PART – B

QA ELECTRICAL

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SUB-SECTION–E-35

CABLING, EARTHING, LIGHTNING AND PROTECTION

QUALITY ASSURANCE & INSPECTION MODULE NO. SQE-16

CABLING, EARTHING, LIGHTNING PROTECTION

ATTRIBUTES / CHARACTERISTICS / ITEMS/COMPONENTS / SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per NTPC
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y		Y	Y	Y	Y	Y
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Cable glands(BS-6121)	Y													Y
Cable lug	Y													Y
Lighting wire (IS-694)	Y											Y		
Flexible conduits	Y											Y		Y
Conduits (Galvanise & Epoxy) IS-9537 & IS-2629, 2633, 6745	Y		Y						Y			Y		Y
RCC Hume Pipe (IS-458)												Y		
Cable termination & straight through joint (IS 13573)	Y											Y		Y
Cable Trays, bends, tees, crosses, Flexible supports system & accessories IS-513, 2629,2633,6745	Y		Y		Y	Y	Y		Y			Y	Y	Y
Trefoil clamp	Y													Y
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)	Y		Y						Y			Y		Y
GI wire (IS-280)	Y											Y		
Fire Sealing System (BS –476)												Y	Y	Y

.Note:1.This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2.* Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the NTPC technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot. This test is not applicable on bends, tees & crosses.

3. Make of all items will be subject to NTPC approval.

SUB-SECTION–E-46

HT LINES

HT LINES

SQE_24

Attributes / Characteristics Items/Components Sub Systems	Make, Type Rating, Model, TC & General Inspection	Routine & Acceptance Test as per relevant Standard	As per NTPC Technical Specification
Galvanized Steel Structure (IS:2633 / 2629 / 6745 / 802)	Y	Y	
Disc/String/Pin Insulator (IS:3188 / IEC:305 /575)	Y	Y	
Rail Pole (IRS:90L)	Y	Y	
Steel Tubular Pole (IS:2713)	Y	Y	
ISMC Channel/Angle/Flat (IS:2062)	Y	Y	
Hardwares (IS:1367)	Y	Y	
Hardwares for Insulator (IS:2486)	Y	Y	
Conductor (IS:398-P-II)	Y	Y	
Strain / Porcelain Insulator (IS:5300)	Y	Y	
Earth wire	Y		Y
Suspension/Tension clamp for Earth wire (IS:398-P-II)	Y	Y	
Danger Plate (IS:2551)	Y	Y	
GI Flat /GI Strip (IS:2629 / 2633 / 6745)	Y	Y	Y
Vibration Damper (IS:9708)	Y	Y	
Stay Set (IS:2141)	Y	Y	Y
Primer (Etch) (IS:5666)		Y	Y
Zinc Paint			Y
Anti Climbing Device			Y
M.S. Rod (IS:7887)			Y

Notes :
1) This is an indicative list of Test/Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2) All major Bought Out Items will be subject to NTPC approval.

SUB-SECTION–E-54

SWITCHYARD

SWITCHYARD **SQE_20**

Attributes / Characteristics / Items/Components Sub Systems	Make, model, Type & Rating, Test Certificate	Routine & Acceptance Test as per IS / IEC	Functional requirements as per NTPC Specification
765 KV GIS (IEC:62271-203)	Y	Y	Y
132 KV GIS (IEC:62271-203)	Y	Y	Y
Capacitor Voltage Transformer (IEC:186A / 358/IS3156/IEC60044/ IEC: 61869)	Y	Y	Y
Bus Post Insulator (IEC:168 / 815 / IS:2544)	Y	Y	Y
Disc, Pin & String Insulator (IEC:383 / IS:731)	Y	Y	Y
Long Rod Insulator (IEC:433)	Y	Y	Y
Surge Arrestor (AIS) (IEC:99-4/IS:3070)	Y	Y	Y
Hardware fittings for Insulator (IS:2486 / BS:3288)	Y	Y	Y
Spacers, Clamps & Connector (IS:10162 / 5561/ 617)	Y	Y	Y
Aluminium Tube (IS:5082 / 2673 / 2678)	Y	Y	Y
Wave Trap (IEC:353 / IS:8792 / 8793)	Y	Y	Y
Conductor (IS:398)	Y	Y	Y
Galvanised Steel Structures (IS:2062/2629/4759/6745)	Y	Y	Y
Vibration Damper (IS:9708)	Y	Y	Y
Sag Compensating Spring DIN:2089/2096 IS:3195 / 7906	Y	Y	Y
Control & Relay Panel / SAS	Y	Y	Y
SF6 Gas filling & evacuating plant	Y	Y	Y
SF6 Gas Leak Detector	Y	Y	Y
Leakage Current Analyser	Y	Y	Y
Nitrogen Gas Filling Device	Y	Y	Y
Protection Relays	Y	Y	Y
Event Logger	Y	Y	Y
Operation Analyser	Y	Y	Y
Disturbance Recorder	Y	Y	Y
Tariff Metering System	Y	Y	Y
Synchronising Trolly	Y	Y	Y

