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SECTION - 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENT & QUANTITIES

SECTION - 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.1.0 SCOPE

1.1.1 The scope of work under this specification is Civil Works of 400/132/33kV Switchyard at Nabinagar (STPP & TPP-400kV BRBCL) (Excluding Gravelling, fencing and Building works) and work in Bihar being executed by BHEL on turnkey basis. The Customer is Nabinagar Power Generation Company PVT. LTD.

1.1.2 The Civil Works shall generally include, *but not limited to*, following:

(i) Tower and Equipment foundations.
(ii) Cable trenches including precast covers & cable trench crossings.
(iii) Road and Drainage.
(iv) Dismantling of existing foundations, drain and Trench.
(v) Balance activities of Trench, Road, Drain and other civil works
(vi) Any other work required for the project.

1.1.3 The works to be performed in the above construction includes preparation of bar bending schedules, based on the drawings released for construction and getting the same approved by the Engineer-in-charge plus the execution of the work including providing of all labour, supervision, materials, scaffolding, power, fuel, construction equipments, tools and plants, supplies, transportation, all incidental items necessary for successful completion of the work including contractor's supervision and in strict accordance with the drawings and specifications and with inspection and testing standards. The nature of work shall generally involve excavation in all type of soil including dewatering, shoring, strutting, and filling under and around structures, backfilling with available excavated earth around completed structures, cable trenches with covers, disposal of surplus soil, steel formwork, providing necessary steel embedments and other inserts, roadwork, drainage work, concreting, brickwork etc. all complete as per detailed specification, drawings and directions of Engineer-in-charge.

1.2.0 SPECIFIC TECHNICAL REQUIREMENT

1.2.1 The specific technical requirements for the execution of civil works shall be as per Customer's specification (Section-3) /I.S Specification. In case of any conflict between these Customer's specification shall prevail.

1.3.0 BILL OF QUANTITIES

1.3.1 The Bill of Quantity shall be as per page 3 to page 6.

1.3.2 The quantities indicated in the 'Bill of Quantity cum price schedule' are indicative and can vary to any extent. Contractor shall not be entitled for any claim for any such variation in the quantities.

1.3.3 The provision of Bill of Quantity, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, the clarification shall be obtained from the Engineer-in-charge whose decision shall be final and binding.

1.3.4 Method of measurement:

1.3.4.1 Excavation shall be measured in cubic meters. The lateral dimensions to be considered for working out excavation quantity shall be the PCC dimension below the footing as per approved drawing. Nothing extra shall be paid for slope cutting, etc. Backfilling & disposal qtys shall be worked out based on the above dimensions only.

For other items, unless otherwise described the method of measurement as described in 'Method of Measurement of Building and Civil Engineering Works'-IS 1200(Part I to XXV) latest edition of BIS shall be followed.

SECTION - 2

STANDARD TECHNICAL SPECIFICATION
(N.A.)

SECTION - 3

ENCLOSURES TO THE SPECIFICATION

(a) Part II Technical Specification Civil

(b) Sampling testing and QA for Civil Works

© Indicative Field Quality Plan

PART-II

TECHNICAL SPECIFICATION

CIVIL

PART-II
TECHNICAL SPECIFICATION
CIVIL

CHAPTER – C0:
SWITCHYARD CIVIL WORKS

SWITCHYARD CIVIL WORKS

1.00.00 GENERAL

This chapter includes the technical requirements for 400/132kV Switchyard package including associated design and preparation of all civil & structural drawings and execution of all associated civil works. This Chapter deals mainly with technical specifications for the design, supervision and construction of complete civil & structural works complete under the scope of this contract.

The specifications are intended for general description of work, quality and workmanship. The specifications are not however exhaustive to cover minute details and the work shall be executed according to relevant latest Indian Standards / IRC or IRS Specifications. In the absence of the above, the work shall be executed according to the best prevailing practices in the trade, recommendations of relevant American or British Standards or to the instructions of Engineer. The List of IS standards / IRC or IRS specifications to be followed are mentioned in the technical specifications. They shall be latest edition / version of the same issued 15 days prior to the date of opening of this tender. The Bidder is expected to get himself clarified on any doubts about the specifications etc. before bidding, and the discussions recorded in writing with the Employer in respect of interpretation of any portion of this document.

This specification covers design, preparation of general arrangement drawings, construction and fabrication drawings, supply of materials and construction of all civil, structural and architectural works.

Description of various items of work under this specification and nature of work in detail are given hereinafter. Complete work under this scope is referred to as civil works. List of various civil works covered under the scope is given in Part-I and herein.

The work to be performed under this specification consists of design, engineering and providing all labour, materials, consumable, equipment, temporary works, temporary storage sheds, temporary labour and staff colony, temporary site offices, constructional plant, fuel supply, transportation and all incidental items not shown or specified but reasonably implied or necessary for completion and proper functioning of the plant, all in strict accordance with the specifications and including revisions and amendments thereto as may be required during execution of the work.

All materials including cement, reinforcement steel and structural steel etc. shall be provided by the Bidder. The material arranged by the contractor shall conform to quality standard specified elsewhere in the specification and shall be procured from licensed agencies / sources only with prior approval of Employer.

The scope shall also include setting up by the Bidder a complete testing laboratory in the field to carry out all relevant tests required for the civil works for the project. Minimum facilities as specified in Sub-section-QA (Civil Work) shall be provided by the Bidder in this laboratory.

For his site office and covered store buildings, the contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated or uninsulated roof and wall coverings (fabricated out of permanently color coated metal sheets). Alternatively, contractor can adopt readymade 'Portacabin' or similar construction. Contractor shall ensure that all such constructions are well engineered, neatly constructed and overall present a pleasing look.

In line with Gazette Notification on Ash Utilisation issued by MOEF and its amendment thereafter, contractor shall use ash and ash based products in works as specified in these specifications, drawings and as per instructions of the Engineer. He shall also use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill.

Contractor shall establish/ set up at site suitable repair facilities for construction plant, equipment and machinery (like piling rigs, cranes, batching plant, dewatering pumps etc.). In case of piling rigs, cranes, batching plant etc. he will also make arrangements/ tie up with equipment manufacturers/ suppliers for periodic overhaul/ maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/ suppliers or as instructed by the Engineer. Contractor shall deploy dedicated qualified, full time mechanical/ electrical foreman/ supervisors for manning the repair facilities as specified above.

The work shall be carried out according to the design/ drawings to be developed by the Bidder and approved by the Employer. For all building & structures, foundations, etc., necessary layout and details are to be developed by the Bidder keeping in view statutory & functional requirements and providing enough space & access for operation, use and maintenance. Certain minimum requirements are indicated in this specification for guidance purpose only. However, the Bidder's offer shall cover the complete functional requirements as per the best prevailing practices and to the complete satisfaction of the Employer.

All the quality standards, tolerances, welding standards and other technical requirements as covered in this specification shall be strictly adhered to by the Bidder.

The Bidder should fully appraise himself of the prevailing conditions at the proposed site, locations of adjoining facilities/ structures, climatic conditions including monsoon pattern, 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

The Bidder shall take all necessary precautions to protect all the existing equipments, structures, facilities & buildings if applicable etc. from damage. In case any damage occurs due to the 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 Engineer. The Bidder shall also take all necessary safety measures, at his own cost, to avoid any harm / injury to his workers and staff from the equipment & facilities of the power station.

During the progress of work, the Engineer will exercise supervision of the work to ensure that the technical provisions of the contract are being followed and the work is being executed accurately and properly. However, such supervision shall in no way relieve the Contractor of the responsibility for executing the work in accordance with the specifications.

Before submitting the bid, the Bidder shall inspect and examine the site and its surroundings and shall satisfy himself as to the nature of the ground and subsoil, the availability of materials necessary for completion of the work, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No extra claim consequent on any misunderstanding or otherwise shall be allowed.

The layout and levels of all structures etc. shall be made by the Contractor at his own cost from the general grid of the plot and bench marks given by the Engineer. The Contractor shall give all help in instruments, material and men to the Engineer, at no extra cost, for checking the detailed layout & correctness of the layout and levels. However the Contractor shall be solely responsible for their correctness.

2.00.00 SUBMISSIONS

The following documents shall be submitted by the Bidder for approval of the Employer, prior to commencement of fabrication and erection / construction. This list is not exhaustive but indicative only:

1. G. A. drawing showing co-ordinates of various Gantry structures and facilities.
2. Drawing showing underground facilities with co-ordinates of all facilities such as Tower/LM foundations, equipment foundations, R.C.C cable trenchs, cable ducts, drains, sump pits, culverts, other foundations etc.
3. Proposed erection / construction scheme for various structural and civil works envisaged as per design requirement.
4. Foundation design & drawing for Towers & LM.
5. Foundation design & drawing for equipment supports, their control cubicles, bus post supports and bay marshalling kiosks
6. Details of RCC cable trenches and duct banks with necessary precast RCC removable covers with lifting facility, sump pits, cable tray supports etc.
7. Foundation design & drawing for Interconnecting Transformers (ICT) / Shunt reactors / Misc. transformers as required including associated rail tracks, oil soak pits, oil separation pits etc.
8. Design & drawing of roads and drains within switchyard including road/drain/trench crossings.
9. Site preparation, soil sterilization / antiweed treatment including gravel filling, but excluding major leveling as required.

10. Fencing along with gate for the switchyard wherever required

11. Design & drawings for Switchyard Control Room Building

12. Foundation design & drawing for switchyard bay KIOSK

13. Structural steel fabrication drawings and Reinforcement bar bending schedules for reference.

14. Electronic soft copy of all the approved drawings/calculations in Cat-II / Cat-I.

3.00.00 DESIGN CRITERIA

3.01.00 General

3.01.01 All switchyard structures and buildings including Control Room Building Gantry Towers & Beams, Lighting mast, Equipments supporting structures, Switchyard bay KIOSK, Transformer foundations including oil pit, rail track, fire wall, cable trenches, Roads, Culvert, Drains, sewers, water supply, fencing with gates, gravel filling & antiweed treatment, disposal of soil, leveling/dressing of switchyard area etc. and other related works all complete are covered in the specification.

3.01.02 Structures shall be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, piping loads (static and dynamic), wind loads, seismic loads and temperature loads. In addition, loads and forces developed due to differential settlement shall also be considered.

3.02.00 Loading

3.02.01 Dead Loads

Dead loads shall include the weight of structure complete with finishes, fixtures and partitions and shall be taken as per IS: 875 (Part - I).

3.02.02 Imposed Loads

Imposed loads in different areas shall include live, erection, operation and maintenance loads. Equipment loads (which constitute all loads of equipment to be supported on the building frame) are not included in the imposed loads furnished below and shall be considered in addition to imposed loads.

For consideration of imposed loads on structures, IS: 875 (Part – II) “Code of practice for design loads (other than earthquake) for buildings & structures” shall be followed. The following minimum imposed loads as indicated for some of the important areas shall, however, be considered for the design. If actual expected load is more than the specified minimum load, then actual load is to be considered.

a)	Roofs	150 Kg / Sq.m

b)	Building floors	1000 Kg / Sq.m
c)	RCC floors (General) outdoor platforms	500 Kg / Sq.m
d)	Stairs, Landing and Balconies	500 Kg / Sq.m
e)	Toilets	200 Kg / Sq.m
f)	Chequered plates, Grating Floors etc.	500 Kg / Sq.m
g)	Walkways	300 Kg / Sq.m
h)	Roads	As per IRC and MOST
i)	Road Culverts and its allied structures including RCC pipes Crossings & Road Crossings of Trenches	Design for Class - 'AA' loading (wheeled and tracked both) and checked for Class - 'A' loading as per IRC standards.
j)	Underground structures such sumps, pits, trenches, drains etc.	In addition to the earth pressure and ground water pressure, the surcharge of 2000 Kg / Sq.m shall also be considered.
k)	Cable Trench Covers	400 Kg / Sq.m (General)
l)	Rail Culverts	As per Railway 'Bridge Rules'

3.02.03 **Equipment loads**

Loads of all equipment like Electrical control and relay panels, cable load, Pipe load (static and dynamic), Tanks, etc. shall be considered over and above the imposed loads. Cable and piping loads not less than 5 kN/sq.m hanging from the underside, shall also be considered additionally for floors where these loads are expected.

3.02.04 **Crane Loads**

For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS: 875. The longitudinal crane surge shall be 5% of the static wheel load.

Monorail load shall be considered in the analysis of frame according to provisions of IS: 875 (latest revision).

3.02.05 **Wind Load**

a) Switchyard gantries, towers, equipment supporting structures and lighting mast shall be designed as per IS:802. The wind load calculations shall be made as per IS: 802 except the parameters basic wind speed (V_b) and terrain category as stipulated in “Criteria for wind resistant design of structures and equipment” Appendix-I of Part–I, "Project Synopsis" of this specification.

b) All other structures covered under the present package shall be designed as per IS:456 / IS:800. The wind load calculations to be made as per IS: 875 shall be with the parameters as stipulated in “Criteria for wind resistant design of structures and equipment” Appendix-I of Part–I, "Project Synopsis" of this specification.

3.02.06 **Seismic Load**

Seismic forces shall be considered as specified in Appendix-II of Part–I, "Project Synopsis" of this specification. Response spectrum method shall be used for the seismic analysis using at least first five modes of vibration.

3.02.07 **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.

Suitable expansion joints shall be provided in the longitudinal direction wherever necessary. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456-2000 for steel and concrete structures respectively.

3.03.00 **Design Concepts for Buildings**

3.03.01 i) All buildings shall have framed super structure

ii) The Control Room building shall have RCC framed super structure with brick wall cladding on exterior face. The design of shall generally be carried out using limit state method of design as per IS: 456 “Code of practice for plain and reinforced concrete for general building construction”.

iii) The Control room building shall consist of rooms/facilities/ equipments/ monorail as per system requirement.

iv) An open space of one meter width (minimum) shall be provided on the periphery of the panel rows and equipment to allow easy operator movement and access for maintenance purposes.

v) Unless specified, the wall cladding shall be with minimum one brick thick on exterior face.

2.01.02 Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.

2.01.03 The different load combinations shall be taken as per IS: 875 (Part-V) and other relevant IS Codes.

(a.) Wind and seismic forces shall not be considered to act simultaneously.

(b.) For the design of building during seismic condition, the water tanks on the roof shall be considered full up to operating level. However, for other load combinations, water tank on the roof in flooded condition shall be considered.

(c.) 'Lifted load' of crane shall not be considered during seismic condition.

2.01.04 The design and fabrication of steel structures shall be as per provisions of IS: 800 and other relevant IS standards. Flanges and web of crane girder and monorail hoist beams should not have any joints between the supports.

2.01.05 Welding shall be used for fabrication and joints. For site connections, welding or High Strength Friction Grip (HSFG) bolts shall be used. In few cases, for shear connections or removable beam connections, bolted joints with M.S. black bolts may be adopted. IS: 4000 shall be followed for HSFG bolt connection. IS: 816 and IS: 9595 shall be followed for welding of structures.

2.01.06 All structures close to railway line shall have clearances conforming to Railway norms.

2.01.07 a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part)

b) Dispersion of load through concrete shall be considered at an angle of 45 degree with horizontal from the edge of contact area.

3.03.08 The design and construction of RCC structures shall be carried out as per IS: 456 - 2000. Generally limit state method as per IS: 456 shall be used for design and working stress method shall be adopted for the design wherever specifically mentioned in this specification.

For design and construction of steel - concrete composite members, IS: 11384 shall be followed.

For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.

Two layers of reinforcement (on inner and outer face) shall be provided for RCC wall sections having thickness more than 150mm.

3.03.09 For design of all underground structures/ foundations, ground water table shall be considered at the finished ground level.

3.03.10 Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest, coefficient of active or passive earth pressure whichever is applicable depending upon the structural configuration.

3.03.11 If RCC floor/ roof is assumed to act as diaphragm transmitting lateral loads to braced bays it shall be provided with shear connectors. However, whenever large/ number of cut-outs are provided in the floor slab, horizontal floor bracing shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab.

3.03.12 The storm water drainage shall be designed taking into account the finished grade level of the surrounding area, area drainage pattern around the area, intensity of rainfall etc. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/ sec and 1.8 m/ sec. respectively. However, minimum velocity of 0.6m/ sec. for self cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. Maximum rainfall intensity for design of drain shall be in line with the provisions given elsewhere in this specification.

3.03.13 Sewers shall be designed for a minimum self cleansing velocity of 0.75m/ sec and the maximum velocity shall not exceed 2.4m/ sec.

3.03.14 Unless specified otherwise, all roads shall be designed for class ‘E’ of traffic intensity of 450-1500 per day (heavy vehicles exceeding 3 tonnes laden weight) as per IRC: 37-1984 “Guidelines for the design of flexible pavements”. The road shall be designed for 30 years of life and considering a minimum traffic growth of 1%.

3.04.00 Architectural concepts

The switchyard control room building shall be architecturally treated in such a way that it presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehensive scale, bending tonal values with the surroundings and taking full consideration of the climatic conditions and the building orientation. The buildings shall be architecturally treated in such a way so as to be in harmony with the surroundings The over all composition may have straight or curvilinear or sloping profiles.

3.05.00 The buildings shall be also be designed:

(1) To the requirements of the National Building Code of India, and the standards quoted there in. The building shall be designed on the principle of providing barrier free environment for physically disabled person.

(2) To adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.

(3) With a functional space arrangement.

(4) To allow for easy access to equipment and maintenance of the equipment.

(5) With, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.

(6) With materials preventing dust accumulation.

3.06.00 Design Parameters for Gantry Towers & Beams, Lighting Mast and Equipment Supporting Structures

3.06.01 Gantry structure, which consists of open web towers connected by girders, shall be made of structural steel conforming to Grade IS:2062 or IS:8500 and duly galvanized conforming to IS: 2629 and IS: 4759. All joints shall be bolted connections.

3.05.02 All bolts for connections shall be of 16mm dia conforming to IS: 12427 property class 5.6. Nuts shall conform to I.S 1363 (Part 3) of property class 5. Foundation bolts shall conform to IS: 5624.

3.05.03 Butt splice is used for splicing the main members and splice shall be located away from the node point.

3.05.04 IS: 802 “Code of practice for use of structural steel in overhead transmission line towers” shall be followed for design of structures. Height & type of towers shall be established based on electrical requirements. A provision of ± 30 degree angle of deviation of line in horizontal plane and ± 20 degree deviation in vertical plane is considered and the resulting worst combination of forces shall be considered for design. For all outgoing and incoming feeders, the conductor span shall be taken as 200m for design purpose.

