followed for fabrication works at site
2.	STORAGE: INSTRUCTIONS & FACILITIES	Availability of storage / preservation instructions/ procedure for material at site Material storage & Preservation: Check for proper Storage, Shelf life, Preservation etc.	A A	Verification Verification	100% 100%		storage & preservation instruction/ procedure/ recommendation of manufacture/ NTPC As per storage Instructions Point No. 1 above	Site register/Log Book Site register/Log Book	✓	
3.	FOUNDATION CHECK	Dimensions and levels- Shape, lines (Including diagonal checks) Foundation Bolts and Embedment's - Verticality, Levels, pitch distance	B	Physical/ Measure ment	Each Foundation		Tech Specs / Const. Drawings	Report	✓	
4	PRE- ASSEMBLY / ERECTION CHECK	Punch Erection marks and match marks on members	C	Visual, Physical	Each structural member		Tech Specs and Const. Drawings	-	-	Markings for - Assembly designation, Part number , Any other important Identifications.
5	ERECTION CHECKS	Alignment, slopes, level, tolerances of erected member	B	Measurement	Each structural member		Tech Specs and Const. Drawings	Report	✓	100% By Agency, RANDOM BY
		Tightening of bolts/ Torque setting, Including foundation bolts with lock nuts, Structural Bearings check	B	Visual/ Physical	Each structural member		Tech Specs and Const. Drawings	Report	✓	100% BY agency AND 10% RANDOM WITNESS NTPC Exec.
	PERMANENT BOLTS	Acceptance of erected structure Theodolite, Tape, plumb, piano wires etc	B	Visual/ Physical	Each structural member		Tech Specs and Const. Drawings, IS 7215 and IS 12843	Report	✓	
		Contact surfaces before bolting	C	Physical	Random before assembly for bolting		Tech Specs and Const. Drawings, IS 4000	-	-	
6	AND NUTS AND WASHERS	Inspection of the assembled bolts	B	Physical	Randomly in each shift for assembled		Tech Specs and Const. Drawings, IS 4000	Report	✓	

		Acceptance of installed bolts	-	B	Physical	Each bolt	Tech Specs and Const. Drawings	Report	-	
7.1	ELECTROFORGED GRATINGS (if applicable)	Acceptance of Erection, alignment and each Installation	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	Report / Log	✓	
7.2	GALVANISED STEEL HAND RAILS (if applicable)	Acceptance of Erection, alignment and each Installation	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	Report / Log	✓	
7.3	PERMANENTLY COLOUR COATED SHEETS, METAL DECKING (if applicable)	Installation lap alignment & workmanship	As required /agreed	B	Visual / Physical	Random	Tech Specs and Const. Drawings	-	✓	
		Finishing and acceptance	As required /agreed	B	Visual / Physical	Random	Tech Specs and Const. Drawings	Report	✓	
8	WELDING (IN CASE OF SITE WELDING AS PER APPROVED DRAWING, IF ANY)									
8.1	WELDING – PRE- WELDING REQUIREMENTS	Welding Procedure Specification WPS, (EIC Approved)	-	A	Review	Each Welding Process	Technical Specification and Construction Drawings, ASME-IX/ AWS D 1.1	WPS	✓	IF SUPPORTING PQR IS NOT APPLICABLE, PQR SHALL BE CONDUCTED AT SITE IN PRESENCE OF FQA.
		Welder's Qualification, Welding consumables	-	A	Visual & NDT	Each welder	WQR, AWS-D1.1/ASME-IX, Technical Specification Approved WPS, Latest NTPC Rationalized list of Electrodes.	Test Report	✓	Random surveillance by NTPC FQA
		Marking and cutting	Tape, ruler etc	C	Visual &	Each plate/ Section	Technical Specification and Construction Drawings/ Technical Specification and Construction Drawings	-	-	-
8.2	FIT UP	Weld Fit Up- Edge Preparation/ Gap/ Alignment	-	C	Physical	Each fit-up	Technical Specification and Construction Drawings, IS 7215	Report	-	Ensure match markings are punched for all trial assembled
		Pre-Heating Temperature	Tape, ruler etc	B	Physical	Each fit-up	Technical Specification and Construction Drawings, IS 7215	Report / Log sheet	✓	If required, suitable stiffeners shall be provided to prevent deflection.
8.3	PRE- HEATING (wherever applicable)	Sequence of welding	Thermal chalk	B	Measure ment	Random	Technical Specification and Construction Drawings, Approved WPS	SiteRegister/Log Book	✓	
		Removal/ grinding of temporary attachments	-	C	Physical	Random in each shift	Technical Specification and Construction Drawings, Agreed scheme	Certificate of Conformance from Agency		
8.4	WELDING REQUIREMENTS	Completeness after welding- Dimensions/ distortion	-	C	Measure ment	All cleats/ attachments	Technical Specification and Construction Drawings, Approved Dwg.	-		
		Completeness of welding (each butt & fillet weld)	Weld gauge	B	Visual & Measure	Each structure component	Technical Specification and Construction Drawings, IS 822	SiteRegister/Log Book	✓	
9	NON- DESTRUCTIVE AND DESTRUCTIVE TESTING (IN CASE OF SITE WELDING AS PER APPROVED DRAWING, IF ANY)									
9.1	FILLET WELDS	Size and visual examination	As required/ agreed	C	Visual/ Measure ment	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	Report /Log	-	
		Dye Penetration Test	As required/ agreed	B	Physical	25% weld length of tension member of crane girder (if applicable)and 5% of Weld length with min. 300mm at	As per technical specifications and construction drawings, IS 822, AWS D 1.1	Report	✓	10% RANDOM WITNESS NTPC FQA
		UT on Full Penetration Welds (other than Butt welds)	As required/ agreed	A	Physical	100% on Web to Flange joint of crane girder (if applicable).	As per technical specifications and construction drawings, IS 822, AWS D 1.1	Report	✓	
		Visual examination	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and construction drawings, IS 822, AWS D 1.1	Report	✓	100% by Agency & Random by NTPC Exec
9.2	BUTT WELDS	DPT	As required/ agreed	B	Physical	100% on all butt welds after back gouging on root run and 10% on final weld.	As per technical specifications and construction drawings, IS 822, AWS D 1.1	Report	✓	All butt welds to be back gouged before DPT. 10% RANDOM WITNESS NTPC FQA