Attributes / Characteristics / Items/Components Sub Systems	Make, Type Rating, and Model, Test Certificates	Routine & Acceptance Test as per relevant IS/IEC	Functional requirements as per NTPC Specification
Relay Test Kit	Y	Y	Y
Lighting Panels	Y	Y	Y
Surge Monitor	Y	Y	Y
Energy meter	Y	Y	Y

Notes : 1) This is an indicative list of test/checks. The manufacture is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during QP finalisation for all items.

2) All major Bought Out Items will be subject to NTPC approval.

PART – B

QA CIVIL

PART – B QUALITY ASSURANCE (CIVIL)	
E-74	CIVIL WORKS

SUB-SECTION – E-74

CIVIL WORKS

QUALITY ASSURANCE AND INSPECTION 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.

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 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 of the technical specifications. The QA and QC activities in all respects as specified in the technical specifications/ drawings / data sheets / quality plans / contract documents shall be carried out at no extra cost to the NTPC.

1.4.0 The contractor shall prepare detailed construction and erection methodology scheme which shall be compatible to the requirements of the desired progress of work execution, quality measures, prior approvals if any and the same shall be got approved by the Engineer. If required, work methodology may be revised/ reviewed at every stage of execution of work at site, to suit the site conditions by the contractor at no extra cost to the NTPC.

2.0.0 QUALITY ASSURANCE PROGRAMME

2.1.0 The contractor shall adopt suitable Quality Assurance Programme (QAP) to ensure that the equipments and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-contractor's premises or at the NTPC's site or at any other place of work are in accordance with the specifications. Such QAP shall be outlined by the contractor and shall be finally accepted by the NTPC or their authorized representative after discussions before the start of work. The QAP shall be generally in line with IS/ISO Systems.

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

- Organization structure for the management and implementation of the proposed quality assurance programme
- Quality System Manual
- Design Control System
- Documentation and Data Control System
- Qualification data / details for Contractor's key personnel
- The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased, etc.
- System for shop manufacturing and site erection controls including process, fabrication and assembly

- Control of non-conforming items and system for corrective actions and resolution of deviations
- Inspection and test procedure both for manufacture and field activities
- Control of calibration and testing of measuring testing equipment
- System for Quality Audits
- System for identification and appraisal of inspection status
- System for authorizing release of manufactured product to the NTPC
- System for handling, storage and delivery
- System for maintenance of records
- Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of work/ equipment/component.

3.0.0 QA AND QC MANPOWER

3.1.0 The contractor shall nominate one overall QA coordinator for the contract detailing the name, designation, contact details and address at the time of post bid discussions. All correspondence related to Quality Assurance shall be addressed by the contractor's QA coordinator to NTPC. NTPC shall address all correspondence related to Quality issues to the contractor's QA coordinator. The contractor's QA coordinator shall be responsible for co-ordination of Quality activities between various divisions of the contractor and their sub-vendors on one hand & with NTPC on the other hand.

3.2.0 The contractor shall appoint a dedicated, experienced and competent QA&QC in-charge at site, preferably directly reporting to the Project Manager, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP. An indicative structure of contractor's QA&QC manpower required to be deployed at site is enclosed at **Annexure-I**. Based on the finalized L-2 network and the approved Field Quality plan, the contractor shall finalize and submit a deployment schedule of QA&QC personnel along with their details to NTPC for approval/ acceptance and further shall ensure their availability well before the start of the concern activity.

3.3.0 The QA&QC in-charge shall have the organizational 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 Civil, Electrical, Mechanical Engineers and Laboratory assistants with their supporting staff both at their works and site.