3.06.05 Loads and Loading Conditions

Switchyard structures shall be designed for the worst combination following loads:

1) Dead loads (load of wires/conductors, insulator, electrical equipment and structural members),

2) live loads,

3) Wind load on bus bars, shield wires, insulator strings, electrical equipment, structural members etc as per IS:802,

4) seismic loads,

5) temperature load,

6) loads due to deviation of conductor (gantries shall be checked for ± 30 deg. deviation in horizontal plane and ± 20 degree deviation in vertical plane),

7) loads due to unbalanced tension in conductor/wire,

8) Torsional load due to unbalanced vertical and horizontal forces,

9) Erection loads,

10) Short circuit forces including snap in case of bundled conductors, etc.

Note:

(i) The occurrence of earthquake and maximum wind pressure is unlikely to take place at the same time. The structure shall be designed for either of the two. However, temperature stresses can be ignored, as these towers are freestanding structure in open space.

(ii) Direction of wind shall be assumed such as to produce maximum stresses in any member for the combination of wind load with conductor tensions. The wind acting perpendicular and parallel to bus conductor and shield wire shall be considered separately.

(iii) The conductor tension shall be assumed as acting on only one side of the gantry for the analysis and design of switchyard gantries for both normal and short circuit condition.

(iv) The distance between terminal and dead end gantry shall be taken as 200 meters.

3.06.06 **Factor of safety:**

The factor of safety for the design of members for switchyard structures shall be considered as 2.0 for normal condition and 1.5 for short circuit condition.

3.06.07 **Design consideration for Equipment support**:

The supporting structure for B.P.I., LA, CVT and Isolator equipment's shall be comprised of GI (ERW) pipe of grade YST:210 or of higher grade conforming to IS: 1161 & shall be designed as per IS:806 "Code of Practice for use of steel tubes in general building construction".

Minimum diameter of the pipe type support for 400kV structure shall be 250NB and that for 132kV shall be 200NB.

The supporting structure for CT & Wave Trap equipment shall be comprised of lattice structural steel conforming to IS 2026 and shall be designed as per IS: 802.

Common raft foundation shall be provided for each pole of isolator.

3.06.08 **Special design consideration for lighting Mast:**

Diagonal wind condition shall be considered for Lightning Mast. Provision of IS: 875(Part-III) shall apply for inclined wind condition. Lightning mast shall be provided with minimum two nos. of platforms as per requirement and an internal ladder for climbing purpose shall be provided up to the platforms. Top of platform shall have grating, railing and two guard plates. The minimum width of platform shall be 900mm.

Live load of 300kg/m2 above platforms shall be considered for design of Lighting Mast.

The fabrication and erection of the switchyard works shall be carried out generally in accordance with IS: 802 and IS: 800. All materials shall be completely shop fabricated and galvanized.

3.06.09 **Minimum Thickness of Members & Galvanization**

All steel work used in construction of switchyard structures such as Towers & Beams, Lighting mast and equipment supporting structures including nuts, bolts and washers shall be galvanized.

Minimum section thickness shall not be less than 4 mm. Weight of zinc coating shall be at least 0.610 kg/m2 and foundation bolts shall have heavier zinc coating at least 0.80 kg/m2.

3.06.10 Design consideration for Foundation

Design of foundation shall be as per IS: 4091 “code of practice for design and construction for transmission line tower and poles”.

The F.O.S. for foundation shall be 10% more than factor of safety for supporting structure i.e. 2.2 for normal condition and 1.65 for short-circuit condition

4.00.00 GRAVEL FILLING

Entire area of switchyard & 33kV Transmission line Sub-stations shall be provided with broken stone filling which shall consist of two layer of 75mm thick stone metal filling of 20 mm stone aggregate. Each layer shall be compacted by using half ton roller with 4-5 passes and suitable water sprinkling. Before laying the broken stone fill, the top layer of the soil shall be treated for anti-weed considering the type of weeds found in the vicinity. The antiweed - soil sterilisation details such as manufacturer's name, their specification, test certificate, etc. shall be furnished for Owner's approval. Any modification if required in the proposed antiweed treatment chemical shall have to be done by the contractor at no extra cost to the Owner. The contractor shall be required to furnish a performance guarantee of three years for the antiweed treatment. This guarantee shall be commenced from the date of completion of work or date of handing over, whichever is later.

5.00.00 CABLE TRENCHES

Cable trenches shall be provided for routing of cables as required and shall be of adequate size. The trenches located within switchyard shall project at least 300 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of trench shall be provided with a longitudinal slope of 1:500. The downstream end of cable trenches shall be connected to sump pits. The precast covers shall not be more than 300mm in width and shall not be more than 65 kg. Lifting hooks shall be provided in the precast covers. Trenches shall be given a slope of 1:50 in the direction perpendicular to the run of the trenches. Angle of size 50x50x6 mm (minimum) with lugs shall be provided in the edges of RCC cable trenches supporting cover, edges of manhole supporting, supporting edges of precast RCC cover and any other place where breakage of corners of concrete is expected.

6.00.00 SWITCHYARD DRAINS

Open RCC storm water drains shall be provided on both sides of the road and shall be designed to drain the road services as well as all the free and covered areas, etc. as shown in Tender Drawing. All drains shall be designed for maximum runoff velocity of 1.8 m/sec. The thickness of side wall and bottom slab of RCC drains shall be minimum 100 mm or as per design consideration whichever is higher. RCC box/pipe culvert shall be provided for road, rail and trench crossings.

7.00.00 SWITCHYARD ROAD

Roads for the switchyard area shall be of single lane roads with 3.75m wide black topping along with 1.0 m wide shoulder on either side. The base and sub base of the road shall be of water bound macadam. All roads shall be constructed as per section shown in Tender Drawing including edging and shoulder. Finished top of road shall be 300 mm above the surrounding ground level.

Road construction including bitumen macadam, water bound macadam base and sub-base shall be as per IRC standards. For premix carpet, recommendation of IRC-14 shall generally be followed.

8.00.00 CHAIN LINK FENCING

Chain link fence and fixing detail including materials, all quality control tests and checks etc. for the work shall be as per IS:2721. The fence shall comprise of PVC coated G.I. chain link fencing of minimum 4 mm dia wire including PVC coating and with 2.5 mm dia GI bare wire with mesh size of 75X75 mm and of a height 2.5 m above the toe wall with a 600 mm high galvanised concertina at the top, such that total fence height of 3.1m above toe wall level is achieved. Toe wall shall be minimum 200 mm above the formation level/natural ground level (NGL).

The PVC coated chain link wire mesh will be stretched and attached by clips at 0.5 m intervals to 3 strands of High Tensile Spring Steel (HTSS) wire of 4 mm dia interwoven in chain link wire mesh and kept under tension which in turn are attached to the fence post with security nuts and bolts. On every fourth post a clamping strip will be threaded through the links of chain link and bolted to the fence post with the

help of security nuts and bolts. All nuts, fasteners, bolts, clamping strips, clamps, clips, etc. shall be galvanised.

Above the chain link fence a 600 mm High Tensile Serrated Wire (HTSW) galvanised Concertina shall be provided at a maximum spiral pitch of 300mm and attached to 3 strands of HTSS wire by means of 'C' clips at 1 m intervals. The 3 HTSS wire strands will be attached to angle iron posts with 1/2" security fasteners.

All bolts provided in the fence work shall be minimum 12 mm diameter. Length of all bolts shall be such that after fixing in position it shall have at least 12 mm projected length beyond the nut. All nuts & bolts shall be high quality as per BIS standard and heavy duty galvanized. The threads of projected length of the all bolts beyond nut after fixing in position shall be destroyed by hammering or by any suitable means to protect from any possible theft by miscreants.

All fence posts shall be 75X75X6 MS angles spaced at 2.5m c/c distance. All straining posts i.e. end posts shall be 75X75X6 MS angles. All corner posts will have two stay posts and every tenth post will have a transverse stay post.

Concrete foundations for the angle iron posts and stays shall be provided. Toe walls of brick masonry with bricks of minimum 75 kg/cm2 compressive strength shall be provided between the fence posts all along the run of the fence with foundation. Toe wall shall be minimum 200 mm above the formation level with 75 mm thick PCC coping (1:2:4).

M. S. Gate of minimum 4.0 mts wide and 2.25 mts. high shall be provided to provide access through the fencing. It shall be made in two leafs with locking arrangement. Hinges, aldrops, guide tracks, ball and bearing arrangement, castor wheel and other accessories shall be provided for effective working of the gate.

All MS angles used in posts and gates shall be finished by blast cleaning of steel surfaces to near white metal surface (Sa 2 ½ Swedish standard) and applying inorganic zinc silicate primer of minimum 75 microns (DFT), followed by an intermediate coat of minimum 75 micron (DFT) epoxy based titanium dioxide / micaceous iron oxide, followed by finish painting with Epoxy based colour pigmented finish Poly amide cured paint. All paints including primer shall be of reputed brand / manufacturer and as approved by the Engineer.

9.00.00 **CORROSION PROTECTION MEASURES**

All structural steel and RCC members/ structures shall have to be provided with corrosion protection treatment unless specified otherwise.

9.01.00 **Structural Steel**

Corrosion Protection

i) General

a) All Painting shall be done as per approved painting scheme of the Vendors/ Manufacturers, which shall be submitted by the Bidder and as approved by the Employer. Painting scheme shall also include Item codification/ Description of all Coats of Paints for manufacturer's, from whom the Paint is intended to be procured.

b) All Steel structures (except those embedded in Concrete), unless specified otherwise shall be provided with painting as given below which is designed for a minimum maintenance free life of Ten (10) years (expected life, long range Ten (10) years & expected life, long range Ten (10) to Twenty (20) years , as per BS : 5493.

c) All Paints shall be of high build constitution.

ii) Painting of Steel Surfaces embedded in Concrete

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).

iii) Painting of Steel Surface

a) All Steel surfaces shall be provided with self curing Inorganic Zinc Silicate Primer Coat (Solid by Volume Minimum 60%) of Minimum 75 Micron Dry Film Thickness (DFT) applied over blast cleaned surface to near white metal conforming to Sa 2 ½ finish of Swedish standard SIS –05-5900.

b) Primer Coat shall be followed with the application of Intermediate Coat of Polyamide Cured pigmented Titanium Dioxide (TiO2) or Micaceous Iron Oxide (MIO) Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This coat shall be applied in Shop after an interval of Minimum overnight (from the application of Primer Coat).

c) Intermediate Coat shall be followed with the application of Finish Coat of Polyamide Cured colour pigmented Epoxy based paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied after an interval of Minimum overnight and maximum indefinite (from the application of Intermediate Coat) either before Erection by Airless spray technique or after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer. The Finish Coat thickness of 75 Micron can be built up either in Single application at Shop or in two applications one at Shop and the other at Site.

d) Finish Coat shall be followed with the application of Final Finish Coat of Polyurethane based colour pigmented Paint (Solid by Volume Minimum 40%) of Minimum 30 Micron DFT. This Coat shall be applied within Seven (7) days (from the completion of Finish Coat) after Erection by brush and/ or spray. Colour and shade of the Coat shall be as approved by the Employer.

iv) Touch-up Painting on damaged areas

a) For Coatings damaged up to metal surface

Surface preparation shall be carried out by Manual Cleaning. Minimum 6 inches adjoining area with existing Coating shall be roughened by Wire brushing, emery paper rubbing etc., for best adhesion of patch Primer.

Primer Coat of self-priming Epoxy Touch-up Primer applied by brush immediately after the surface preparation. (Minimum DFT 100 Microns).

Over this Primer Coat, Intermediate Coat, Finish Coat and Final Finish Coat shall be applied as covered above by brush with Intermediate Coat applied within maximum seven (7) days of application of touch up Primer.

b) For Coatings damaged up to Intermediate Coatings (i.e. where Primer Coat is intact).

Damaged area including Minimum 6 inches adjoining area with existing Coating should be roughened by wire brushing emery paper rubbing etc., for best adhesion of patch Primer without damaging the Primer Coat.

Touch-up Primer, Intermediate, Finish and Final Finish Coats shall be applied as specified above for Coatings damaged up to metal surface.

v) Painting of Welded areas / painting of areas exposed after removal of temporary supports/ Touch-up Painting on damaged areas of Employer's Structures, where inter-connection, Welding/ modification etc. has been carried out by the Bidder.

a) Clean the surface to remove flux spatters and loose rust, loose Coatings in the adjoining areas of Weld seams by wire brush and emery paper.

b) Painting procedure to be followed as mentioned above for Touch-up Painting on damaged areas.

vi) Coating for Mild Steel parts in contact with Water

All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of zinc shall be 610 gms/ Sq. M. for galvanised Structrues and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629.

OR

All mild steel parts coming in contact with water or water vapour shall be pointed with sealed sprayed zinc coating, conforming to BS:5493 (Table -3, part-8) for very long (20 or more) years of maintenance interval.

vii) Gratings

All gratings shall be blast cleaned to Sa 2 ½ finish of Swedish standard SIS–05-5900 and shall be hot dip galvanised at the rate of 610 gms / Sq.M.

viii) Hand Railings and Ladders

All handrails and ladders shall be galvanised at the rate of 610 gms / Sq.M as per IS: 4736.

9.02.00 **RCC Members (Superstructure)**

The following preventive measures are required to be adopted by the bidder as minimum requirement.

i) For Indoor RCC Members

a) Dense and durable concrete is to be used. Minimum grade of concrete shall be M25.

b) Water/ cement ratio shall generally be restricted to 0.5. Plasticizer, if required may be used.

ii) For Outdoor (or exposed) RCC Members

a) Dense and durable concrete is to be used. Minimum grade of concrete shall be M25.

b) Water/ cement ratio shall generally be restricted to 0.5. Plasticizer, if required may be used.

c) Clear cover to reinforcement shall be increased by minimum 10 mm over and above the values specified for normal conditions in relevant IS Codes.

d) A coat of water repellent siliconate based (transparent) paint shall be applied over the final finished surface.

9.03.00 **RCC Members (Underground Sub-Soil Condition)**

The type of corrosion protection measures for concrete reinforcement steel and structural steel for under ground structures/ facilities shall be as specified elsewhere in specification.

Protective measures shall be according to Geotechnical investigation and foundation system. In addition the following shall also be adopted:

i) Water/ cement ratio shall generally be restricted to 0.45.

ii) Clear cover to reinforcement shall be minimum 50 mm for thin sections like trenches.

10.00.00 FINISHING SCHEDULE

Floor finish, skirting, wall finish, dado**:**

10.01.00 Floor Finish:

The nominal thickness of floor finish shall be 50 mm.

a) Floors of Office rooms, Conference Rooms, PLC Room, BPU/BCU/SAS and AC areas shall be finished with 9mm thick vitrified ceramic tiles (polished finish) of approved make and colour shade (50% premium colours and 50% non-premium colours) and of 600mm x 600 mm size.

b) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Substation/Switchgear/PLC rooms for mounting Control panels / MCC.

c) Well polished 18mm thick Rajnagar Marble stone flooring shall be provided for staircases, passages, lobbies and general circulation areas.

d) Toilets, laboratory and pantries shall be provide with 300mm x 300mm x 7mm grade v heavy duty ceramic tile flooring and 300mm x 200mm x 7mm designer ceramic tile up to 2.2 m height.

e) IPS (Cement concrete flooring) with metallic hardener topping shall be provided in rest of the other areas.

f) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting.

g) Skirting shall be minimum 150 mm high and shall match with floor finish. All structural steel work including shutters shall be painted as specified elsewhere in the specifications.

h) The colour scheme of various finishes shall be subject to the approval of the Employer.

l) Battery room shall be provided with acid /alkali resistant tile flooring.

10.02.00 **Internal Wall Finish**

Testing Lab, Conference Room, BPU/BCU/PLCC, PLC Rooms and Air-conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint over POP punning.

All other areas shall be applied with minimum 2 coats of acrylic distemper over POP punning.

Toilet, Pantry / Kitchen areas shall have dado with 7mm thick ceramic tiles (matt finish) up to 2.2 m height and shall match with floor finish. Above dado, oil bound distemper shall be applied.

Battery room areas coming in contact with chlorine fumes or acid / alkali shall have tile dado up to 1.2 m height, with chemical resistant paint above on wall and ceiling.

The paint shall be of approved colour shade and make.

10.03.00 **External Wall Finish**

Ready mix, 2 components, resin polymer bonded granular textured coating with 2.5 mm natural stone chip finish of approved shade, colour and make in combination with acrylic resin based paint and glass reinforced concrete tiles shall be applied.

Toe wall of chain link fencing shall be provided with two coats of water proof cement paint.

The finish shall be of approved colour shade and make.

10.04.00 **Ceiling Finish**

Ceiling shall have Three (3) coats of oil bound distemper.

10.05.00 **Flooring**

10.05.01 The nominal total thickness of floor finish shall be 50mm i.e. underbed & topping. The floor shall be laid on an already laid and matured concrete base. The underbed for floors and similar horizontal surfaces shall consist of cement concrete (1 part cement, 2 part sand and 4 part stone chips by volume), Stone chips shall be 12.5mm down well graded.

10.05.02 Sunken RCC slab shall be provided in false flooring area and toilet area so as to keep the finished floor level of these areas same as that of the surrounding area.

10.05.03 Wherever specified metallic hardener topping shall be 12mm thick using uniformly graded iron particles, properly treated.

10.05.04 Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer (Kajaria, Spartek or equivalent) of approved finish shade and colour to be used.

10.05.05 Skirting in general shall be 150mm high, Dado in toilet shall be upto specified height from finished floor level. Skirting and Dado shall match with the floor finish.

10.05.06 **Paving**

a) RCC paving in buildings shall be minimum 150mm thick of grade M15 (Minimum), with minimum reinforcement of 8 dia (HYSD) bars @ 200 c/c bothways, top & bottom, over an underbed as specified herein and shall be provided for areas mentioned below. The underbed shall consist of preparation and consolidation of subgrade to the required level, laying of stone soling of 225mm compacted thickness with 63mm and down aggregate with interstices filled with selected sand followed by 75mm thick M-10 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate.

b) PCC paving of nominal M-15 (1 part cement: 2 parts sand: 4 parts aggregate) 100mm thick laid over 75mm thick bed of dry brick aggregate shall be provided for 750mm wide plinth protection around buildings.