		Mechanical testing on production test coupons	As required/ agreed	A	Physical	Minimum one joint per built up beam, columns and crane girders (if applicable) 100% RT/UT on butt welds of tension flange (bottom flange) of crane girder (Thickness=32mm). All other butt welds of 10mm<Thickness<32mm RT shall be subjected to 10% weld joints	As per technical specifications and construction drawings. IS 822, AWS D 1.1	Report	✓	Test on production test coupons
		Radiography Test / Ultrasonic Test	As required/ agreed	A	Physical		As per technical specifications and construction drawings. IS 822, AWS D 1.1	Report	✓	Wherever RT is not feasible UT to be carried out. In case of failure of any welds in SRO/RT or UT the % of re-testing shall be doubled at that location. Acceptance criteria of NDT on welds shall be as per AWS
		Time and Temp Control	Major	A	Review of HT Chart	100%	As per technical specifications and construction drawings	Review of HT Chart	✓	
9.4	Pipe Lines PAINTING SYSTEM (For any site fabrication/welding work or final touch up)	Hydro Test Painting Materials and accessories	Major	A	Physical Review of MTC	100% Each batch of delivery	1.5 X DP or 2 X MWP whichever is higher	Report	✓	Mfr.'s T.C. shall be correlated with the Consignment received.
10		Surface preparation / Cleaning	As agreed / required	B	Physical Visual	Random	Tech Specs and Const. Drawings. Relevant	Report	✓	-
		DFT of paint	Elco meter	B	Measure ment	Random	Tech Specs and Const. Drawings	Report	✓	-
		Adhesion Test	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings. Relevant code/ standards	Report	✓	-
11.	Completion Activity	Final Acceptance of Erected Gallery	Major	B	Physical	100%	As per Appd GAD	Report		
		LEGEND: * RECORDS IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS #: A = CRITICAL, P=MAJOR, C=MINOR A = Witness by QA Engineer in association with Execution Engineer, B=NTPC Execution Engineer, C= Contractors Quality Engineer ; SR = Site Register, TR = Test Report, Mfr TC = Manufacturer's Test Certificate					DOC. NO.:		REV.....	
		MAIN-SUPPLIER					FOR			
		SIGNATURE					NTPC USE		APPROVED BY	APPROVAL SEAL