3.4.0 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.

4.0.0 SAMPLING AND TESTING OF CONSTRUCTION MATERIALS

4.1.0 The method of sampling for testing of construction materials and work / job samples shall be as per the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans. All samples shall be jointly drawn, signed and sealed wherever required, by the contractor and the engineer or his authorized representative.

4.2.0 The contractor shall carry out testing in accordance with the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans.

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 testing shall be done in the presence of the engineer or his authorized representative.

4.3.0 Before execution of any civil work the contractor shall conduct full-scale suitability tests on various construction and building material such as fine and coarse aggregates, cement, reinforcement, construction chemicals, supplementary cementitious materials and construction water to ascertain their suitability for use and the concrete mix designs conducted from reputed institutes such as NCB-Ballabhgarh, CSMRS-Delhi, IIT's, etc. as agreed by the engineer. A list of NTPC acceptable specialist laboratories is enclosed at **Annexure-II**. The test samples for such full scale testing shall be jointly sampled and sealed by the engineer and contractor, thereafter these shall be sent to the concerned laboratory through the covering letter signed by field quality assurance (FQA) representative of the engineer.

4.4.0 The contractor shall timely initiate the action with regard to the evaluation of aggregates and other building material including concrete mix design, so as to ensure completion of these tests before start of civil works at site, thereby not affecting any project work. The test reports and recommendations for suitability of the materials including concrete mix design shall be promptly submitted by the contractor to the engineer.

4.5.0 Evaluation of aggregate for potential alkali-aggregate reactivity shall be carried out as per following scope of work

A. Evaluation of Aggregates for Mechanical / Physical Properties

a) 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.
b) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material, soundness, silt content, clay content and organic impurities as per IS: 2386.
c) To prepare evaluation report based on test results of a) and b) above and to advise regarding suitability of fine and coarse aggregates.

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

a) 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 22 days test).
b) If rock type is limestone, alkali carbonate reactivity test shall also be carried out wherein the parameters shall be reported in conjunction with the petrographic analysis. Additionally, X-Ray diffraction test (XRD) shall be carried out to determine critical clay mineral in the rock for preliminary conclusions. For limestone aggregates to be used in dynamic foundations like TG, BFP, Fans, mills and crushers, repeated temperature cycle test shall also be carried out, to determine residual expansion of aggregate for concrete.
c) To prepare a report based on test results of a) and b) above and to advise regarding suitability of aggregates to be used and further testing required if any.

5.0.0 LABORATORY AND FIELD TESTING

5.1.0 The field laboratory for QA and QC activities shall be constructed and set-up by the contractor in line with the indicative field QA&QC laboratory set-up enclosed at **Annexure-III**. The Laboratory building shall be constructed and installed with the adequate facilities to meet the requirement of envisaged test setup. Temperature and humidity controls shall be available wherever necessary during testing of samples. The quality plan shall identify the testing equipments/ instrument, which the contractor shall deploy and equip the field quality laboratory for meeting the field quality plan requirements. The contractor shall furnish a comprehensive list of testing equipments/ instrument required to meet the planned/scheduled tests for the execution of works for NTPC acceptance/ approval. The contractor shall mobilize the requisite laboratory equipment and QA&QC manpower at least 15 days prior to the planned test activity as per the schedule of tests.

5.2.0 All equipments and instruments in the field shall be calibrated before the commencement of tests and then at regular intervals, as per the manufacturer's recommendation and as directed by the NTPC. The calibration certificates shall specify the fitness of the equipments and instruments within the limit of tolerance for use. Contractor shall arrange for calibration of equipments and instruments by an NABL / NPL accredited agency and the calibration report shall be submitted to NTPC.

5.3.0 The tests which cannot be carried out in the field laboratory shall be done at NTPC acceptable testing laboratories. 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 NTPC engineer. The test report along with the recommendations shall be obtained from the laboratories without delay and submitted to NTPC.

5.4.0 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 organize to carry out the tests as scheduled / agreed.

6.0.0 PURCHASE AND SERVICE

6.1.0 The major items/ equipments/ components to be manufactured in the shop of the contractor i.e. in-house items and those procured from sub-vendors / sub- manufacturer / sub-contractors i.e. bought out items (BOIs) shall be listed out by the contractor in their bid proposal.