10.05.07 Plinth level of all buildings shall be kept at least 500 mm above the finished grade/ formation level.

10.06.00	**Roof**
10.06.01	Roof of switchyard control room building shall have cast - in - situ RCC slab.
10.06.02	For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by screed concrete M-15 (using 12.5 mm coarse aggregate) and/ or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface before application of roof treatment. Rain water gutters shall be provided as per requirement.
10.06.03	Roof water proofing treatment shall be provided using high solid content liquid applied elastomeric water proofing membrane with separate wearing course as per ASTM C - 898. Thickness of the membrane shall be 1.5 mm. This treatment shall include application of polymerised mastic over the roof to achieve smooth surface and primer coat. Wearing course on the top of membrane shall consist of 25 mm thick PCC (M-15) cast in panels of maximum 1.2.x1.2m size and reinforced with 0.55 mm dia. galvanised chicken wire mesh and sealing of joints using sealing compound/ elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS: 13801 for width of 1000 mm Slope of the roof shall not be less 1 in 100.
10.06.04	Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work or sheeting , to match with the exterior finish. The number and size of downcomers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3.
10.06.05	The rainwater down comers shall be provided with suitable C.I. grating at inlet point.
10.06.06	Accessible roofs shall be provided with access through staircase. All staircases in buildings shall be of RCC. The staircase shall be provided with Mumty at top.
10.06.07	RCC parapet wall of minimum 900 mm height for all accessible roofs and 600 mm height for all non - accessible roofs shall be provided.
10.06.08	All staircases shall have a riser height not more than 180 mm and minimum tread width of 250 mm. The minimum width of staircase shall be 1200 mm. Edges of steps of concrete stairs shall be protected with 50x50x6 mm galvanised MS edge protection angles. Steel staircase shall have stringers of rolled MS channels and treads shall be of galvanised MS gratings and shall be provided with anti skid nosing.
10.06.09	Non - accessible roofs Roof of all buldings shall be provided with access through ladder.

10.06.10	Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster.
10.07.00	**Walls**
10.07.01	All external walls shall be minimum 230 mm thick using bricks of minimum class designation 75. Partition walls shall be 115 mm thick using bricks of minimum class designation 75 and shall be provided with reinforcement consisting of 2 numbers of 8 mm dia. HYSD bars at every fourth layer. RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork. Thickness of brick encasement shall be minimum 115mm and shall be provided with reinforcing bars at every fourth course.
10.07.02	50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/ sq.m. shall be provided at plinth level before starting the masonry work.
10.07.03	The bricks used shall be of minimum class designation 75. The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction.
10.08.00	**Plastering**
10.08.01	Outer face (i.e., rough side) of all brick walls shall have 18 mm thick and inner face (i.e., smooth side) of all brick works shall have 12 mm thick cement sand plaster 1:6.
10.08.02	Wherever specified the plaster of paris (Gypsum Anhydrous) conforming to IS: 2547 shall be used for plaster of paris punning. The finish surface shall be smooth and shall be of 2 mm nominal thickness.
10.08.03	All exposed faces of R.C.C. walls of buildings shall have minimum 12 mm thick cement sand plaster 1:6.
10.08.04	All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.
10.08.05	All plastering work shall conform to IS: 1661.
10.08.06	Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3).
10.09.00	**Painting**
10.09.01	All painting on masonry or concrete surface shall preferably be applied by roller. If applied by brush then same be finished off with roller.
10.09.02	All paints shall be of approved make including chemical resistant chlorinated rubber paint.

10.09.03	Minimum two finishing coats of paint shall be applied over a coat of primer.
10.09.04	Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428 -2000.
10.09.05	Fire resistant transparent paint (conforming to IS: 162) shall be provided on all wood work over French polish or flat oil paint. French polish shall conform to IS: 348. Flat oil paint shall conform to IS: 1237.
10.09.06	For painting on concrete, masonry and plastered & surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed. For painting on wood work IS: 2338 shall be followed.
10.10.00	**Doors & Windows**
10.10.01	Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top.
10.10.02	Unless specified all doors, windows and ventilators of air conditioned areas, entrance lobby of all buildings and windows / ventilators provided on the outer face of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet areas shall have prelaminated solid core wood shutter with pressed steel frames. All doors of office area shall be of aluminium frame work with fixed glass.
10.10.03	All windows on ground floor shall be provided with anodized aluminium grill of approved design
10.10.04	All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.
10.10.05	Wherever functionally required, rolling shutters of suitable size approved by the Employer, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248.
10.10.06	Fire proof doors with panic devices shall be provided at all fire exit points as per the recommendations of Tarrif Advisory committee (TAC). These doors shall generally be as per IS: 3614 (Part – II). Fire rating of the doors shall be as per TAC requirements. However minimum rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation.

10.10.07	Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL or equivalent shall be used for all aluminium doors, windows and ventilators.
10.11.00	**Glazing**
10.11.01	Ground glass of minimum 4 mm thickness shall be used for all windows/ ventilators in toilets.
10.11.02	Unless specified otherwise in this specification minimum thickness of plain sheet glass used for windows/ ventilators shall be 4 mm. All ventilators fixed glazing above 3.5 m height shall have 6 mm toughened glass.
10.11.03	Float glass or flat transparent sheet glass shall conform to IS: 2835.
10.11.04	All glazing work shall conform to IS: 1083 and IS: 3548.
10.11.05	The door and window frames shall be suitable for glazing. Aluminium doors and partitions shall be provided with minimum 6.0mm thick clear float glass glazing. All accessible windows and ventilators shall be provided with minimum 4mm thick clear float glass glazing. However windows in toilet areas shall have 6mm thick ground glass glazing. All doors /windows in A/C areas of building coming in interior shall have hermetically sealed, composite double glazing 6mm tinted glass on outer face and 6mm plain glass on inner face, separated by 12mm air gap. All doors /windows in A/C areas of building coming in exterior shall have Composite double glazing, 24mm thick consisting of 6mm thick clear float glass on inner side and 6mm thick reflective toughened glass on outer side. The two glasses shall be separated by 12mm air-gap and hermatically sealed by beading of anodized aluminium with outer edge sealed with silicon sealant. Outer glass of 6mm thickness shall have following technical characteristics: Solar factor 25% or less, U-value less than 2.268 W/ SQMK,VLT min 30%: The glass to be used should be from the manufacturers of glass like Glavebel (Belgium), Saint Gobain (France) or Fort (USA) Or equivalent. The glass should be free from distortion and thermal stress.
10.11.06	Doors and windows on external walls shall be provided with sunshade over the openings with width 300 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings & 750 mm over door openings or as decided and approved by the Engineer.
10.12.00	**False Ceiling**
10.12.01	Wherever required, 15 mm thick Mineral Fiber Board false ceiling shall be provided with in flat/curved shape. The false ceiling shall include all necessary suspension arrangement with height adjustment clips from RCC slab as per manufacturer's recommendations. The false ceiling shall be finished in all respects including the cutouts for lighting fixtures. Minimum headroom below false ceiling shall be 2.7 m.

10.12.02 Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil & 24 G x 25 mm mesh wire netting and shall be fixed to ceiling with 24 G wire ties.

10.13.00 WATER SUPPLY AND SANITATION

10.13.01 Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be minimum 500 litres.

10.13.02 Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for potable water supply.

10.13.03 Sand C.I. pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.

10.13.04 The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed. Sewage system for switch yard area and connecting to Employer ,s nearest sewage supply line located at nearby area .

10.13.05 Each gents toilet block shall have:

a) European water closet with all fittings including photo-voltaic control flushing arrangement of appropriate capacity and type -- 1 No.

b) Urinal with all fittings with photo voltic control flushing system as per IS: 2556 (Part - 6, Sec. - 1) -- 1 Nos.

Conference toilet block shall have European WC as per IS with all fittings including photo-voltaic control flushing arrangement of appropriate capacity and type -- 1 No.

Ladies toilet block shall European water closet) with all fittings including photo-voltaic control flushing arrangement of appropriate capacity and type – 1 No

10.13.06 The following minimum facilities shall be provided in each toilet block:

a) Wash basin (oval shape) with all fittings including photo-voltaic control system as per IS: 2556 to be fixed on concrete platform finished with 12 mm thick polished granite stone -- 1 nos.

b) Wall to wall Bathroom mirror (5.5 mm thick float glass) with bevelled edges including all fittings.

c) Stainless steel towel rail (600 x 20 mm) -- 1 No.

d) Stainless steel liquid soap holder cum dispenser -- 2 Nos

10.13.07	Provision for installation of drinking water facility and janitor room shall be provided in each floor.
10.13.08	Unless specified all the fittings shall be of chromium plated brass (fancy type).
10.13.09	Cement concrete pipes of class NP-3 as per IS: 458 shall be used below ground level for sewage disposal. However, for pressure pipes, spun C.I. pipes conforming to IS:1536 of required class shall be used.
10.13.10	RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS: 4111 (Part 1).
10.13.11	Sunken RCC slab shall be provided in toilet area at upper storey so as to keep the floor level same as that of the surrounding area.
11.00.00	**MISCELLANEOUS SPECIFICATIONS**
11.01.00	Two - part polysulphide sealant conforming to IS: 12118 shall be used for sealing of joints.
11.02.00	Preformed bitumen impregnated fibre board conforming to IS: 1838 shall be used as joint filler.
11.03.00	Monorails, monorail girders and fixtures shall be provided, wherever required to facilitate erection/ maintenance of equipment.
11.04.00	In design of all buildings fire safety requirements conforming to IS: 1641 and IS: 1642 shall be followed in addition to TAC requirements. The height of RCC fire protection wall between transformers shall be as per system requirement.
11.05.00	Wherever possible all floor openings shall be provided with 100mm thick 150 mm high RCC kerb all around. MS Angles of minimum size 50 x 50 x 6 mm with 8mm dia - 150mm Long MS lugs @ 150mm c / c shall be provided for edge protection around all cutouts / openings in floor slabs / walls, edges of drains supporting grating / pre-cast covers, edges of cable trench supporting pre-cast covers or chequered plates, edges of manhole supporting covers, around periphery of all removable pre-cast covers and any other place where breakage of corners of concrete is expected.
11.06.00	Grouting of all pockets, blockouts, sleeves and the openings around the embedment, inserts, bolts etc. and under pinning below the base / sole plate shall be with non - shrink flowable grout. Grade of grout shall be one grade higher than concrete. However minimum grade of grout shall be M - 30.
11.07.00	a) All drains inside the building shall have minimum 40mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating. b) Peripheral drains around building shall have perforated precast RCC covers of minimum 50mm thickness with provision of openable steel grating cover at about 4.0m interval. In areas where vehicular loads would be coming precast

RCC covers of suitable thickness without perforations and designed for the vehicular loading shall be provided.

11.08.00 Anti termite chemical treatment shall be given to all vulnerable areas susceptible to termite including column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards.

11.09.00 Wherever possible minimum 900 mm high hand railing shall be provided around all floor/ roof openings, projections/ balconies, platforms, walkways etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (medium class) conforming to IS: 1161 and shall be galvanised as per IS: 4736 and IS: 1239. All rungs and ladders shall also be galvanised. Minimum weight of galvanising shall be 610g/ sq.m.

11.10.00 For RCC stairs, hand railing with 20 mm square M.S. bar balustrades with suitable M.S. flats and aluminium hand rail shall be provided.

11.11.00 Suitable arrangement for draining out water collected from floor washings, fire fighting etc. shall be provided for each floor with suitable floor drains.

11.12.00 Duct banks consisting of PVC conduits for cables shall be provided with proper sealing arrangement consisting of fire retardant sealing compound.

11.13.00 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.

However, sub - grade for the roads shall be compacted to minimum 95% of the Standard Proctor density at Optimum moisture content (OMC).

11.14.00 All buildings shall be provided with peripheral drains by the side of plinth protection for catering to the rain water from roofs and storm water from adjacent area.

11.15.00 Non - shrink flowable grout shall be used for under - pinning work below base plates. 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-30.

11.16.00 Civil works for laying and fixing of rail including nuts, bolts, plates etc. and all associated works complete

11.17.00 Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.

11.18.00 The building auxiliary services like air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant section or elsewhere in this Specification.

11.19.00 The building lighting shall be designed in accordance with the requirements of relevant section.

11.20.00 All access/approach roads are in the scope of the bidder

11.21.00	Plywood formwork shall be used for all concrete works
11.22.00	Water supply line and drainage of buildings shall be connected to the drainage network
11.23.00	Design, construction and joints of all the structures shall be as per relevant Indian Standard Codes unless specified otherwise.
11.24.00	All foundation embedments, inserts, blockouts required for mounting of equipments and supporting any other facility like pipes etc. shall be provided.
11.25.00	All cable trenches shall be provided with suitable insert plates for fixing support angles of cable trays.
	11.26.00 All internal cable trenches shall have minimum 6mm thick (o / p) chequered plate covers while external cable trenches shall have pre - cast RCC covers. However, the portion of the cable trench behind and sides of control panel / MCC shall be provided with suitable chequered plate covers as directed by the Engineer.
11.27.00	Earthing mat shall be provided around buildings and structures as per specifications / approved drawings.
11.28.00	All foundations and surfaces of substructures coming in contact with earth shall be applied with a protective coating, if required, as per “Geotechnical investigation and Foundation system” with three coats of hot applied industrial bitumen conforming to IS : 702 (latest), of Grade 85 / 25, at the rate 1.7 Kg / Sq.m / coat.
11.29.00	Detailed scheme for dewatering shall be prepared before starting of deep excavation work. IS: 9758 shall be followed as general guidance for dewatering.
11.30.00	Broad gauge rail (52kg/m minimum) shall be used for rail tracks required for movement of ICT/Shunt Reactor.
12.00.00	**REQUIREMENTS FOR CONCRETE AND REINFORCEMENT**
12.01.00	Structural concrete shall be of design mix complying with the relevant provisions of IS Codes or any International Code of Practice as approved by the Employer. All concreting shall be carried out using centralized batching plant, transit mixers and concrete pumps. Numbers and capacity of batching plant, transit mixers and concrete pumps to be deployed by the bidder to achieve the required progress of work shall be specified in the relevant schedules of the bid documents.
12.02.00	Minimum grade of structural concrete shall be M25 as follows conforming to IS: 456:
	Blinding concrete below foundations, cable trenches shall be 75mm thick PCC of minimum grade M-7.5 and under brick foundations minimum 150mm thick PCC of minimum grade M-10.
12.03.00	Reinforcement shall be TMT conforming to grade Fe 500 as per IS: 1786 except noted otherwise.

12.04.00	Coarse and fine aggregates shall be specially selected to ensure that they are not susceptible to alkali/ chloride attack or prone to disintegration at high temperatures. In particular, limestone aggregates shall never be used. The maximum size of coarse aggregate shall not be larger than 1/8th of narrowest dimension between reinforcement bars nor more than 20 mm.
12.05.00	Washing and screening of coarse and fine aggregates to remove fines, dirt of other deleterious materials shall be carried out by approved means if desired by the Employer.
12.06.00	The maximum water cement ratio by weight shall be 0.45 or 0.50 as specified elsewhere, including moisture in the aggregates, and slump should be suitably decided to provide good quality concrete work, as specified elsewhere in the specification.
12.08.00	**Admixture** Admixtures may be permitted to be used in accordance with relevant IS codes to modify the rate of hardening or setting, to improve workability or as an aid to control concrete quality. The Employer reserves the right to direct the Bidder to conduct laboratory tests or use test data, or other satisfactory reference before granting approval. The cost of all tests conducted shall be borne by the Bidder. The admixture shall be used in strict accordance with the manufacturer's directions and/ or as directed by the Employer. No extra payment will be made to the Bidder on account of using admixtures.
12.09.00	Removal of air and water at the form surface shall be by vibration and rodding. Particular attention shall be paid to accurately shape the corners at the openings.
12.10.00	Point of discharge of the concrete in to the forms shall be 1500 mm above the concrete surface. Concrete shall be deposited in layers of approximately uniform level not greater than 400 mm deep unless permitted otherwise.
12.11.00	Sampling and testing of concrete shall be carried out as stated elsewhere in Technical Specification and as per relevant Indian Standard Codes.
12.12.00	**Cover to Reinforcement** Unless indicated otherwise the clear concrete cover for reinforcement shall be as per IS Codes. The correct cover shall be maintained by cement mortar cubes or other approved means. Reinforcement for footings/ pile caps, grade beam, and slabs on subgrade shall be supported on precast concrete cover block as approved by Employer. The use of pebbles or stones as cover blocks shall not be permitted.
12.13.00	The 28 days crushing strength of cement mortar cubes/ precast concrete cover block shall be atleast equal to the specified strength of concrete in which the cubes/ blocks are embedded.

12.14.00 The minimum clear distance between reinforcing bars shall be in accordance with IS: 456 (Latest edition) or as specified elsewhere in this specification.

12.15.00 All lapping of reinforcement bars shall be by lapping as per relevant codal provisions. Prior approval of the Employer shall be taken for deciding the method of lapping the reinforcement bars.

13.00.00 **MATERIALS**

13.01.00 **Cement**

Cement shall be Ordinary Portland Cement (grade 43) conforming to IS: 8112 or Fly ash based Portland pozzolana cement conforming to IS: 1489 Part-I or any other type of cement, meeting IS: 456 requirement as directed by the engineer. However, Fly ash based Portland pozzolana cement shall have compressive strength of 43 MPa at 28 days.

13.02.00 **Aggregates**

a) Coarse aggregate - Coarse aggregate for concrete shall be chemically inert, hard, strong durable against weathering, of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383.

b) Sand - Sand shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Sand, when used as fine aggregate in concrete shall conform to IS: 383. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116.

13.03.00 **Reinforcement Steel**

All reinforcement bars shall be TMT (Thermo Mechanically Treated) of grade Fe 500 conforming to IS: 1786 with minimum percentage of elongation of 14.5 %.

Mild steel & medium tensile steel bars and hard drawn steel wire shall conform to grade - 1 of IS: 432 (Part - I). Welded wire fabric shall conform to IS: 1566.