FIELD QUALITY PLAN											
ITEM : FQP FOR STRUCTURAL STEEL FABRICATION WORKS (For Gallery & Trestle)				QP NO.: REV. NO.:		PROJECT: PACKAGE: Proposed Cable Trestle Woks					
SUB-SYSTEM:MISCELLANEOUS STRUCTURAL STEEL WORKS				DATE: PAGE:		CONTRACT NO. : MAIN-SUPPLIER:					
SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS/ INSTRUMENTS		CLASS OF	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.		
1	RAW MATERIAL Plate, pipes for structures, structural steel sections(hollow, square, rectangle),checkeredplate, rolled/forged bar	Major a)Chemical & Mech Properties b)UT of plates >40mm thick(shall be degassed & furnace normalized) c) Forged/rolled bar dia> 50mm	B B B	Chem Analysis NDT	100%	a)As Per PO specs/SoW/Apd Drwg/Relevant Std b)ASTM A-578 Level B-52 c)ASTM 388M	a)As Per PO specs/SoW/Apd Drwg/Relevant Std b)ASTM A-578 Level B-s2 c)ASTM 388M	MTC/TC/Report		Sources of raw material procured shall be communicated to NTPC EIC before procurement Internal test Report/supplier Tc shall be submitted for review/verification	
2	IN-PROCESS ACTIVITIES										
2.1	FILLET WELDS	a)IPI b)Macro-Etch Examination(# for T>32mm per one coulmnn one test per"+/ "1"column built up beam	As required/ agreed As required/ agreed C	C	Visual Visual	100% * 100% **	ASME Sev-V/ASME E165/AWS D1.1	Report /Log Report	✓	Valid WPS/PQR to be provided for NTPC Review a)10% verification by NTPC Execution * b) 5% witness by NTPC FQA**	
2.2	NDT for Edge Preparation(EP) area	UT In EP area +50mm Heat affected zone only for Thickness >40mm	Major	A	Physical	100%	ASME Sev-V/ASME E165/AWS D1.1	Report	✓		
2.3	BUTT WELDS & full Penetration Branch Weld Quality	a) Butt weld soundness for plate 10mm<thickness<32 mm RT / UT b)Full penetration weld other than butt weld :UT	Major	A	Physical	10%	ASME Sev-V/AWS D1.1	Report	✓	1)Wherever RT is not feasible UT to be carried out. In case of failure of any welds in SPOT/RT or UT the % of re-testing shall be doubled at that location. 2) RT film evaluation & report review shall be done by NTPC FQA 3)All butt welds to be back gouged	
2.4	PH/PWHT/PFHT (as applicable)	Butt weld soundness for plate thickness>32 mm RT / UT	Major	A	Physical	100%	ASME Sev-V/ASME E165/AWS D1.1	Report	✓		
		Time and Temp chart	Major	B	Review of HT Chart	100%	As per technical specifications /WPS	Review of HT Chart	✓		

2.5	PTC coupon	Mech Test on PTC coupon	Major	A	Review of HT Chart	1 per every 50 MT	AW5 D1.1	PTC Report	✓	Witness by NTPC at NABL accredited Lab or any 3rd part lab accredited as per ISO/IEC 17025
3	FINISHED PRODUCT/FINAL INSPECTION									
3.1	Final Inspection	Dimension/Camber/Sweep/Match Marking/Level Marking/OLV/WL/diagonal & pitch distance of hole/Pin gauge checks for holes:individual/Trial assy.	Major	A	Visual/measurement	10% of individual built-up column beam & 10% of trial assy shall be witnessed by NTPC FQA	Tech Specs and Const. Drawings	Test Report/Log book	✓	100% shall be witnessed by Agency
3.2		Visual inspection of loose items supplied like steel plates/sheets/Foundation bolt/Fastners	Major	A	Visual	10%	Tech Specs and Const. Drawings	Test Report	✓	100% shall be witnessed by Agency
3.3		LPI for fillet weld & MPI for groove weld & Butt joint <32mm	Major	A	Visual/measurement	10%	Tech Specs and Const. Drawings	Test Report	✓	100% shall be witnessed by Agency
3.4		Painting Materials and accessories	Major	B	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings/Painting Procedure	Report / MTC	✓	Mfr.'s T.C. shall be correlated with the Consignment received.
		Surface preparation / Cleaning,DFT ,paint shade	Major	B	Physical /visual	Random	Tech Specs and Const. Drawings, Relevant code/ standards	Report	✓	The surface shall be blast cleaned to near white metal surface (Sa 2.1/2). For blast cleaning shot blasting shall be used -
			LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR				DOC. NO.:	REV.....		
MAIN-SUPPLIER			A = Witness by FQA Engineer in association with Execution Engineer, B=NTPC Execution Engineer, C= Contractors Quality Engineer ;				FOR NTPC USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL
SIGNATURE										

SUB-QUALIFYING REQUIREMENTS

1.00.00 The following are the qualification requirements in respect of the following:

- a) Civil and Structural design
- b) Shop fabrication and Painting

1.01.00 Civil and Structural design:

The civil and structural design for the works under the scope of this contract shall be carried out by an agency who should have designed civil and structural works of Building (minimum four storey) /CHP trestle / Pipe trestle/ Cable trestle.

1.02.00 Shop fabrication and Painting:

The shop fabrication and painting for the steel structural works under the scope of this contract shall be carried out by an agency who should have done shop fabrication and painting of steel structural members.