6.2.0 An indicative list of major bought out items (not exhaustive) and services for civil works is enclosed at **Annexure - IV**, for which the contractor shall submit the requisite details / lists of manufacturer's in their bid proposal. The list of manufacturers/ sub-vendors for all the BOIs envisaged in contract including shall be included in the bid proposal by the contractor which shall be discussed / reviewed by the NTPC during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOIs shall be agreed/ approved. If any item is left out or gets included during detailed engineering, the contractor shall propose the manufacturer's / sub-vendor's details for review / approval of NTPC, prior to initiating the procurement of such materials.

6.3.0 Where the manufacturers are placed in details required ("DR") category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the NTPC for approval in the prescribed NTPC format within the period agreed at the time of

post bid discussions. The contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-contractor detail submission / approval shall be furnished. Such manufacturers / sub-vendors approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

6.4.0 To facilitate advance planning of material testing/ approval of bought out items, well before the start of activity as per L-2 network, representative samples shall be procured by the contractor from approved sub-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 (MTC) is submitted for acceptance, it shall be clearly traceable and correlated with the consignment received at site. MTC of all bought out items shall essentially contain all the test parameters / characteristics specified in the technical specifications / standards / codes. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to NTPC. 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 performance and quality of material.

6.5.0 Structural and reinforcement steel supply if in the scope of the contractor shall be procured from Main Steel Producers like SAIL, TISCO, RINL, Essar Steel, Ispat Industries, JSW Steel, Uttam Value Steel, Jindal Steel & Power and Jai Balaji Industries Ltd, Durgapur (for 8-40mm reinforcement steel).

7.0.0 MANUFACTURING QUALITY PLAN AND FIELD QUALITY PLAN

7.1.0 All materials / components and equipment covered under the scope of work, shall be procured by the contractor for the purpose of the contract, after obtaining the written approval of the NTPC, which are to be manufactured at shop/ factory of the vendor/sub vendor shall be covered under a comprehensive quality assurance programme. The contractor's purchase specifications and inquiries shall call for Manufacturing Quality Plans (MQP) to be submitted by the sub-contractor/ sub-supplier/ sub-vendor. The MQP called for from the sub-contractor shall detail out for all the components and equipment, various tests / inspection, to be carried out as per the requirements of this specification and standards mentioned therein, quality practices and procedures followed by contractor's / sub-contractor's / sub-supplier's quality control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/ performance testing. Such quality plans of the vendors / sub-vendors shall be submitted to the NTPC for approval for MQP and such approved quality plans shall form a part of the purchase order / contract between the contractor and sub-contractor. The quality plans shall be submitted on electronic form e.g. CD or E-mail in addition to hard copy, for review and approval of NTPC. After approval the same shall be submitted in compiled form on CD in addition to hard copy.

7.2.0 The contractor shall furnish copies of the reference documents/ plant standards / acceptance norms/ tests and inspection procedure etc., as referred in quality plans. These quality plans and reference documents/standards etc. will be subject to NTPC approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, NTPC shall identify

customer hold points (CHP), i.e. test/ checks which shall be carried out in presence of the NTPC engineer or his authorized representative and beyond which the work shall not proceed without consent of NTPC in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to NTPC along with technical justification for approval and dispositioning.

7.3.0 Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the NTPC for reference / record by the contractor along with a report of the purchase orders placed so far for the contract.

7.4.0 Well before the start of the work, the contractor shall prepare and submit the Field Quality Plans (FQP) and obtain approval of NTPC, which shall detail out for all the works, equipments, services, quality practices and procedures etc in line with the requirement of the technical specifications to be followed by the contractor at site. This FQP shall cover for all the items / activities covered in the contract / schedule of items required, right from material procurement to completion of the work at site. An Indicative Field Quality Plan for civil works is enclosed at **Annexure – VA** (Indicative FQP for civil works for EPC), **Annexure – VB** (Indicative FQP for civil works for Township) and **Annexure –VI** (Indicative FQP for structural steel works).

8.0.0 DISPOSITIONING OF NON CONFORMITIES

8.1.0 The non-conformity for the site works on being detected / noted shall be reported by the contractor in the standard format of NTPC under the system of dispositioning of non conformity report (NCR) to the engineer. The dispositioning of the NCR relating to equipment, assemblies, materials condition or process during construction / erection shall describe the proposed correction and also include the preventive / corrective action plan for future.