13.04.00 **Structural Steel**

Structural steel (including embedded steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall be of tested quality and shall be of Mild steel of Grade ‘A’ upto 20mm thickness and of Grade 'B' normalised for thickness above 20 mm and shall conform to IS: 2062. High Strength low alloy steel (HSLA) conforming to IS: 8500 may also be used in place of Mild steel. Chequered plate shall conform to IS: 3502 and pipes for hand rail shall conform to medium grade IS: 1611.

All gratings shall be pressure locked/ electroforged. Minimum thickness of the grating shall be 40mm. The opening size shall not be more than 30mm x 100mm.The minimum thickness of the main bearing bar shall be 3mm. All gratings located inside the building shall be sand blasted and provided with two coats of suitable primer and

two coats of finish paint(black colour) as per approved painting system. All gratings located outside the building shall be hot double dip galvanised at the rate of 610 gms / Sq. M. Supply of all structural steel shall be in Bidder's scope.

13.05.00 **Bricks**

Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75 kg/cm^2. Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS:13757 and IS:12894 respectively. Minimum fly ash content in fly ash based bricks shall be minimum 25%. Common burnt clay bricks shall conform to IS : 1077.

13.06.00 **Water**

Water used for cement concrete, mortar, plaster, grout, washing of coarse aggregate, soaking of bricks, etc., shall be clean and free from oil, acids, alkalis, organic matters or other harmful substances in such amounts that may impair the strength or durability of the structure. Potable water shall generally be considered satisfactory for all masonry and concrete works, including curing. The Bidder shall carry out necessary tests in advance to prove the suitability of the water proposed to be used. When water from the proposed sources is used for making the concrete, the maximum permissible impurties, development of strength and initial setting time of concrete shall meet the requirements of IS: 456.

14.00.00 **STATUTORY REQUIREMENTS**

12.01.00 Bidder shall comply with all the applicable statutory rules pertaining to Factories Act (as applicable for the state of Bihar), Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control, Explosives Act, etc.

12.02.00 Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkway of minimum 500mm wide along the crane - girder level on both sides of building/ pump house, comfortable approach to EOT crane cabin, railing, fire escape, toilets, etc.

12.03.00 Statutory clearances and norms of State Pollution Control Board shall be followed.

12.04.00 Bidder shall obtain approval of Civil/ Architectural drawings from concerned authorities before taking up the construction work.

15.00.00 **GEOTECHNICAL INVESTIGATION & FOUNDATION SYSTEM**

Geotechnical Investigation and Foundation system to be adopted for switchyard area shall be as per the details given in Sub-section C1 for Nabinagar STPP (3x660MW) and Sub-section C2 for BRBCL (4x250MW).

16.00.00 For reference codes and standards, refer APPENDIX-I of this Sub-section.

17.00.00 **TESTS FOR MATERIAL / WORKMANSHIP**

All tests required for various bought out items, materials, quality of workmanship or any other tests as desired by Project Manager and as specified in technical specification shall be carried out by the Contractor at his own cost in the presence of the authorised representative of the Engineer.

The quality assurance check lists are given separately in respective chapters / sections of this specification. The Contractor shall submit comprehensive Quality Assurance plan for all materials, equipment, workmanship, services etc. and get it approved from the Engineer. This shall include setting up a test laboratory at site. However, such check list shall in no way limit the liability and responsibility of the Contractor in regard to quality of workmanship as detailed out in the specifications.

18.00.00 **DRAWINGS**

The successful Bidder shall first submit the structural design calculations along with general arrangement drawings for approval. After the approval of the design calculations by the Owner, detailed construction drawings shall be prepared and submitted for Owner's approval along with revised design calculations, if required, within 15 days. Required number of sets of design calculations, drawings and documents shall be submitted by the Contractor. All documents including design calculations shall be prepared in MS office and all drawings shall be drafted using AutoCAD (Release - 2000 or higher version). During every submission one soft copy of the document shall also be submitted. When final approval is obtained from the Employer the Contractor shall submit all the documents in TWO sets of CD ROM (One + One Back - up) together with minimum three sets of distribution prints well documented and page controlled with details of Employer's approval marked thereon. Approval of drawings / documents shall not relieve the contractor of the responsibility regarding the adequacy of design and correctness of drawings.

19.00.00 **ALTERATION IN SPECIFICATION AND DESIGN**

The Project Manager shall have the power to make any alteration and omissions from, additions to or substitution for, the original specifications, drawings, designs and instructions that may appear to him to be necessary during the progress of the work, and the Contractor shall carry out the work in accordance with any instruction which may be given to him in writing signed by the Project Manager and such alterations, omissions, additions or substitutions shall not invalidate the contract and any altered, added or substituted work which the Contractor may be directed to do in the manner above specified as part of the work shall be carried out by the Contractor on the same conditions in all respects on which the Contractor agreed to do the original contract work. The time for completion of work shall be altered in the proportion that the altered, added or substituted work bears to the original contract work, and the certificate of the Project Manager shall be conclusive as to such proportion.

The rates for the altered items of work shall be worked out on the following basis and necessary alternations in the total amount shall be made on that basis:

(a.) The rates to be reimbursed or recovered shall be taken as same as those given in CPWD - DSR (latest) for those items for which the rates are available in

CPWD - DSR (latest). However, the premium as officially declared by CPWD's official circulars, at the time of carrying out these works, the same shall also be applicable.

(b.) Rates for the items not covered under CPWD - DSR (latest) shall be derived from the rates of similar items of CPWD schedule of rates. However, the premium as officially declared by CPWD on the above DSR rates if existing or prevalent through CPWD's official circulars, at the time of carrying out these works, the same shall be applicable.

(c.) In the event there is no similar class of work specified in the CPWD - DSR (latest) the Contractor shall work on a rate for such an item on the basis of the prevalent market rates for materials / men / machines and submit the same together with the detailed analysis to the Project Manager with in 7 days. The Project Manager shall thereafter review the correctness and then conduct necessary negotiations with the Contractor to arrive at a mutually agreeable rate. Engineer's decision in regard to rates of such items shall be final and binding on the Contractor.

In case of conflict between this chapter and other Chapters of Technical Specifications, provisions given in this chapter shall govern.

APPENDIX-I

1.00.00 CODES AND STANDARDS

1.01.00 All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

1.02.00 In case of conflict between this specification and those (IS standards, codes etc.) referred to here - in, the former shall prevail.

1.03.00 Some of the relevant Indian standards, Acts and Codes are referred to here below:

(a.) EXCAVATION AND FILLING

IS : 2720 (Part - II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL)

Methods of test for soils - determination for water content etc.

IS : 4701	Code of practice for earth work on canals.
IS : 9758	Guide lines for Dewatering during construction
IS : 10379	Code of practice for field control of moisture and compaction of soils for embankment and sub - grade.

(b.) PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIALS

IS : 280	Specification for mild steel wire for general engineering purposes.
IS : 456	Code of practice for plain and reinforced concrete.
IS : 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.
IS : 516	Method of test for strength of concrete.
IS : 650	Specification for standard sand for testing of cement.
IS : 1199	Methods of sampling and analysis of concrete.
IS : 1791	General requirements for batch type concrete mixers.
IS : 1838 (Part - I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non - extruding and resilient type).
IS : 2438	Specification for roller pan mixer.
IS : 2502	Code of practice for bending and fixing of bars for concrete

		reinforcement.
	IS : 2505	General requirements for concrete vibrators, immersion type.
	IS : 2506	General requirements for concrete vibrators, screed board type.
	IS : 2514	Specification for concrete vibrating tables.
	IS : 2645	Specification for Integral cement water proofing compounds.
	IS : 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)
	IS : 2750	Specification for Steel scaffolding.
	IS : 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
	IS : 3025	Methods of sampling and test waste water.
	IS : 3366	Specification for Pan vibrators.
	IS : 3370 (Part I to IV)	Code of practice for concrete structures for the storage of liquids.
	IS : 3414	Code of practice for design and installation of joints in buildings.
	IS : 3550	Methods of test for routine control for water used in industry.
	IS : 3558	Code of practice for use of immersion vibrators for consolidating concrete.
	IS : 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
	IS : 4326	Code of practice for earthquake resistant design and construction of buildings.
	IS : 4656	Specification for form vibrators for concrete.
	IS : 4925	Specification for batching and mixing plant.
	IS : 4990	Specification for plywood for concrete shuttering work.
	IS : 5256	Code or practice for sealing joints in concrete lining on canals.
	IS : 5525	Recommendations for detailing of reinforcement in reinforced concrete work.

	IS : 5624	Specification for foundation bolts.
	IS : 6461	Glossary of terms relating to cement concrete.
	IS : 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
	IS : 6509	Code of practice for installation of joints in concrete pavements.
	IS : 7861	Code of practice for extreme weather concreting. (Parts I & II)
	IS : 9012	Recommended practice for shot concreting.
	IS : 9103	Specification for admixtures for concrete.
	IS : 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
	IS : 10262	Recommended guidelines for concrete mix design.
	IS : 11384	Code of practice for composite construction in structural steel and concrete.
	IS : 12118	Specification for two - parts poly sulphide.
	IS : 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
	IS : 13311	Method of non - destructive testing of concrete.
	Part - 1	Ultrasonic pulse velocity.
	Part - 2	Rebound hammer.
	SP : 23	Handbook of concrete mixes
	SP : 24	Explanatory Handbook on IS : 456 - 1978
	SP : 34	Handbook on concrete reinforcement and detailing.
	(c.) CAST - IN - SITU CONCRETE AND ALLIED WORKS	
	IS : 280	Specification for mild steel wire for general engineering purposes.
	IS : 456	Code of practice for plain and reinforced concrete.
	IS : 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.

	IS : 516	Method of test for strength of concrete.
	IS : 650	Specification for standard sand for testing of cement.
	IS : 1199	Methods of sampling and analysis of concrete.
	IS : 1791	General requirements for batch type concrete mixers.
	IS : 1838 (Part - I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non - extruding and resilient type).
	IS : 2438	Specification for roller pan mixer.
	IS : 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
	IS : 2505	General requirements for concrete vibrators, immersion type.
	IS : 2506	General requirements for concrete vibrators, screed board type.
	IS : 2514	Specification for concrete vibrating tables.
	IS : 2645	Specification for Integral cement water proofing compounds.
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	IS : 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
	IS : 5624	Specification for foundation bolts.
	IS : 6461	Glossary of terms relating to cement concrete.
	IS : 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
	IS : 6509	Code of practice for installation of joints in concrete pavements.
	IS : 7861	Code of practice for extreme weather concreting. (Parts I & II)
	IS : 9012	Recommended practice for shot concreting.
	IS : 9103	Specification for admixtures for concrete.
	IS : 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
	IS : 10262	Recommended guidelines for concrete mix design.
	IS : 11384	Code of practice for composite construction in structural steel and concrete.
	IS : 12118	Specification for two - parts poly sulphide.
	IS : 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
	IS : 13311	Method of non - destructive testing of concrete.
	Part - 1	Ultrasonic pulse velocity.
	Part - 2	Rebound hammer.
	SP : 23	Handbook of concrete mixes
	SP : 24	Explanatory Handbook on IS : 456 - 1978

SP : 34	Handbook on concrete reinforcement and detailing.

(d.) PRECAST CONCRETE WORKS

SP : 7 (PartVI / Sec.7)	National Building Code - Structural design of prefabrication and systems building.
IS : 10297	Code of practice for design and construction of floors and roofs using precast reinforced / prestressed concrete ribbed or cored slab units.
IS : 10505	Code of practice for construction of floors and roofs using pre - cast reinforced concrete units.

(e.) MASONRY AND ALLIED WORKS

IS : 1905	Code of Practice for Structural Safety of Buildings - Masonry walls.
IS : 2212	Code of Practice for Brickwork.
IS : 2250	Code of Practice for Preparation and use of Masonry Mortar.
SP : 20	Explanatory hand book on masonry code.

(f.) SHEETING WORKS

IS : 277	Galvanised steel sheets (plain or corrugated).
IS : 459	Unreinforced corrugated and semi - corrugated asbestos cement sheets.
IS : 513	Cold - rolled carbon steel sheets.
IS : 730	Specification for fixing accessories for corrugated sheet roofing.
IS : 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.
IS : 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.
IS : 3007	Code of practice for laying of asbestos cement sheets.
IS : 5913	Methods of test for asbestos cement products.
IS : 7178	Technical supply conditions for tapping screw.
IS : 8183	Bonded mineral wool.
IS : 8869	Washers for corrugated sheet roofing.

IS : 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.
IS : 12866	Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced).
IS : 14246	Specification for continuously pre - painted galvanised steel sheets and coils.

(g.) FABRICATION AND ERECTION OF STRUCTURAL STEEL WORK

IS : 2016	Specification for plain washers.
IS : 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS : 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS : 3502	Specifications for chequered plate.
IS : 6911	Specification for stainless steel plate, sheet and strip.
IS : 3757	Specification for high strength structural bolts
IS : 6623	Specification for high strength structural nuts.
IS : 6649	High Tensile friction grip washers.
IS : 800	Code of practice for use of structural steel in general building construction.
IS : 816	Code of practice for use of Metal Arc Welding for General Construction.
IS : 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.
IS : 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS : 817	Code of practice for Training and Testing of Metal Arc Welders.
IS : 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS : 7215	Tolerances for fabrication steel structures.
IS : 12843	Tolerance for erection of structural steel.
IS : 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.

SP : 6 (Part 1 to 7)	ISI Hand book for structural Engineers.
IS : 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS : 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube
IS : 802(1977)	Code of practice for use of Structural Steel inOver head Transmission Line Towers.
IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.
IS : 2595	Code of Practice for Radio graphic testing.
IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.
IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

(h.) PLASTERING AND ALLIED WORKS

IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.
IS : 1661	Application of cement and cement lime plaster finishes.
IS : 2333	Plaster - of - paris.
IS : 2402	Code of practice for external rendered finishes.
IS : 2547	Gypsum building plaster.
IS : 3150	Hexagonal wire netting for general purpose.

(i.) WATER SUPPLY, DRAINAGE AND SANITATION

IS : 458	Specification for concrete pipes.
IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.
IS : 651	Specification for salt glazed stoneware pipes.

	IS : 774	Flushing cisterns for water closets and urinals.
	IS : 775	Cast iron brackets and supports for wash basins and sinks.
	IS : 778	Copper alloy gate, globe and check valves for water works purposes.
	IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.
	IS : 782	Caulking lead.
	IS : 783	Code of practice for laying of concrete pipes.
	IS : 1172	Basic requirements for water supply, drainage and sanitation.
	IS : 1230	Cast iron rain water pipes and fittings.
	IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.
	IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
	IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
	IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.
	IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.
	IS : 1726	Cast iron manhole covers and frames.
	IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.
	IS : 1742	Code of practice for building drainage.
	IS : 1795	Pillar taps for water supply purposes.
	IS : 1879	Malleable cast iron pipe fittings.
	IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.
	IS : 2065	Code of practice for water supply in building.
	IS : 2326	Automatic flushing cisterns for urinals.
	IS : 2470 (Part - I & II)	Code of practice for installation of septic tanks.
	IS : 2501	Copper tubes for general engineering purposes.

IS : 2548	Plastic seat and cover for water - closets.
IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
IS : 2963	Non - ferrous waste fittings for wash basins and sinks.
IS : 3114	Code of practice for laying of cast iron pipes.
IS : 3311	Waste plug and its accessories for sinks and wash basins.
IS : 3438	Silvered glass mirrors for general purposes.
IS : 3486	Cast iron spigot and socket drain pipes.
IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
IS : 4127	Code of practice for laying of glazed stone - ware pipes.
IS : 4764	Tolerance limits for sewage effluents discharged into inland - surface waters.
IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS : 5822	Code of practice for laying of welded steel pipes for water supply.
IS : 5961	Cast iron grating for drainage purpose.
IS : 7740	Code of practice for road gullies.
IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.
IS : 8934	Cast copper alloy fancy pillar taps for water services.
IS : 9762	Polyethylene floats for ball valves.
IS : 10446	Glossary of terms for water supply and sanitation.

IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
IS : 12592	Specification for precast concrete manhole covers and frames.
IS : 12701	Rotational moulded polyethylene water storage tanks.
SP : 35	Hand book on water supply and drainage.
-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.

(j.) PILING AND FOUNDATION

IS : 1080	Code of practice for design and construction of simple spread foundations.
IS : 1904	Code of practice for design and construction of foundations in Soils; General Requirements.
IS : 2950 (Part- I)	Code of practice for designs and construction of Raft foundation.
IS : 2974 (Part - I TO V)	Code of practice for design and construction of machine foundations.
IS : 6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.
IS : 8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.
Part - I	Shallow foundations.
Part – II	Deep foundations.
IS : 12070	Code of practice for design and construction of shallow foundations on rocks.
DIN : 4024	Flexible supporting structures for machines with rotating machines.
VDI : 2056	Criteria for assessing mechanical vibrations of machines.
VDI : 2060	Criteria for assessing rotating imbalances in machines.

(k.) ROADS

IRC : 5	Standard specifications and Code of practice for road bridges, section - I general Features of Design.
IRC : 14	Recommended practice of 2cm thick bitumen and tar carpets.

IRC : 16	Specification for priming of base course with bituminous primers.
IRC : 19	Standard specifications and code of practice for water bound macadam.
IRC : 21	Standard specifications and Code of practice for road bridges, section - III - Cement concrete (plain and reinforced).
IRC : 37	Guidelines for the Design of flexible pavements.
IRC : 86	Geometric Design standards for urban roads in plains.
IRC : SP : 13	Guidelines for the design of small bridges & culverts.
IRC - Publication	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.
IS : 73	Specification for paving bitumen
(l.) Loading	
IS : 875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.
IS : 1893	Criteria for earthquake resistant design of structures.
IS : 4091	Code of Practice for design and construction of foundation for transmission line towers & poles.
IRC : 6	Standard specifications & code of practice for road bridges, Section - II Loads and stresses.
M.O.T.	Deptt. of railways Bridge Rules.
(m.) SAFETY	
IS : 3696 (Part I & II)	Safety code for scaffolds and ladders.
IS : 3764	Safety code for excavation work.
IS : 4081	Safety code for blasting and related drilling operations.
IS : 4130	Safety code for demolition of buildings.
IS : 5121	Safety code for piling and other deep foundations.
IS : 5916	Safety code for construction involving use of hot bituminous materials.
IS : 7205	Safety code for erection on structural steelwork.
IS : 7293	Safety code for working with construction machinery.
IS : 7969	Safety code for handling and storage of building materials

IS : 11769 Guidelines for safe use of products containing asbestos.
Indian Explosives Act. 1940 as updated.