9.0.0 QUALITY AUDIT

9.1.0 NTPC reserves the right to carry out quality audit and quality surveillance of the quality management and control activities, systems and procedures of the contractor or their sub-contractor. The contractor shall provide all necessary assistance to enable the NTPC carry out such audit and surveillance. The contractor shall also take necessary measures, raise NCRs wherever required based on the audit findings / observations.

10.0.0 QA DOCUMENTATION PACKAGE

10.1.0 The contractor shall be required to submit the QA documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (√) mark. Typical contents of QA documentation pertaining to field activities as per approved MQP, FQP and other agreed manuals / procedures, prior to commissioning of individual system shall generally contain the Quality Plan, Material mill test reports, Non-destructive examination results / reports, Heat Treatment Certificate/Record, Non-conformance Reports, CHP, Certificate of Conformance (COC) and MDCC.

11.0.0 GENERAL QA REQUIREMENTS

11.1.0 The contractor shall ensure that the works, BOIs and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-

contractor's premises or at the NTPC's site or at any other place of work are in accordance with the NTPC technical specification, applicable standards / codes, approved drawings / data sheets / quality plans and BOQ. All the works, BOIs and services shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer.

11.1.1 STORAGE AND HANDLING OF CONSTRUCTION MATERIALS

All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in NTPC Technical Specification.

11.1.2 EXCAVATION AND FILLING WORKS

The contractor shall submit a work methodology covering various items of works for all stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading , compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance.

For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor.

Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the engineer. However, these tolerances shall be applicable for localized areas only.

Acceptance criteria shall be

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.

11.1.3 MASONRY AND ALLIED WORKS

The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable.

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:

Sl. No.	Type of Check	Tolerance
	Deviation in verticality in total height of any wall of a building	Shall not exceed ± 12.5mm (more than one storey) ± 6mm per 3m height (within a storey)
	Deviation from the position shown on the plan of any brickwork	Shall not exceed 12.5mm (more than one storey)
	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	Shall not exceed 6mm
	Deviation of bed joint from horizontal in any length, and it	Shall not exceed 6mm (upto 12m) Shall not exceed 12.5mm total (in any length over 12m)
	Deviation from the specified thickness of bed-joints, cross-joints or perpends	Shall not exceed ± 3mm
	Finished plastered surface	Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface
	The average thickness of plaster	Not be less than the specified thickness
	The minimum thickness over any portion of the surface	Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster

11.1.4 CONCRETE WORKS

For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement,

compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance.

The equipment, deployment of manpower and machinery shall arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works.

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of engineer-in-charge.

Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars.

Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494.

All the materials, equipments, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete.

If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45μ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production.

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 rata to the concrete cube strength obtained, against that stipulated.

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 NTPC for their record and future reference.

a. Testing data / report of aggregates including petrographic examination & potential reactivity of aggregate and repeated temperature cycle tests wherever specified
b. Mix design details and record of trial mixes carried out at site
c. Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports.
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. Temperature control record of concrete at the time of placement if applicable

m. Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations

n. Batching Plant shall be calibrated regularly at least once in a 3 months. Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used. Production and supply of concrete from batching plant shall conform to the provisions of IS 4926

o. Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per NTPC Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 2% up to 1000 nos., @1% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456

TOLERANCES

	Description of Item/ Structural Element	**Max (mm)**	**Min (mm)**
	Cast In Situ Concrete		
1.	Faces of concrete in foundations and structural members against which back fill is placed	+25	-10
2.	Eccentricity of footing as percentage of footing width in the direction of placement	2% but limited to 50mm	
3.	Top surfaces of slabs and of concrete to receive base plates to be grouted	+5	-5
4.	Alignment of beams, lintels, columns, walls, slabs and similar structural elements	+5	-5
5.	Cross sectional dimensions of walls, slabs and similar structural elements	+5	-5
6.	Deviation from specified dimensions of cross-section of columns and beams	+12	-6
7.	Alignment of holding down bolts without sleeves	+1.5	-1.5
8.	Alignment of holding down bolts with sleeves	+5	-5
9.	Level of holding down bolt assemblies	+10	-10
10.	Embedded Parts (in any direction).	+5	-5
11.	Level of embedment for equipment support	+1.5	0
12.	Level of embedment for other embedded parts	+5	-5
13.	Centers of pockets or holes with greatest lateral dimension not exceeding 150mm	+10	-10
14.	Variation in steps • Riser • Tread	 +1.5 +3.0	 -1.5 -3.0

TOLERANCES				
Description of Item/ Structural Element			**Max (mm)**	**Min (mm)**
	Pre- Cast Concrete			
15.	Length:	+/- 0.1 percent	+/- 5	+ 10
16.	Straightness or Bow	1/750 of the length	+/- 5	+/- 10
17.	Cross-sectional dimensions	+/- 3 mm or +/- 0.1 percent whichever is greater		
18.	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.		
19.	Flatness:	The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm.		
	Placing of reinforcement and for cover		Clause 12.3.1 and 12.3.2 of IS 456	
	Formwork		Clause 9.6 of IS 14687 and 11.1 of IS 456	
	Batching		Clause 10.2.2 of IS 456	

11.1.5 STRUCTURAL STEEL WORK

For structural steel works provisions of technical specifications and IS: 800 shall apply. A detailed methodology for structural steel works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The contractor shall submit the welding procedures specification (WPS), heat treatment procedures, NDT procedures etc. at least ninety days before scheduled start of erection work at site. All welding and brazing shall be submitted to the NTPC and carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC.

All brazers, welders and welding operators employed on any part of the contract either in the contractor's / sub-contractor's works or at site or elsewhere shall be qualified as per AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC.

The records of welding procedure qualification and welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, the tests shall be conducted in presence of NTPC / authorized representative.

No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the

job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC.

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 specification / approved WPS.

The requirements of pre-heating shall be

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

The following tests / checks shall be carried out for structural steel works

SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
1.	Physical and chemical properties of material if supply in the scope of contractor	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	AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards
Fillet Weld		
4.	Macro-etch examination on production test coupons for main fillet welds	Minimum one joint per built up beams, columns and crane girder etc.
5.	Tension member of crane girder	Dye penetration test on 25% weld length
6.	All other fillet welds	DPT on 5% of weld length with minimum 300mm at each location
Butt Weld		
7.	DPT	100% after back gouging on all butt welds except for coal bunker bins 10% after back gouging-For coal bunker bins
8.	Mechanical testing of production test coupons	Minimum one joint per built up beam, column and crane girder.
9.	Radiography test on butt welds (In case of failure of any welds in	100% RT on butt welds of tension flange (bottom flange) of crane

SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
	SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the engineer)	girders 10% RT weld length of each welder on butt welds, except for crane girders and coal bunker 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins
10.	Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints
11.	Control assembly check in shop before erection	1st and further every 10th set of identical structure
12.	Dimensional tolerances during fabrication and erection	as per IS-7215 and IS-12843
13.	Surface Preparation and Paint thickness	SA 2 1/2 , By elcometer random after each coat, each member

11.1.5.1 STOPLOG AND TRASH RACKS

Structural design of stop log gate shall be as per IS 5620 and IS 4622 and as per details given in technical specifications. The trash rack to be provided shall be Type-1 trash rack (removable section rack), conforming to IS: 11388 (latest). Filling valves shall be provided in the stop logs to balance the water pressure before lifting the stop log. Leakage test shall be carried out in the stop logs as per the methodology specified in the technical specification. The leakage measured shall not be more than 5 liters/ minute /meter of length of seal under maximum head. Radiographic examination or magnetic particle testing or other comparable tests shall be carried out for determining the soundness of steel castings and shall be conducted by the contractor as per the technical specification requirements. The contractor shall submit a manufacturing and field quality plans in NTPC format incorporating all the quality aspects mentioned in the technical specifications.

The lifting beam is to be tested for twice the weight of the heaviest component to be lifted by the beam. IS 13591 shall be referred for measurement of the deflection and acceptance criteria.

11.1.5.2 COAL TAR ANTI-CORROSION TAPE (if applicable)

Coal tar anti corrosion tape shall conform to the requirements of technical specifications. The Manufacturers test certificate for each lot of supply of the coal tar anti corrosion tape shall contain the softening point, needle penetration, filler content, breaking load in the longitudinal direction, service temperature, direct impact test, cathodic disbanding and solubility. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to NTPC.
Tests for Adhesion, holiday test and thickness shall be carried out at site.