APPENDIX - I

SAMPLING, TESTING AND QUALITY ASSURANCE FOR CIVIL WORKS

1.0.0 INTRODUCTION

1.1.0 This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification including excavation and filling, cast in situ concrete and allied works, fabrication and erection of structural steel works, masonry / sheeting and allied works, finishing items,etc.

1.2.0 This part of the technical specification shall be read in conjunction with other Parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.

1.3.0 All tests required for all materials (bought by Contractor) and workmanship shall be done / got done by the contractor at his own cost. The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part.

1.4.0 The Contractor shall provide the facilities whatsoever required and also bear the cost for all sampling, testing and quality assurance in the field and in the laboratory. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian standards and / or international standards and this technical specification. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All sampling shall be done in the presence of the Engineer or his authorised representative. The Contractor shall establish the QA&QC laboratory at site and all field tests shall be done in the presence of the Engineer and / or his authorised representative. The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute (like CSMRS, NCBM, IITs, National Test House, Kolkata etc.) as agreed by the Engineer, the test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by FQA representative of the engineer. The cost of transportation and other associative cost including the test charges shall be borne by the contractor. These cost shall deemed to be included in the respective item of work in the contract. If the Engineer desires to witness such tests at laboratory, Contractor shall arrange to conduct the test in his presence. Apart from the above one set of mix design has to be essentially carried out at NCB Ballabgarh/ CSMRS Delhi.

1.5.0 The recommendations and suitability of material for concreting and other building materials like brick, cement, aggregates etc., shall be ascertained by contractor prior to start of work.

Preliminary evaluation of aggregate and its evaluation for potential alkali-aggregate reactivity as per following scope of work shall be done:-

A. Evaluation of Aggregates

i) To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386.

ii) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis soundness, deleterious material, silt content, clay content and organic impurities as per IS: 2386.

iii) To prepare evaluation report based on test results of I) and ii) above and to advise regarding suitability of fine and coarse aggregates.

B. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:

Evaluation for Potential Alkali-Aggregate reactivity as per following scope of work:

i) To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test.

ii) To prepare a report based on test results of I) above and to advise regarding suitability of aggregates and further testing required if any.

The contractor shall initiate the action with regard to the above mentioned evaluation of aggregates and other building material, so as to ensure timely completion of these tests thereby not affecting any project work. All records shall be submitted, unless specified otherwise, as per the format developed by the Contractor and approved by the Engineer.

1.6.0 The contractor shall identify the bought out items as per owner's specification and shall finalize the list of manufacturers/ vendors for each bought out items envisaged in the contract during the pre-award stage. The BOI's shall conform to the relevant IS/technical referred specifications for the highest quality/ grade of material unless otherwise specified. All bought out items shall be procured from the manufacturer's approved by NTPC and tested as per relevant IS Codes/NTPC Specification. To facilitate advance planning (well before the start of activity as per L-2 network) of material testing/ approval of bought out items, representative samples shall be procured by the Contractor (from approved vendors) and submitted to the Engineer for his approval before bulk procurement at least two months prior to start of works. In case of manufacturers test certificate is submitted for acceptance, it shall be clearly traceable and correlated with the consignment received at site. Approval of material / sample by the Engineer shall not relieve the Contractor of his responsibility, for their conformance to the specification, as well as the requisite quality and performance of material.

Structural Steel shall be procured from main steel producers like SAIL, TISCO, IISCO, RINL, Jindal Steels etc. In case of non-availability of some of the sections with main Producers the contractor may propose to procure the sections from the re-rollers of the main steel producers, the name of such re-rollers will have to be cleared by corporate quality assurance of NTPC for which details such as –BIS approval, Main steel producer's approval, Past experience for production of sections of specified material, details of machines plants testing facilities etc., confirmation that the process control and manufacturing of steel sections by re-rollers shall be same as that of main steel producers, that billets for re-rolling will be sourced from main steel producers only shall be furnished with regards to re-roller.

Even after clearance of re-rollers, induction of billets with identified and correlated Mill test certificates (TC's) in the process of re-rolling, sampling of steel, quality checks thereof and stamping of final product for further identification and correlation with TC's prior to dispatch shall be the responsibility of the contractor and these shall be performed in presence of the authorised representative of the main Contractor.

Reinforcement steel shall be procured from main steel producers like SAIL, TISCO, IISCO, RINL, Jindal Steels. In case any size /diameter specified is not available and are proposed to be supplied from the conversion agent of the main Steel producer – the name

of such conversion agent / re roller shall have to be approved by NTPC for which details such as –BIS approval, Main steel producer's approval, Past experience for production of sections of specified material, details of machines, plants testing facilities etc., and confirmation that the process control and manufacturing of steel sections by re-rollers is the same as that of main steel producers, that billets for re-rolling are sourced from main steel producers only shall be furnished with regards to re-roller.

1.8.0 The Field Quality Plans shall detail out all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.

The contractor shall furnish complete QA & QC programme for the work envisaged which may include the following :-

- The organisation structure for the management and implementation of the proposed Quality Assurance Programme.
- Documentation Control System
- The procedure for procurement of materials and source inspection.
- System for site controls including process controls.
- Control of non-conforming items and systems for corrective action
- Inspection and test procedures for site activities
- System for indication and appraisal of inspection status
- System for maintenance of records
- System for handling, storage and delivery.
- Quality Plan detailing out quality practices and procedures, relevant standards and acceptance levels for all types of work under the scope of this contract.

The Contractor shall appoint a dedicated, experienced and competent quality management representative on site, preferably directly reporting to the Project Manager, supported by experienced personnel, to ensure the effective implementation of the approved quality assurance programme.

The onsite quality management representative shall have the organisational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints.

The QA & QC setup of the contractor shall consist of qualified and experienced engineers, with their supporting staff. The QA&QC set up in addition to requisite mechanical & electrical engineers, shall consist sufficient graduate civil engineers & supervisors to take care of quality assurance activities of both site & laboratory. An indicative QA & QC organisation chart is attached as annexure-I. The deployment of man power for QA & QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the Engineer-in-charge for acceptance.
Based on the schedule of work agreed with the Engineer-in-charge and the approved FQP, the Contractor shall prepare a schedule of tests and submit them to the Engineer-in-charge and organise to carry out the tests as scheduled/ agreed.

1.9.0	The QA&QC laboratory shall have all necessary equipment, instruments and shall be managed by a qualified / experienced person. An indicative list of test equipment is attached at Annexure-II. All these testing equipment shall be provided by the contractor at his own cost. The contractor shall maintain the equipment in good working condition along with valid calibration certificates, for the duration of the contract. Any other equipment though required for testing but not listed in the equipment list shall be provided / arranged by the contractor at his own cost. QA&QC laboratory building shall be constructed by the Contractor at their own cost. The laboratory building shall be constructed and installed with the appropriate facilities. Temperature and humidity controls shall be available wherever necessary during testing of samples.
1.10.0	The contractor shall prepare and obtain approval of the Owner of the Field Quality Plan (FQP) well before the start of the work. This FQP shall cover for all the items / activities covered in the contract/schedule of items and required for completion of the work.
1.11.0	All materials / components and equipment covered under the scope of work which are to be manufactured at shop/ factory of the vendor/subvendor shall be covered under a comprehensive quality assurance programme. The detailed quality plan for manufacturing shall be drawn up by the contractor and will be submitted to the owner for approval in the prescribed format for manufacturing quality plan. Manufacturing Quality Plan (MQP) shall detail out all the components and equipment, various test/inspection, to be carried out as per the requirements of this specification and standards mentioned therein. The quality practices and procedures followed by Bidder's/Sub-Bidder's/ sub-supplier's Quality Control Organisation shall include , the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of material procurement, manufacture, assembly and final testing / performance testing . The quality plan shall be submitted on electronic media e.g. CD – ROM or E-mail in addition to hard copy, for review and approval. After approval the same shall be finally submitted in compiled form on CD-ROM.
1.12.0	The contractor shall store and handle the materials as per the requirements of the relevant standards at his own cost.
1.13.0	All T&P / equipment brought at site for the use shall be in a good working condition and shall preferably be not more than three years old. In case of outage of any T&P / equipment for more than 40% of requirement, the contractor shall ensure the deployment of additional T&P / equipment to augment the mechanised work at no extra cost to owner. All the equipment shall be duly calibrated by NABL accredited laboratories/accreditation agencies.
1.14.0	All major bought out items shall be included in the field quality plan/ quality plan. The Quality plan shall interalia include following works/ Bought out items wherever relevant to the scope of work, Technical specifications, BOQ & drawings. • Earthwork including selection of fill material, compaction, proctor density tests etc. • Piling work • Cement, reinforcement steel & structural steel procurements. • Coarse/ Fine aggregates, ash, water for concrete. • Cast-in-situ concrete & allied works. • Pre cast cement concrete • Supply and laying of RCC pipes

- Masonry & allied works.
- Plastering and allied works.
- Road works.
- Fencing and gate.
- Anti-weed treatments
- Damp proofing
- Grouting
- Electro forged grating
- HSFG Bolts
- Galvanized steel structure/ pipe support structure
- Sheeting work
- Flooring and allied work
- Doors and window
- Glass and glazing
- Pilling work
- False ceiling
- Water proofing
- Water supply and drainage
- Earthing mat

The bidder shall furnish the list of manufacturer s of each bought out items in their bid, which shall be reviewed and finalized during the post bid discussions with the successful bidder .
Where ever the manufacturer's /sub vendors are placed in "DR"(Details Required) category, during the post bid discussions, the details of such manufacturer's /sub vendors shall be submitted in NTPC prescribed format, within two months from the date of award, for review /approval of NTPC, failing which, these sub-contractor proposals shall be treated as withdrawn.

1.15.0 List of Annexure is as follows :

a) Annexure I Typical QA&QC Lab
b) Annexure II- QA&QC Organisation Set up
c) Annexure-IV-Indicative Field Quality Plan(Note: The field quality plan attached is indicative and the contractor shall prepare the field Quality plan covering the entire scope of work in the contract and submit the same to corporate QA for acceptance/approval. However any addition or deletion in the scope of work, during detailed engineering shall be accordingly added/ deducted from the Field Quality Plan)

2.0.0 GENERAL QA REQUIREMENTS

2.1.0 QA REQUIREMENTS FOR PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIALS

1. All the materials brought to site for incorporation in the work like Bricks, Stones, Concrete Blocks,Cement, Water, Aggregates, Sand, Reinforcement Steel, Structural Steel shall conform to the relevant IS Codes/NTPC Technical Specification requirements.

2. All materials shall be stacked and stored by the Contractor as per IS-4082 unless otherwise mentioned and in a manner affording convenient access for identification and inspection all the times. Any material rendered unserviceable during the

contractor's custody, shall be replaced or repaired by the contractor as determined by the engineer.

3. All material shall be stacked separately.

4. Cement shall be stored on a raised platform in Weather Proof, Dry & Leak Proof Conditions stores.

5. Different consignment of different types of cement shall be stored separately with clear identification mark.

6. Cement stored for more than 60 days in contractors godown shall be retested to check their suitability for use.

7. Cement shall be consumed on first in first out basis.

8. Steel shall be stacked and stored consignment wise, on raised wooden battens size wise and grade wise with identification mark.

9. For properties, storage and handling of all materials used shall comply to the requirements of NTPC Technical Specification .

10. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage.
11. The packets/ sheets must be covered with water proof covering to protect from moisture rain and foreign particles.
12. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating , and cause corrosion.

2.2.0 QA REQUIREMENTS FOR PRE CAST CONCRETE WORKS

1. All the materials used in Pre cast Concrete work shall be tested and conform to the requirements of IS codes and NTPC Tech. Specification.
2. Concrete mix for Pre cast members shall conform to IS-456-2000.
3. All relevant QA requirements pertaining to cast insitu concrete shall be applicable.
4. Load test on Pre cast members shall be carried out for the type of members at the 5% random or as decided by NTPC Engineer.
5. Pre Cast Concrete member shall be checked for dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances shall be as per NTPC Technical Specification.

2.3.0 QA REQUIREMENTS FOR RCC - BORED CAST-IN-SITU PILES

1. Standard Penetration Test (SPT) as per IS-2131 and NTPC Technical Specification to determine the founding level of piles.
2. Founding level of the piles shall be decided based on the criteria given in NTPC Technical Specification.
3. Check for control of position and alignment of piles as per IS-2911 Part I/Sec-2
4. Boring & Drilling : Drilling mud shall be tested for the following
   - Liquid limit of drilling mud (Bentonite Slurry) as per IS-2720 Part V.
   - Sand content of Bentonite powder (shall not be greater than 7%).
   - Density of freshly prepared Bentonite suspension shall be checked in each pile bore before concreting and it should be between 1.034 and 1.10 gm/ml depending upon the pile dimension and type of the soil in which the pile is to be installed.

However, the density of bentonite suspension after getting mixed with deleterious material in the pile bore may be up to 1.25 gm/ml.

- Marsh viscosity (when tested by marsh cone shall be between 30 to 60 seconds).
- Differential free swell index.
- pH value of Bentonite suspension (shall be between 9 and 11.5).

Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, minimum once per week or as found necessary by the engineer. One sample consisting of 3 specimens shall be tested for the above.

5. Check cleaning of pile bore

6. Concreting: All the checks/tests on concrete and concrete materials shall be carried out as per FQP and IS-2911 Part I/Sec.2

   a) Before starting concreting the contaminated drilled mud at the (slurry collected in sampler tube) bottom of pile bore shall be tested for density and sand content. Density should not be more than 1.25T/CuM.

   b) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Subsequently minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength

7. Reinforcement bars used for concreting of piles shall be of tested quality and conform to the requirements of relevant IS codes.

   a) Check distances between two adjacent main reinforcement bars and it should be as specified in Technical Specification.

   b) Check proper cover and central placement of reinforcement cage in the pile bore by suitable concrete spacers/rollers. Check minimum clear cover to reinforcement should be as specified in technical specification.

8. Check cut off level of piles as per drawing.

9. Check recording of all data during installation of piles in prescribed pile data sheet.

10. Slumps of concrete shall be tested at every one-hour interval.

11. Checking position and Alignment: Each pile shall be checked for its position w.r.t. Specified location. Each pile shall be checked for its alignment. Permissible limits for deviation shall be as specified elsewhere in the Technical Specification.

12. Check for Pile Bore: On completion of boring and cleaning, the bottom of each pile bore shall be checked from the samples collected from near the bottom of pile bore or any other method approved by the Engineer, to ensure that it is free from pile bore spoil/debris and any other loose material before concreting.

13. Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Technical Specification. This test shall be suitably used to identify the piles for routine tests.

14. High Strain dynamic test shall be done as per the technical specification. The frequency of the test shall be as per the BOQ .

Apart from the above the following shall also apply for the requirement of piling work:-

a) Time gap between completion of pile boring and start of concreting should be kept to the minimum. However the maximum time gap shall not be more than 6 hours.
b) Muck Debris should be removed from the pile bore by air lift technique(by keeping the tremie & air pipe as close as to bottom of pile bore),
   i) After completion of boring.
   ii) After completion of SPT(wherever applicable)
   iii) After lowering reinforcement cage, but before start of concreting.
c) Density of bentonite slurry shall be checked from the sample taken from the bottom of pile bore (not at 1.0 m above the bottom of the pile bore)
d) Minimum two welding stets shall be kept ready to join the two cages of reinforcement by engaging 3 or more welders. This will ensure the lowering of R/F cage in minimum time.
e) While lowering the R/F cage into the pile bore, two hooks shall always be used to ensure balanced/symmetrical insertion of cage into the pile bore.
f) Concrete cover blocks at the junction of two R/F cage shall be ensured before lowering the second segment.
g) Surge concreting of about 1.0 cum shall be ensured at the start of concreting (i.e. in the first pour), by suddenly allowing to fall through the tremie pipe from the funnel. This will help in displacing left out muck/debris in the pile bore(by the impact).
h) Continuous feeding of concrete shall be ensured by deploying at least two transit concrete mixers (if required to be deployed)and mixing done through concrete batching plant(if deployed). Cold joints in the pile shall be avoided.
i) Ina pile group, SPT shall be carried out at termination level in the pile, taken up first.
j) Bentonite slurry circulation to be ensured from start of boring to start of concreting. Flushing of bentonite slurry will only ensure maintaining of density of bentonite slurry uniformly and will not allow bentonite jelly to settle at the bottom, whereas air lift technique with bentonite circulation will ensure removal of muck debris from the bottom of pile bore.

2.4.0 QA REQUIREMENTS FOR RCC PILES LOAD TEST ON RCC PILES

1. Pile load testing shall conform to IS-2911 (Part IV) and the Technical Specification.

2. Check all the equipment and instrument used are properly calibrated.

3. Initial load test shall be conducted to assess the safe load carrying capacity of pile before start of work.
   a) Cyclic vertical (compression) load test to assess safe vertical load capacity.
   b) Lateral load test to assess safe horizontal load capacity.
   c) Pull out (Tension) load test to assess safe pull out load capacity.

4. Routine Load Test shall be conducted on Working Piles, to verify their load carrying capacity.
   a) Direct Vertical (Compression) load test for vertical load capacity.
   b) Lateral load test for horizontal load capacity

5. All other tests on piles shall be carried out as specified in Technical Specification.

6. Pile load-testing procedure and the test setup/scheme to be submitted for approval from NTPC. The contractor shall use the test setup having arrangement for reaction piles for both vertical compression and uplift (tension) Load test (initial) on piles. The cost of reaction system/ piles shall deem to be included in the cost of test piles

7. All the gauges(pressure etc.) and the instruments shall be calibrated before the start of the tests on test piles and working piles and the calibration record shall be verified before start of execution of the test.

2.5.0 QA REQUIREMENTS FOR PLASTERING & ALLIED WORKS

1. Materials like sand, plaster of paris for preparation of putty, coarse aggregate, gypsum etc. shall confirm to the relevant IS codes specified in NTPC Technical Specification.
2. Check proper mixing of mortar
3. Plaster surface shall be checked for following defects and the remedial measures for the same shall be adopted as per IS-1661.
   a) Blistering
   b) Bond filer or loss of adhesion.
   c) Cracking and crazing
   d) Efflorescence
   e) Grinning
   f) Irregularity of Surface Texture
   g) Popping or blowing
   h) Recurrent surface dampers
   i) Softness or chalkiness
4. Trueness of Plastering System:
   Finished plaster surface shall not show any deviation more than 4mm when checked with straight edge of 2 Mt. length.
5. Check thickness of plaster.

2.6.0 QA REQUIREMENTS FOR CONCRETING

All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference.

a) Testing data / report of aggregates
b) Mix design details.
c) Testing records of admixture including dosage, workability and setting time.
d) Approved scheme for concreting.
e) Hourly records of concreting including pour card.
f) Protocol indicating the dimensional tolerance and details of inserts.
g) Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used.
h) Bar bending schedule.
i) Location and details of mechanical anchoring used for reinforcement.
j) Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings.
k) Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification.
l) Report on petrographic examination & potential reactivity of aggregate and the repeated temperature cycle tests.
m) All tests/checks shall be carried out as per FQP.
n) Check temperature control of fresh concrete temperature of fresh concrete should not exceed 25 degree C at the time of placement.
o) Plasticizer cum Retarder type mixture to be added in the concrete shall be tested as per IS-9103.
p) REINFORCEMENT :

- Check conformity of material to relevant IS codes.
- Check lapping/spacing of Reinforcement staggered as under no circumstances more than 50% of bars at cross section shall be lapped.
- Sample test for mechanical bars grips shall be carried out upto the yield strength of reinforcement of bars. The no. of tests to be carried out shall be 3% of the no. of bar grips used subject to a minimum of three.

q) Batching Plant shall be calibrated regularly atleast once in a 3 months and computerized output shall be taken for each batch of production of concrete. The calibration if the batching plant shall be done by NABL accredited laboratories/weights of NPL traceability.

r) All precautions and control as specified in NTPC Technical Specification shall be taken care of during concreting. IS 456-2000 shall be applicable for acceptance of execution of concrete works & test results.

2.7.0 QA REQUIREMENTS FOR STRUCTURAL STEEL WORK

1. Physical and chemical properties of material as per relevant codes. Review of correlated Mill Test Certificates or check testing in absence of MTC.
2. Ultrasonic test on plates above 40mm as per ASTM A435.
3. Welding Procedure & Welders Qualification Test as per ASME Section IX/AWS D1.1
4. Fillet Welds:
   a) Check for size and visual examination.
   b) Microetch examination on production test coupons for main fillet welds with minimum one joint per built up beams, columns and crane girder etc.
   c) 25% weld length of tension member of crane girder shall be subjected to Dye Penetration Test.
   d) On all other fillet welds, DPT on 5% of weld length with minimum 300mm at each location shall be carried out.
5. Butt Welds:
   a) DPT on all butt welds after back gouging.
   b) Mechanical testing of production test coupons with minimum one joint per built up beam, column and crane girder.
   c) 100% radiography test on butt welds of tension flange (bottom flange) of crane girder. All other butt welds shall be subjected to Radiography test on 10% weld length of each welder. Wherever RT is not feasible, UT shall be carried out.
   d) Full penetration welds (other than butt welds) shall be subjected to Ultrasonic Testing in following quantum :
      i) 100% UT on web to flange joint of crane girder.
      ii) 10% UT on other full penetration joints.
6. Every 1st and further every 10th set of identical structure shall be checked for control assembly in shop before erection.
7. All structure components/members shall be checked for dimensional tolerances during fabrication and erection as per IS-7215 and IS-12843 respectively.
8. Check for Surface Preparation and Paint thickness.
9. In case of failure of any welds in SPOT RT/UT, the %age for retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.
10. Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specs. /approved WPS.

2.8.0 **PAINTING & ALLIED WORKS.**

1. Various materials used shall conform and be tested for the requirements of Indian/International Codes specified in the Technical Specification.
2. Surface to receive paint shall be made smooth.
3. Painting shall be checked for thickness of different coats as specified in schedule of items and the Technical Specification/Drawing.

2.8.01 **GALVANISING TESTS**

on galvanized structures shall be carried out as per IS: 2629 and IS: 2633.

2.9.0 **ARCHITECTURAL & MISC. WORKS**

1. Material used for floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in NTPC Technical Specification.
2. Finishes shall be checked for the following:
   - Level, Slope, Plumb
   - Pattern & Symmetry
   - Alignment of joints, dividing strips etc.
   - Colour, Texture
   - Surface Finish
   - Thickness of Paint
   - Details of edges, junction etc.
   - Performance
   - Precautions specified for durability.
3. For fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. The following checks shall be carried out.
   - Overall Dimensions
   - Mullions Transoms
   - Doors & Windows shall operate without jamming
   - Doors, windows & frames etc. shall be on a true plane, free from wrap or buckle.
   - All welds shall be dressed flush on exposed and contact surfaces.
   - Correctness of locations and smoothness of operation of all shop installed hardware and fixtures.
   - Provision of hardware & fixtures to be installed at site.
   - Glazing beads shall be cut with mitered corners.
   - Glazing clips, fixing devices etc. shall be supplied in adequate nos.
   - Shop coats shall be properly applied.
   - Exposed aluminium surface shall be free from scratches, stains and discoloration.

2.10.0 **QA REQUIREMENTS FOR ROAD WORK**

Quality Assurance and testing requirements for roadwork shall be as per IRC19/ relevant IRC codes.

1. Check for control of alignment and surface regularity.
2. Quality control tests during construction.
3. Tests on earth work for embankment and sub grade construction.
4. Tests on sub bases and bases (excluding bitumen bound base).
5. Tests on bituminous constructions (Bituminous works).

3.0.0 CONSTRUCTION TOLERANCE AND ACCEPTANCE CRITERIA

3.1.0 Excavation and Filling

Tolerance

Finished surface level shall be within 20mm of the level shown in the drawing.

Acceptance Criteria

Following acceptance criteria shall be followed.

a) When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation

b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation.

c) Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.

d) Tolerance on finished levels for important filling areas at approved interval shall be + 20mm. However, for an unimportant area, tolerance upto +75mm shall be acceptable at the discretion of the Engineer. However, these tolerances shall be applicable for localised areas only.Cast-in-situ concrete and Allied works

3.1.1 **Tolerances**

a) Cast-in-situ concrete

Unless otherwise specified, the tolerance in construction shall be as follows:

Description of Item / Structural element	Permissible Deviation in mm	
The dimensions of concrete as cast when compared with those on the drawings shall be within the tolerance given below:		
▪ Faces of concrete in foundations and structural members against which backfill is placed.	+ 25	- 10
▪ Eccentricity of footing	2% of footing width in the direction of placement but limited to 50mm.	
▪ Top surfaces of slabs and of concrete to receive base plates to be grouted.	+ 5	- 5

- Alignment of beams, lintels, columns, walls, slabs and similar structural elements. + 5 - 5
- Cross sectional dimensions of walls, slabs and similar structural elements. + 5 - 5
- Deviation from specified dimensions of cross-section of columns and beams. + 12 - 6
- Alignment of holding down bolts without sleeves + 1.5 - 1.5
- Alignment of holding down bolts with sleeves. + 5 - 5
- Level of holding down bolt assemblies. + 10 - 10
- Embedded Parts (in any direction). + 5 - 5
- Level of embeddment for equipment support +1.5 0
- Level of embeddment for other embedded parts + 5 - 5
- Centres of pockets or holes with greatest lateral dimension not exceeding 150mm. + 10 - 10
- Variation in steps:

  Riser + 1.5 - 1.5

  Tread + 3.0 - 3.0

(b) Reinforcement

Tolerance on placing of reinforcement and for cover shall be as per clause 12.3 of IS: 456.

Reinforcement shall be placed within the following tolerances:

a) For effective depth 200 mm or less ± 10mm

b) For effective depth more than 200 mm ± 15mm

Tolerance for cover

Actual concrete cover should not deviate from the required nominal cover by + 10 mm

(c) Pre cast concrete

Tolerance on dimensions of pre-cast units shall be as follows:

Length: +/- 0.1 percent subject to minimum of +/- 5 mm and maximum of + 10 mm.

Cross-sectional dimensions: +/- 3 mm or +/- 0.1 percent whichever is greater.

Straightness or Bow: 1/750 of the length subject to minimum of +/- 5 mm and maximum of +/- 10 mm.

Squareness: When considering the squareness of the corner the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm.

Flatness: The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm.

(d) Formwork and staging

(i) Staging shall be checked for its soundness as a whole and for adequacy of the joints and its foundations. Formwork joints shall be inspected for soundness of connections. All joints shall be either vertical or horizontal and shall be such as to avoid loss of liquid through the formwork.

(ii) Dimensional tolerance for formwork shall be as per Clause 9.6 of IS : 14687 and 11.1 of IS : 456, which is reproduced as given below:

Deviation from specified dimensions of : +12mm
Cross section of columns and beams : - 6 mm
Deviation from dimensions of footings :
1) Dimensions in plan: + 50mm - 12 mm
2) Eccentricity : 0.02 times the width of the footing in the direction of deviation but not more than 50 mm
3) Thickness : ± 0.05 times the specified thickness

The above tolerances apply to concrete dimensions only, and not to positioning of vertical reinforcing steel or dowels.

(iii) Checklist for formwork shall be as per Clause 9.9 of IS : 14687. Format as per Annexure-C of IS14687 shall necessarily be made for all important structures including all machine foundations.

3.1.2 **Acceptance Criteria**

(a) The acceptance criteria of concrete shall be in accordance with clause no.16 of IS : 456. However in exceptional circumstances, and that too in non-critical areas, the Engineer may accept concrete work which is marginally unacceptable as per the criteria

laid down in IS : 456. For such accepted work, payment shall be made at a reduced rate pro rate to the concrete cube strength obtained, against that stipulated.

(b) Unacceptable concrete work shall be dismantled by the Contractor and replaced by fresh work, meeting the specification requirements. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, by the Contractor, to the satisfaction of the Engineer, at no extra cost to the Owner.

(c) Test shall be conducted for the water tightness of the liquid retaining structures as per IS : 3370 and IS : 6494.

3.2.0 Fabrication and Erection of Structural Steel Work

3.2.1 Tolerances

I. Fabrication tolerances

All tolerances for below shall be as per drg / IS : 7215

(a) maximum permissible gap in built up members

(b) maximum permissible deviation in depth and/or width of girder at the joints

(c) maximum permissible out-of-square of flanges in built-up girders

(d) tolerances on length of beams and girders and their components

(e) permissible deviation in column heights

II. Erection tolerances

All tolerances for below shall be as per approved drg / IS : 12843

(a)permissible tolerances in erected steel columns

(b)permissible tolerances in erected steel trusses

(c)permissible tolerances in crane girder and rails

III. Requirement of pre-heating

Thickness of thickest part at the area of welding / heat affected zone	Welding using other than low hydrogen welding electrodes IS : 2062	Welding using low hydrogen welding electrodes or submerged arc welding IS:2062
Upto 20 mm (including)	None	None
Over 20 mm to 40 mm (including)	Not allowed	20^0 C

Over 40 mm to 63 mm (including)	Not allowed	66^0 C
Over 63 mm	Not allowed	110^0 C

3.2.2 **Acceptance Criteria**

(a) The acceptance criteria of Non Destructive Testing (NDTs) on welds shall be as per AWS D1.1 (Dynamically Loaded Structures - tension welds). In case of failure of any of the tests, the Contractor at his own cost shall also carry out rectification of such defective welds. Retesting of the rectified joint, shall also be carried out by the Contractor at his own cost.

(b) Every 1st and further every 10th set of identical structure shall be checked for control assembly in shop before erection.

Embedded part

The tolerances for embedded parts shall be as specified under concrete works.

3.3.0 **Masonry & Allied works**

3.3.1 Tolerances

(a) All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below:

i) Deviation in verticality in total height of any wall of a building more than one storey in height shall not exceed ± 12.5mm.

ii) Deviation from vertical within a storey shall not exceed ± 6mm per 3m height.

iii) Deviation from the position shown on the plan of any brickwork more than one storey in height shall not exceed 12.5mm.

iv) Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment shall not exceed 6mm.

v) Deviation of bed joint from horizontal in any length upto 12m shall not exceed 6mm, and in any length over 12m it shall not exceed 12.5mm total.

vi) Deviation from the specified thickness of bed-joints, cross-joints or perpends shall not exceed ± 3mm.

b) The **plastered surface** shall be checked for

i) Blistering, bond failure or loss of adhesion, cracking, crazing, efflorescence, grinning, irregularity of surface texture, popping or blowing, recurrent surface dampness, softness or chalkiness defects and the remedial measures for the same shall be adopted as per IS: 1661.

ii) The finished plastered surface shall not show any deviation more than 4 mm when checked with a straight edge of 2 metre length placed against the surface.

iii) The thickness of the plaster shall be measured exclusive of the thickness of key i.e., grooves or open joints in brickwork. The average thickness of plaster shall not be less than the specified thickness. The minimum thickness over any portion of the surface shall not be less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster. Extra thickness required in dubbing behind rounding of the corners at junctions of wall or in plastering of masonry cornices etc. shall be ignored.

3.3.2 Acceptance Criteria

Following acceptance criteria shall be followed:

- General workmanship is being good and as recommended by the manufacturer and approved by the Engineer.
- Tolerances are within the specified limit.
- Material test certificate is in compliance with the applicable codes/standards.
- Bought out material is from the approved manufacturer / vendor.
- Bought out material is matching with the approved sample.

3.4.0 Finishing & Allied works

3.4.1 Tolerances

a) The **floor finish** shall be checked specially for the following:

i.) Level, slope, plumb as the case may be

ii.) Pattern and symmetry

iii.) Alignment of joints, dividing strips etc.

iv.) Colour, texture

v.) Surface finish

vi.) Thickness of joints

vii.) Details of edges, junction etc.

viii.) Performance

ix.) Precautions specified for durability

Local depressions on account of faulty workmanship shall not be acceptable. Tiles / natural stones with cracked or broken/chipped edges shall not be acceptable.

b) **The door, window, ventilator, partition** during and after fitting and fixing etc shall be checked for the following:-

i) Installation shall be at correct locations, elevations and in general on a true vertical plane.

ii) Fixing details shall be strictly as shown on drawings.

iii) Assembly of composite units shall be strictly as per drawing, with mastic caulking at transoms and mullions, gaskets, weather strips etc. complete.

iv) All frames on external wall shall be mastic caulked to prevent leakage through joint between frames and masonry.

v) All openable sections shall operate smoothly without jamming. Lock, fasteners, etc, shall engage positively. Keys shall be non-interchangeable.

vi) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint or same quality as shop paint.

vii) Aluminium doors, windows, ventilators, partitions etc., shall be free from scratches, stains or discolouration.

viii) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm.

3.5.0 **For False ceiling/ Flooring system the following shall be checked for :-**

i) As installed shall be true to shape, level.

ii) Correctness for the opening for the fixtures, colour and shade.

iii) All joints shall be in the same line and cross joints shall be securely fixed to walls.

iv) There shall not be any sagging and/ or unevenness in the surface

3.5.1 Acceptance criteria

Ceiling panels shall be best quality material in thickness and properties called for in the specification /schedule of items. Material Test Certificate to be submitted before bulk supply.

Finished ceiling shall be at the correct plane and prevent an aesthetically pleasing and uniform appearance, free from sags and warps. Joints and exposed grids shall be in true

lines and symmetrically placed in manner as shown in drawings. Cut outs for light fixtures, diffusers and other relevant services shall be of exact dimensions and in exact locations.

3.6.0 **Water Supply, Drainage & Sanitation**

3.6.1 Tolerances

a) All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drain laid below ground shall be watertight.

b) Obstruction / Straightness Test

The obstructions shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight.

c) Service pipes testing with water

The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working condition of pressure and flow, when all draw off taps are closed. The service pipes shall be checked for satisfactorily support and protection from damage corrosion and frost.

d) Fixtures etc.

All fixtures and fittings shall be connected by watertight joints. No dripping of water shall be acceptable.

3.6.2 <u>Acceptance Criteria</u>

Following acceptance criteria shall be followed:

General workmanship is being good and is recommend by the manufacturer and approved by the engineer.

Tolerances are within the specified limit.

Material test certificate is in compliance with the applicable IS Codes.

Bought out material is from the approved manufacturer / vendor.

Bought out material is matching with the approved sample.

TYPICAL QA/QC LAB EQUIPMENT **ANNEXURE - I**

S.No	Equipment	Nos.
1	Vicat Apparatus with deskpot	1
2	Le chatelier flask	1
3	Le chatelier Mould	1
4	Cube Moulds for cement testing	6
5	Vibration Machine	1
6	Length comparator	1
7	Shrinkage Bar mould	1
8	Sieve shaker	1
9	Sieves for sand, coarse & fine aggregate	1 set for each
10	Sieves for coarse aggregate for Road	1 set
11	Proctor testing equipment	2 sets + 18 cores
12	Slump testing equipment	2 sets
13	Oven	2
14	Physical balance	1
15	Rapid moisture meter	2
16	Thermometer	1
17	Burret	2
18	Measuring cylinders	2
19	Measuring flasks	2
20	Compression testing machine	1 sets of 2000 kN capacity each
21	Cube moulds	18
22	Electronic balance	1 (12 kg capacity),1(200 mg capacity)
23	pH balance	As per requirement
24	Radiographic facilities(if required)	As per requirement, (Party should deploy BARC approved source/ manpower/technicians for carrying out RT)
25	Mechanical weighing machine	1 (100 kg capacity)
26	Ultrasonic testing machine(if required)	As per requirement
27	D.P. Test kit	As per requirement
28	Vernier 300 mm, 600 mm	2
29	Micrometer (0.25 mm) out side (25.00)	2
30	Radiography film viewer(if required)	1
31	Inside Micrometer 25-750 dia	1
32	Digital elcometer for paint thickness(if required)	1
33	Baking oven for electrode	1
34	Portable ovens	2

Note:

1. The equipments listed above are indicative and required to be mobilised as minimum requirement. Additional equipment if any, required for successful completion of work shall be provided /arranged by the contractor.

2. All test reports/ inspection reports have to be computerized and maintained on LAN with an access to the owner
3. Computers - 2 Nos shall be deployed with Windows operating system and connected to the NTPC server
4. Based on the schedule (L2/L3 Network), Quality control & Quality Assurance work plan shall be finalized by the contractor and the same shall be submitted to the engineer-in-charge for acceptance/approval. The Finalized work plan shall be maintained on the computer to be accessed by the owner for database and day to day monitoring.

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Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	D*	Remarks
1	2	3		4	5	6	7	8	9		10
1.0	EXCAVATION AND FILLING										
1.1		Nature of soil/rock	As required	B	Visual	Random	As per Contractors scheme for excavation/appd. Drg.		SR		
1.2		Initial ground level	Digital Total Station	B	Measurement	100%	-do-		SR		
1.3		Dimensions of excavated pit.	As required	B	Measurement	100%	-do-		SR		
1.4		Final pit/bed level.	As required	B	Measuement	100%	-do-		SR		
1.5		Side slope during excavation	As required	B	Measurement	Random	-do-		SR		
1.6		Excavation in Hard Rock.									
		a) Receipt & Storage of Explosive	-	A	Physical	100%	Indian Explosive Act 1940/all statutory norms		SR		Agency employed shall have to be approved from NTPC Site Engr. Incharge.
		b) Blasting Operation	Compressor / Drilling Machine	A	Physical	100%	IS:4081		SR		
1.7		Excavation in Hard Rock (Blasting Prohibited)	-do-	A	Physical	100%	As per approved drawing/ scheme		SR		
		LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA **Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR,TR,MfrTC, LB**						**DOC. NO.:**			
Sub-supplier	Main-supplier	**'A'** shall be witnessed by NTPC FQA, **'B'** shall be witnessed by ntpc erection / construction deptt. and **'C'** shall be witnessed by erection supplier (A & B check shall be NTPC CHP stage) **SR** = Site Register , **TR**= Test Report,**MfrTC** =Manufacturer's Test Certificate					For NTPC USE				
Signature		This document shall be read in conjunction with NTPC Tech. Specifications, BOQ & Drawings& FQP No.2.						REVIEWED BY	APPROVED BY		APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F2-RO

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1	2	3		4	5	6	7	8	9		10
1.8.0	FILL (SUITABILITY OF BORROW MATERIAL) these tests shall be carried out only when the soil is brough from outside the plant boundary area.										
1.8.1		Grain size analysis	Set of Seives, Hydrometer etc.	B	Physical	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV)		SR/TR		
1.8.2		Liquid & plastic limit	Mechanical liquid limit device, grooving tools, Evaporating Disc,Spatula, Palette knives, Balance oven containers, etc.	B	Physical	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV)		SR/TR		
1.8.3		Shrinkage limit	-do-	B	Physical	One in every 5000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV)		SR/TR		
1.8.4		Free Swell Index	Measuring cylinders, etc.	B	Physical	One in every 5000 cum for each type and source of fill materials	IS:2720 (Pt.XI)		SR/TR		
1.8.5 I		Chemical Analysis Organic Matter	Oven chemical balance, volumetric flasks, burettes, pipettes, conical flasks, set of seives, measuring cylinders etc.	B	Physical	One in every 5000 cum for each type and source of fill materials	IS:2720 Pt.XXII		SR/TR		
		LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR,TR,MfrTC, LB						DOC. NO.:			
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1	2	3		4	5	6	7	8	9	D*	10
ii		Calcium carbonate	Reagents and indicators,Burette,flasks,funnels etc.	B	Physical	One in every 5000 cum for each type and source of fill materials	Part XXIII of IS-2720		SR/TR		
iii		pH value	As required	B	Physical	-do-	Part XXVI of IS-2720		SR/TR		
iv		Total soluble sulphate	As required	B	Physical	-do-	Part XXVII of IS-2720		SR/TR		
1.8.6		Standard proctor Test to determine optimum moisture content and max.	As per IS: 2720, Proctor needle apparatus,etc.	A	Physical	One in every 2000 cum for each type and source of fill materials	IS 2720 (Pt.VII)		SR/TR		
1.8.7		Moisture content of fill before compaction	As per IS: 2720, balance, oven etc.	A	Physical	One in every 2000 cum for each type and source of fill materials	IS 2720 (Pt.II)		SR/TR		
1.8.8	**Degree of compaction fill**										
i		Dry density by core cutter method OR	As per IS: 2720/compaction test (core cutter), balance etc.	A	Physical	i) For foundation back fill one for every 10 foundations for each compacted layer.	IS 2720 (Pt. XXIX)		SR/TR		test for soil
		Dry density in place by sand displacement method	As per IS: 2720/compaction test ,sand replacement apparatus etc.	A	Physical	ii) For area filling, one every 1000 SQM area for each compacted layer.	IS 2720 (Pt. XXVIII)		SR/TR		test for soil
ii		Relative density (Density Index)	As per IS: 2720, balance oven etc.	A	Physical	-do- (i) & (ii) above	IS 2720 (Pt. XIV)		SR/TR		
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1	2	3		4	5	6	7	8	9	D*	10
iii		Dry Density by proctor needle penetration	As per IS-2720, proctor nedle apparatus etc.	B	Physical	Random checks to be carried out for each compacted layer	Standard practice		SR/TR		
1.8.9		Sand	As per IS-2720,383	B	Physical	Random	IS-2720 ,383		SR/TR		applicable where sand and stone is used as filling material
1.8.10		Stone	As per IS-2720,383	B	Physical	Random	IS-2720,383		SR/TR		
2.0	CAST-IN-SITU CONCRETE										
2.01	MATERIALS										
2.01.01	CEMENT										
		a) Ensure that cement is stored in weather tight covered storage on raised platform.	as per IS: 4082	B	Visual	100% covered storage	Covered storage, weather tight on raised platform.		SR/LB		Each consignment of cement shall be duly correlated with manufactureres TC,in case the cement is supplied by the contractor one sample from each lot shall be tested for stetting time and compressive strength . Acceptance norms shall be as per relevant IS
		b) If cement is stored more than 60 days in godown of contractor same shall be retested for comp. Strength & setting time.	Vicat Apparatus, standard sand compression testing machine etc.	A	Testing	At Random	As per relevant IS Codes		Test Report		
2.01.02-i)	Coarse Aggregate	Moisture content	.	B	Physical	Once for each stack of 100 Cu.M. or part there of Except during monsoon when this has to be done every day before start of concreting	IS:2386 Part-III IS : 456 IS : 383/Tech Spec		SR/LB		Accordingly water content of the concrete will be adjusted
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1	2	3		4	5	6	7	8	9		10
ii		Specific gravity, bulk density, voids, water absorption,	Balance, seives (conforming to IS:460-1962) etc.	B	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS:456, IS:383/Tech Spec		SR/LB/ Test Report		These tests will be carried out white establishing design mix and the results to be intimated to NTPC.
iii		Particle, size & Shape-(Sieve analysis, determination of material finer than 75 micron, flakiness index, elongation index, angularity number)	Seives, balance oven , thickness guage ,length gauge metal scoop etc.	B	Physical	One per 100 cum., or part thereof/change of source whichever is earlier	IS: 2386 Part-I, IS:383/Tech Spec		SR/LB		-do-
iv		Deleterious materials & organic impurities (determination of clay lumps, fine silt, fine dust , light weight pieces , soft particle & estimation of organic impurities.)	Balance, seives (conforming to IS:460-1962) etc.	B	Physical	Once per source/ on every change of source	IS: 2386 Part-II, IS:383/Tech Spec		SR/LB/ Test Report		Experts opinion regarding suitability of the aggregates shall be obtained from the specialist agency such as NCB BallbhGarh etc. finalised during preaward. Results will be reported nearest to 0.1% of clay lumps.
		LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA **Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR,TR,MfrTC, LB**						**DOC. NO.:**			
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1	2	3		4	5	6	7	8	9	D*	10
v		Soundness	reagents (sodium sulphate or magnesium sulphate)etc	B	Physical	-do-	IS: 2386 Part-V, IS:383		SR/LB/ Test Report		
vi		Alkali aggregate reactivity	scales, weight, sieves, glass graduates, mixing bowl, trovel, container, length comparetor, etc	B	Physical	-do-	IS: 2386 (Part-VII), IS:383 /Tech Spec		SR/LB/ Test Report		the quantity of dissolved silica , and reduction in alkalinity to be reported and hence the aggregate type(deleterious/innocuous)result should be supported by petrographic examination
vii		Petrographic examination	screens , hand lens, microscope etc	B	Physical	-do-	IS: 2386 Part-VIII, IS:383 /Tech Spec		SR/LB/ Test Report		Reporting of petrographic examination shall be done as illustrated in IS 2386 (part-VIII)-1963. petrographic report shall be supported by the analysis and recommendation by a specialist instute.
viii		Crushing value abrasion value and impact value	standard apparatus for these tests shall be used	B	Physical	-do-	IS:383, IS-2386 Part IV/Tech Spec		SR/LB/ Test Report		
		LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA **Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR,TR,MfrTC, LB**						DOC. NO.:			
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2.01.03	**Fine Aggregate**										
i		moisture content	balance , oven etc	B	Physical	To be done every day before start of work	IS: 2386 Part-III IS:383		SR/LB/TR		Volume of sand and weight of water shall be adjusted as per moisture content.
ii		Mortar making properties	As per IS Code	B	Physical	Once per source& for on every change of source	IS: 2386, IS:383		SR/LB/TR		
iii		Silt, Clay content and organic impurities	As per IS Code	B	Physical	Once per source& for on every change of source	IS: 2386 Part-II, IS:383		SR/LB/TR		Acceptance limit as per relevant IS code
iv		All other tests similar to coarse aggregates as mentioned above.		B		Refer S.No. 2.01.02	IS-2386, IS-383		SR/LB/TR		
2.01.04	**Water**										
i		Test for acidity & alkalinity by using neutralization of water using indicator,and check for sulphateand chloride content.	Buret, conical flask, pipette etc	B	Testing	One per month for each source.	IS:3025 part 22 and 23 (for test procedure), IS:456(for acceptance criteria)		SR/LB/TR		100 ml of water should not require more than 5 ml .02N NaOH (using Phenolphthaline indicator),and 25 ml of .02N Sulphuric acid,
ii		Tests for ascertaining limit of solids	As per IS Code	B	Physical	One per month for each source.	IS:3025 part 18 (organic),IS:456		SR/LB/TR		-do-
iii		Tests for pH Value	pH meter	B	Testing	One per month for each source	IS:3025, IS:456		SR/LB/TR		
iv	Check for initial set time for used water and distilled water	vicat appratus			Test	Once per source					Initial set time with used water should not be less than that with distilled water. This check is to be carried out only if the results of the tests mentioned at sl. no. 2.01.04 i),ii)& iii) mentioned above
		LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA **Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR,TR,MfrTC, LB**						DOC. NO.:		
Sub-supplier	Main-supplier	**'A'** shall be witnessed by NTPC FQA, **'B'** shall be witnessed by ntpc erection / construction deptt. and **'C'** shall be witnessed by erection supplier (A & B check shall be NTPC CHP stage) **SR** = Site Register , **TR**= Test Report,**MfrTC** =Manufacturer's Test Certificate					For NTPC USE			
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v	Check for Concrete compressive strength with used water and distilled water	standard sand and compression testing machine			Test	Once per source					This check is to be carried out only if the results of the tests mentioned at sl. no. 2.01.04 i),ii)& iii) mentioned above
2.02.01	**Concrete**										
i		Workability - slump test	Standard appratus for different method used for measuring workability	B	Physical	One sample every 2 hrs. from every mixing plant	IS:456/NTPC Tech. Spec.		SR/LB/TR		Slump test for medium and high workability, Compaction factor test for medium and low workability, V.B. test for low to Very low workability
ii		Trial mix (Cubes compressive strength) Mix Design	As required	A	Physical	Min. 4 Trial Mixes with admixtures and Without admixtures With fly ash.	IS: 516 & IS:456, IS:10262/ NTPC Tech. Spec.		SR/LB/ Test Report		For trial mix min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength. Mix design shall carried out at agency finalised during pre award)
iii		Compressive strength (works Tests cubes)	As required	A	Physical	As per IS 456	IS:516, IS:456, NTPC Tech. Spec.		SR/LB/ Test Report		Min. of 6 cubes for each sample, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength.
iv		Water cement ratio	Chemical Reagent, Buret, Conical flask,	B	Physical	At random at the time of batching.	As per IS:1199 and approved design mix.		SR/LB		
v		Cement content	As required	B	Physical	At random at the time of batching.	IS:1199 and approved design mix.		SR/LB		
vi		Admixtures for Concrete	As per IS Code	B	Testing	100%	IS:456 and appd. Design mix.		Test Report		Admixture of appd. Brand and tested quality shall be used.
vii		Water Tightness Test for Water Retaining Structures	As per IS Code	B	Test	100%	IS:3370 (Tanks and Revision)		Inspection Report		
viii		Dimensions and visual examination of finished structure	-do-	B	Physical	100%	As per Tech. Specification./Appd. Drg./IS-456		-do-		
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2.02.02	**Concrete conveying, placing& compaction**										
i	Mixing of concrete	mixing of concrete shall be done in a approved mixer such as to produce a homogenous mix				To be calibrated at the time of starting and subsequently once in three months, and shall confirm to IS:4925	Review of calibration chart/ Certificate, IS 457			√	time of mixing will be as given in IS 457
iii		Handling and Transportation of concrete	buckets,chutes,belts,conveyer etc	B	Physical	100%	as per construction/erection methodology		SR		Free fall or drop shall be limited to 150 cm unless permitted concrete should be placed within 30 min of its removal from mixure . Construction methodology to be approved one week prior to start of work.
iv		Placement of concrete	Visual	B	Physical	100%	as per construction/erection methodology as per tech.specs		SR		No concrete shall be placed until the place of deposit has been throughly inspected and approved, the concrete shall be deposited in such a manner to maintain, until completion of unit, a plastic horizontal surface throughout
vi		Check for placement	visual	B	Physical	100%	As per approved construction methodology		SR		if water accumulates at surface due to bleeding or other causes taking place concreting shall be stoped as far as possible, for reconsideration of mix design, accumulated water shall be removed by sponge, in no case the such accumulation of water shall be covered with concrete, or dry concrete
vii		Compacting	As required	B	Physical	At Random	Check for segregation as per IS 456		SR		
viii		Curing	As required	B	Physical	At Random	Check for period of curing as per IS 456		SR		Exposed concrete surface shall be protected against heating and drying for atleast 72 hrs after placement, curing compound may be used
ix		Cleanliness, provision of chute and arrangement for transportation & placement of concrete.	As required	C	Visual	100%	Before clearance for concreting		Inspection Report		
x		check for segregation	As required	C	Visual	100%	Tech Spec/Relevant IS , IS :456				
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2.02.03	TEST/CHECK ON RCC STRUCTURE IN HARDENDED CONDITIONS										
iii		Dimensional check on finished structures & Dimensional tolerances	As required	B	Measurement	Approved Drawing	As per IS:456/ tech. Specification.		SR/LB		
v		Rebound Hammer test	As required	A	physical	as required by the NTPC engineer	As per relevant / tech. Specification.		SR/LB		
2.03	REINFORCEMENT STEEL										
i		Physical and Chemical Properties for each lot as per relevant IS codes	As required/ agreed	A	Review of TCS	Each consignment	IS : 1786, IS:432, IS:1566		Mfr. TCS		Tested steel to be supplied by NTPC. In the absence of manufacturer's test certificate testings shall be carried out. Consignment shall be considered in lots of 50MT
ii		Cutting tolerance	As required	B	Measurement	At Random	IS : 1852, IS: 432, IS:1786		SR/LB		Tolerance as per specifications
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iii		Freedom form cracks surface flaws, Lamination. (Visual Examination).	As required	B	Visual	100%	IS: 1852, IS:432, IS:1786		SR/LB		To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.
2.03.01	**Placement of Reinforcement Steel**										
I		Check for bar bending schedule with necessary laps. Spacers & Chairs	As required	B	Visual & Measurement	100%	Approved Drawings		SR		
ii		Check for cover, spacing of bars	As required	B	Visual & Measurement	100%	Approved Drawings		SR		
iii		Check for bending of bars	As required	B	Visual & Measurement	100%	Approved Drawings		SR		
iv		Check for spacers and chairs after the reinforcement cage is put inside the formwork	As required	B	Visual & Measurement	100%	Approved Drawings		SR		
v		Lapping of bars	As required	B	Measurement	100%	IS : 456/ Drawings & approved bar bending schedule		SR		
vi		Check all joints, Crossing	As required	B	Visual	Random	Approved drawing/bar bending schedule		SR		
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2.04	STAGING AND FORMS										
2.04.01		Materials and accessories	As required	B	Visual	Once	As per relevant IS		SR		Proper care should be taken in order to combat corrosion. Proper care should be taken while cleaning, moving and stacking the scaffolds
i		Soundness of staging, shuttering and scaffolding	As required	B	Visual	Once	As per manufacturer's spec.and as per 3696,4014, 4990		SR		
ii		Plywood for concrete shuttering work (Moisture content, glue adhesion in dry state, water resistance test)					IS 4990:1993, IS 1734; (Part 1 -11)				Manufacturer will supply technical data (type of addhesive used , type of preservative used, density of plywood species of timber etc.) and recommended method of use and loading
iii		Connection between individual scaffolding units and safe slenderness ratio. Two independent safety measures against collapse	As required	B	Visual	Fortnightly	As per National Safety council & relevant IS Codes I.e. IS:14687& IS:3696		SR		
iv		Concrete strength during climbing process.	As per IS provision	B	Physical Testing	For each lift of shuttering	As per provisions and tolerances		SR		
v		Hoisting for personnel and materials	As required	B	Visual	Fortnightly	As per manufacturer recommendation & safety codes		SR		
vi		Alignment/Shape	As required	B	Measurement	For each lift of shuttering	As per approved drawings		SR/LB		
vii		Check form's seam marks and water tightness	As required	B	Physical	Random	As per approved drawings		SR/LB		
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2.05	**Embedded part(including laying of rails &anchor fasteners)**										
i		Position and level of embedded parts	As required	B	Dimensional	100%	As per drawing/ Technical Specifications.		SR		Exposed surfsce of the embeded parts other than holding down bolts are to be painted with primer ,chlorinated , rubber baed zinc phosphate
ii		Position depth and size of bolt hole	As required	B	Dimensional	At random	As per drawing/ Technical Specifications.		SR		
iii		Location verticality of pipe sleeve/opening of bolt hold	As required	B	Dimensional	At random	As per drawing/ Technical Specifications.		SR		
iv		Welding / tieing of embeddment to reinforce-ment	As required	B	Dimensional	At random	As per drawing/ Technical Specifications.		SR		
2.06	**Pre-cast concrete**										
i		crushing strength	compression strength testing machine	A	Physical	one sample of six cubes per 50m m3 or part thereof	6:516&IS; 456		SR/LB		a minimum of three specimen shall be tested for 28 days comp. strength
ii		Workmanship free from visual defects	Visual	B	Physical	100%	Tech. Spec.		Register		The precast units shall be free from defects like honeycombing, reinforcement exposure and should have good finish. All relevant tests like workability, cube test shall be carried out as per IS 456-2000 Same as applicable to cast in situ concrete.
iii		Dimension of finish structure	As required	B	Measurement	100%	As per IS:456/NTPC Tech. specification.		SR		If the material already tested of the cast-in-situ concrete and part of the same is used for precast concrete, further testing is not required, otherwise testing is required for every 50 Cum. Of Concrete.
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iv		Load Test	As required	B	Physical	5% at random or as decided by NTPC E-I-C.	IS:456/ As decided by NTPC Site Engr. Incharge.		Inspection Report		These tests shall also be carried out, in case of doubt regarding grade of concrete and poor quality.
v		Workability	slump test apparatus	B	Physical	one sample every two hrs from mixing plant	IS:1199 &IS:456		SR/LB		According to the mix design
vi		Water cement ratio	As required	B	Physical	At random	IS:1199		SR/LB		According to the mix design
vii		Cement content	As required	B	Physical	At random at the time of batching	IS:1199 /tech spec				According to the mix design
3.00	**Brick Masonry & allied works**										
3.01 i)		Brick Masonry Test on Bricks									
		Dimensions, colour,	As required	A	Measurement/ Physical Test	As per relevant IS Code/ One Sam ple for 30,000 Nos. or part thereof	IS: 1077,		Inspection Report	√	Efflorescence shall be checked at each source.
		compressive strength, water absorption, warpage efflorescence.	Balance Oven compression testing machine etc.				IS: 1077, IS:3495 part I (Compressive Strength) Part II (Water Absorbtion) Part III(Efflorescence) Part IV (War page)			√	Preconditioning of brick shall be done as per IS. For comperssive strength, warpage and water absorbtion
ii)		Test on Mortar Compressive strength, consistency and water retentivity for each portion of walls, plasters and ceilings.	As required	B	Test	At random	IS 2250-1981		-do-		Cement used in mortar shall confirm to either IS 269: 1976 or IS 455- 1976 sand shall confirm to IS 2116 -1980
iii)		Masonry construction Workmanship, verticality and alignment	As required	B	Visual/ Physical	100%	IS 2212, IS 1905 As per Technical Specifications		SR/LB		
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4.00	FINISH ITEMS										
4.01	Plastering										
i)		Check for defects and the remedial measure for bond filler , blistering , cracking and crazing , efflorescence and irregularity of surface texture	As required	B	Visual/ Physical	at random	As per Tech. Specs./relevent code		SR		
il)		Truness of plastering system	As required	B	Visual/ Physical	at random	As per Tech. Specs./relevent code		SR		finished plaster surface shall not show any deviation more than 4 mm when checked with straight edge of 2 m length
iii)	Materials- Fine sand Sand for Plastering	General quality	As required	B	visual	one per 100 m3 or part there of or change of source whichever is earlier	As per Tech. Specs./relevent code,Cl. 6.3.4 of IS:1905		SR		
a)		Deleterious Material	As required	B	Physical	-do-	As per Tech. Specs./relevant code, IS : 2386 (Part-I &II) & IS :2116		SR		
b)		Grading	As required	B	Physical	50 Cum./or part thereof	IS:3150,1542& Apprd. Drgs		SR		Table –I of IS:2116
c)		Galvanized hexagonal wire netting for lath plastering	As required	B	Review of Mfr.T.C.	100%	As per Tech. Specs./relevent code,		-do-		
iv)		Ensure that the plastering of brick walls shall be of min. 18mm thick for outside & 12mm for inside face	Steel Tape	B	Visual/ Measurement	100%	As per IS 1661 /Technical Specifications/approved drawings		SR/LB		finished plaster surface shall not show ant deviationmore than 4 mm when checked with straight edge of 2 m length
v)		Ensure that the plastering of concrete ceiling 6mm thick (min.) mortar	Steel tape	B	-do-	100%	-do-				
vi)		Ensure that the curing of plastering surface are carried out for 7 days (Min.)		B	Visual	100%	-do-		-do-		
vii)		plaster of paris		B	Physical	50 Cum./or part thereof	As per IS : 2547/ IS 2333/tech :1542 spec				

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5.00	GROUTING										
5.01		Grouting pressure	Test Set Up	B	Physical	At Random	Approved drawings		SR		Random to be checked by FQA
5.02		Composition of grout		B	Physical	Each Lot/ Batch	As per manufacturer's technical specifications		SR		
5.03		compressive strength	Test set up	A	Test	Each Lot/ Batch	NTPC tech. Specifications		SR/TR		
6.00	Bought out Items										
a		All bought out items to be procured from the approved vendor and on approval of Quality plans by NTPC	-	B	Verification of TC and/or Testing	100%	NTPC Tech. Spec. /BOQ		SR/LB		The TC submitted should bear proper identification or correlation with the batch of material supplied and same shall be brought out in the challan/ consignment note .
b	Submission of list of Bought out items and their vendors for each of the bought out item identified ,for approval within the period agreed , in LoA.		-	A	Physical	One time					To be submitted to CQA for approval with a copy to site .
		LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA **Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR,TR,MfrTC, LB**						**DOC. NO.:**			
Sub-supplier	**Main-supplier**	**'A'** shall be witnessed by NTPC FQA, **'B'** shall be witnessed by ntpc erection / construction deptt. and **'C'** shall be witnessed by erection supplier (A & B check shall be NTPC CHP stage) **SR** = Site Register , **TR**= Test Report, **MfrTC** = Manufacturer's Test Certificate					**For NTPC USE**				
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1	2	3		4	5	6	7	8	9	D*	10
7.00.00	**Anti weed treatment**										
		anti weed treatment before gravel filling	As required	B	Visual	100%	NTPC Specification		SR/LB		
		Procurement of soil sterlization chemical	As required	B	Visual	100%	NTPC Specification		SR/LB		
8.00.00	**RCC PIPES**										
8.01.00	**Tests at Manufacturer's Works**										
8.01.01		Hydrostatic Test	As required / agreed	A	Physical	As per IS 458	Testing Procedure as per IS 458		IR/TC	√	Frequency of sampling & testing procedure and acceptance norms as per IS 458
8.01.02		Absorption Test	As required / agreed	A	Physical	As per IS 459	Testing Procedure as per IS 459		IR/TC	√	
8.01.03		3 Edge Bearing Test	As required / agreed	A	Physical	As per IS 460	Testing Procedure as per IS 460		IR/TC	√	
8.01.04		Straightness Test	As required / agreed	A	Physical	As per IS 461	Testing Procedure as per IS 461		IR/TC	√	
8.01.05		Dimensional Check & Visual Inspn.	As required / agreed	A	Physical	As per IS 462	Testing Procedure as per IS 462		IR/TC	√	
8.02.00	**Checks at site**										
8.02.1		Check for Laying and Jointing	As required / agreed	B	Visual	As per IS 783	As per IS 783 & NTPC Tech. Spec		IR/TC	√	
9.00.00	**ROAD WORKS : ALL TESTS AS PER IRC19/ RELEVANT IRC CODES.**										
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10.00.00	STRUCTURAL STEEL WORKS										
10.01.00	Material	i) Physical and Chemical Properties of Material	As required/ agreed	A	Review of MTC/ TR	Once per each Lot	Manufacturer's TC or Laboratory Test Report, Technical Specification		MTC/TR	√	Review of co-related Mill Test Certificates or check testing in absence of MTC.
		ii) UT on Plates 40 mmand beyond thick	NDT	A	Review of MTC/ TR	Each plate	UT report. As per ASTM A435		SR	√	UT to be carried out by L2 qualified personnel
10.02.00	Welding	i) Welding Procedure and welder qualification test	As required/ agreed	A	WPS	Before start of welding	As per ASME Section IX/AWS D 1.1		SR	√	As per requirement of NTPC Engineer
		Fillet Welds i). Check for size and visual examination	As required/ agreed	B	Measurement	Random	As per technical specifications and construction drawings		SR	√	As per requirement of NTPC Engineer
		ii). Microtech Examination on production test coupons	As required/ agreed	B	Physical	Main plate weld with min one joint per built up beam, columns and crane girders	As per technical specifications and construction drawings		SR	√	-Do-
		iii). Dye Penetration Test - Crane Girder	As required/ agreed	B	Physical	25% weld length of tension member of crane girder	As per technical specifications and construction drawings		SR	√	-Do-
		iv). Dye Penetration Test - Except Crane Girder, other Fillet Welds	As required/ agreed	B	Physical	5% of Weld length with min. 300mm per loaction	As per technical specifications and construction drawings		SR	√	-Do-
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		Butt Welds									
		i) Visual examination	As required/ agreed	B	Visual	100%	As per technical specifications		SR	√	As per requirement of NTPC Engineer
		ii) DPT	As required/ agreed	B	Physical	100%	As per technical specifications		IR	√	All butt welds to be back gouged before DPT
		iii) Mechanical testing	As required/ agreed	B	Physical	Min. one joint per built up beams, coloums and crane girder.	As per technical specifications and construction drawings		IR	√	Test on production test coupons
		iv) Radiography Test	As required/ agreed	A	Physical	100% radiography test on butt welds of tension flange (bottom flange) of crane girder. All other butt welds shall be subjected to 10% weld length of each welder.	As per technical specifications and construction drawings		IR	√	Wherever RT is not feasible UT to be carried out.
10.03.00	Other Full Penetration Welds	i). Ultrasonic Testing	As required/ agreed	A	Physical	i) 100% UT on the web flange joint of crane girder ii) 10% UT on other full penetration joints	AWS D 1.1 and Technical Specifcations		IR	√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular loaction. Acceptance criteria of NDT on welds shall be as per AWS D1.1.
	Fabrication and erection of structures	i) Check for Shop Assembly in shop before erection	As required/ agreed	A	Measurement/ Visual	1st and 10 th set of identical structure shall be checked for control assembly at shop.	As per technical specifications and construction drawings		IR	√	
		ii) Dimensional Tolerances	As required/ agreed	B	Measurement/ Visual	All Structures	As per IS 7215 and IS 12843		IR	√	
		iii) Erection , Alignment & Levelling	As required/ agreed	B	Measurement/ Comparison	As required by NTPC engineer	As per technical specifications and construction drawings		IR	√	
11.00.00	**PAINTING AND ALLIED WORKS**										
		a) Check for the Materials	As required/ agreed	A	Review of MTC	Each Lot	As per Technical Specifications and approved drawings		MTC	√	
		b) Preparation of the Surfaces (SA 2 1/2)	As required/ agreed	B	Physical	random	As per Technical Specifications and approved drawings, BS		SR/LB	√	
		c) Application of Paint	As required/ agreed	B	Physical	Random in Each Shift	As per Technical Specifications		SR/LB	√	
		d) Check for DFT and no of Coats	As required/ agreed	B	Physical	Random in Each Shift	As per Technical Specifications and approved drawings		SR/LB	√	
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12.00.00	**FENCING AND GATES**										
i)	Materials			B	Review of Mfr. T.C	once per lot	Tech Specs./Relevant IS	Apprd. drgs	SR/MTC		Mfr.'s T.C. shall be correlated with the consignment received.
ii)	Workmanship	As Required		B	Visual / Physical	100%	-do-	Apprd. drgs	SR		Erection shall be as per NTPC Tech. Specs
iii)	Verticality & Alignm	As Required		B	Physical	100%	-do-	Apprd. drgs	SR		
13.00.00	**WATER SUPPLY - Drainage & sanitation**										
13.01.00	**Viterous China sanitary appliances (Water closets, Wash basins, urinals)**										
13.01.01		Surface finish, freedom from cracks and other defects.	As required	B	Visual as per IS 2556 (Pt. 1)	Each	As per Technical Specification		SR/LB		a)Tolerance limit as per IS 2556 (Pt. 1) b) Make size and colour shall be as per approved drawing and shall be of 1st. Quality.
13.01.02		Dimensions and construction	As required	B	IS 2556 (Relevent part)	10% subject to minimum 3 nos. each type of appliance.	As per Technical Specification		SR/LB	√	Tolerance limit shall be as per relevant part of IS: 2556
13.02.00	**Pantry Sink**										
13.02.01		Material Grade	As required	B	Visual as per MTC	Each	As per Technical Specification		MTC	√	Make size and colour shall be as per approved drawing
13.02.02		Dimensions and construction	As required	B	Physical	As desired by Engineer	As per Technical Specification		SR	√	-
03.02.03		Surface Finish	As required	B	Physical	As desired by Engineer	As per Technical Specification		SR	√	-
13.03.00	**Photo Voltaic Control System**										
13.03.01		Make and size	As required	B	Visual as per MTC	Each	Relevant Is Codes		TC	√	Make size and colour shall be as per approved drawing. Tolerance limit shall be as per relevant IS Codes.
13.04.00	**Misc. Sanitary fittings**										
13.04.01		Matrerials & finish dimensions	As required	B	Visual / Physical	10% subject to minimum 3 nos.	IS 2556 pt 1and Tech Specification		TC	√	
13.04.02		Powder coating thickness	As required	B	Visual / Physical	10% subject to minimum 3 nos.	Make colour and drawing shall be as per approved drawing		SR	√	
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13.05.00	**Cast Iron Pipe fittings**										
13.05.01		Surface finish	As required	B	Visual / Physical	10% subject to minimum 3 nos.	Technical Specification and Relevant IS Codes	SR		√	Tolerance limit as per applicable Is code (IS: 1729, 1536)
13.05.02		Hammer test	As required	B	Test	10% subject to minimum 3 nos.	Technical Specification and IS 1729	SR		√	
13.05.03		Leakage Test	As required	B	Test	10% subject to minimum 3 nos.	Technical Specification and IS 1729, IS 1230 IS 1537	SR		√	Pipes shall be capable of withstanding at least 1 5 sec an internal hydrostatic pressure of 0.7 kg/cm^2
13.05.04		Dimensions & Class	As required	B	Visual / Physical	10% subject to minimum 3 nos.	Technical Specification and Relevant IS Codes	SR		√	
13.06.00	**Concrete Pipe**										
13.06.01		Surface finish	As required / agreed	B	Visual IS : 458	Each 5% of each lot	Technical Specification and Relevant IS Codes	SR		√	Tolerance as per relevant IS codes
13.06.02		Dimensions & Class	As required / agreed	B	Visual IS : 459	Each 5% of each lot	Technical Specification and Relevant IS Codes	SR			
13.07.00	**Overhead/Loft tank**										
13.07.01		Capacity	As required / agreed	B	Visual as per specification	Each	Technical Specification and Relevant IS Codes	SR			a) Tolerance as per relevant Is codes
13.07.02		Water tightness	As required / agreed	B	Leakage test as per specification	Each	Technical Specification and Relevant IS Codes	SR			b) Make size and colour shall be as per approved drawing.
13.08.00	**After installtion a) Water pipes and fittings b) Drain and sewer pipes**										
13.08.01		Hydraulic Pressure Test and flow	As required / agreed	B	Physical	Each Streach	IS 2065	SR		√	a) Make size and colour shall be as per approved drawing.
13.08.01		Air, Smoke water and straightness test	As required / agreed	B	Physical	Each Streach	Technical Specification and Relevant IS Codes	SR		√	b) Tolerance as per relevant Is codes
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14.00.00	FOUNDATION SYSTEM										
14.01.00	Open / Shallow Foundation										
14.01.01		Check for the foundation excavation - Location, Layout, size, depth etc	As required / agreed	B	Physical	Each location	As per technical specifications and construction drawings		SR	√	lines and levels to be checked
14.01.02		Check for the foundation casting - Layout, Shape, dimensitions, Reinforcement, concreting, curing etc	As required / agreed	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
14.02.00	Pile Foundation										
14.02.01		Check for Piling Layout,	Theodolite	B	Measurement	100%	As per technical specifications		SR	√	
14.02.02		Check for Lines and Levels	As required / agreed	B	Measurement	Each pile	As per technical specifications and construction drawings		SR	√	
14.02.03		Boring, Cleaning/Flushing of Piles	As required / agreed	B	Visual	Random	As per IS 2911		SR	√	
14.02.04		Check for Size and termination of boreholes	As required / agreed	B	Physical	Each borehole	As per technical specifications and construction drawings		SR		
14.02.05		Check for pile casting - reinforcement, concreting etc	As required / agreed	B	Physical	Each pile	As per technical specifications and construction drawings		SR	√	
14.02.06		Pile Termination level	As required / agreed	A	Soil data	Each pile	As per technical specifications		SR	√	
14.02.07		Check for Pile Caps - Lines, levels, shape, size, reinforcement, concreting, curing etc.	As required / agreed	B	Physical	Each pile cap	As per technical specifications and construction drawings		SR		
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14.03.00	Tesing :										
14.03.01		Check for Bentonite	As required / agreed	B	Physical	Once per each Lot	As per technical specifications		SR / LB	√	
14.03.02		Collection and testing of mud sample from bottom of pile bore	As required / agreed	B	Physical	Each pile	As per technical specifications and and relevant IS code		SR / LB		
14.03.03		Check for Slump test of concrete, cube Test (work test cubes)	As required / agreed	B	Physical	As per above for concrete works	As per technical specifications and and relevant IS code		SR / LB	√	
14.03.04		Initial pile load test, Vertical (compression), Lateral (horizontal) and pullout (tension)	Calibrated dial gauges, Jacking system as required	A	Testing	As specified in technical specifications	IS 2911 & as per Tech Spec.		SR / LB	√	
14.03.05		Routine pile test, Compression and horizontal	Calibrated dial gauges, Jacking system as required	A	Testing	As specified in technical specifications	IS 2911 & as per Tech Spec.		SR / LB	√	
14.03.06		Pile Integrity Test	NDT	A	Testing	Each pile	As per technical specifications and and relevant IS code		Test Report	√	Draft/interim report tobe submitted at site along with plots
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