11.1.6 PAINTING WORKS

Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for painting works shall broadly contain the source of approved brand of paints, shot / sand blasting as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance. For PU coating works if specified, material shall be procured from NTPC approved source and the application of the PU coating shall be carried out by an experienced authorized applicator of the material supplier approved by NTPC. A separate quality plan and methodology for PU coating works shall be submitted by the contractor for approval of NTPC. Based on the approved quality plan, the tests on material and works shall be got conducted at specialist laboratories like IICT Hyderabad, CECRI Karaikudi.

11.1.7 SHEETING WORKS

All bought out items shall be procured from the manufacturer's approved by engineer and tested as per relevant IS Codes/ Specification. Raw material of colour coated sheets shall meet the chemical & physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for colour match, bare metal thickness, weight of Z/AZ coating, thickness of painting system, reverse impact, T-Bend adhesion, scratch resistance, salt spray test for 1000 Hrs and any other test / properties as specified in the technical specifications. Colour coated sheets shall be marked with video jet printing at the interval not more than 2m bearing manufacturer's name, date and time of manufacturing. Fasteners shall also be tested for 1000 hrs salt spray test as per the requirement of technical specifications.

Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183.

For sheet installation no gas cut opening g shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion.

11.1.8 TILE WORKS

The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the NTPC approved brand / source. Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable.

The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832,

part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness.

11.1.9 FIRE PROOF DOORS

Fire Proof doors shall be tested for the requirements mentioned in the Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system

11.1.10 WATER PROOFING

The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the NTPC approved brand / source and the works shall be executed by the authorized applicator of the supplier.

Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel / drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course.

11.1.11 PILING WORK (If Applicable)

For piling works provisions of technical specifications, approved drawings, BOQs and relevant IS codes / standards shall apply. The piling works shall be executed by the agency meeting the qualifying requirements as specified. A detailed methodology for piling works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for piling works shall broadly contain the method of boring, stability of bore hole, termination criteria, tests / checks for termination level, fabrication of cage, cage lowering, concrete batching / mixing, transportation, placing, recording of the time of construction operations, method of conducting initial and routine load tests, testing and sampling of concrete during production and placement and acceptance checks on piles for final clearance.

The equipment, deployment of manpower and machinery shall be arranged by the contractor to prevent the collapse of bore hole and to ensure continuous rate of placement of specified grade of concrete.

The piling works shall be executed as per the technical specifications, approved drawings, relevant codes / standards, FQP and BOQ. In addition to the requirements of technical specifications, the following shall also be ensured while execution of piling works:

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.e. after completion of boring, after completion of SPT(wherever applicable), 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 sets 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) In a 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.

k) 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.

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

m) 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. 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

PILE LOAD TEST

Pile load testing shall conform to the requirements of IS-2911 (Part IV) and the technical specification. Initial load tests as specified in the contract documents shall be conducted to assess the safe load carrying capacity of pile before start of work. To verify the load carrying capacity of the working piles, routine load test shall be conducted.

Pile load-testing procedure and the test setup / scheme shall be submitted for approval of NTPC. The contractor shall use the test setup having arrangement for anchor piles / rock anchors alone or combination of anchor piles / rock anchors and

kentledge 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

All the gauges and 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.

11.1.12 WATER SUPPLY, DRAINAGE & SANITATION

Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in NTPC technical specification.

The obstructions in sewer lines 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.

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 test / working condition of pressure and flow, when all draw-off taps are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost.

11.1.13 ARCHITECTURAL & MISC. WORKS

Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in NTPC technical specification.

Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. 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.

Materials used in glass and glazing shall be procured from source approved by NTPC and shall conform to the requirements of the Technical Specification and IS Codes.

False 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.

All bought items covered in the scope of contract shall be procured from sources approved by NTPC and shall conform to the requirements of the technical specifications and referred standards /codes.

11.1.14 ROAD WORK

Quality Assurance and testing requirements for roadwork shall be as per the MOSRTH-Specification (Section 900), IRC specifications or CPWD specifications as specified in the technical specifications and BOQ of the contract.

The testing and sampling shall include the checks on earth work for embankment and subgrade, sub bases and bases and bituminous constructions. The sampling and testing of concrete pavements shall be as per the respective items of earthwork, subgrade / sub-base, concrete, etc.

11.1.15 FABRIC EXPANSION COMPENSATOR:

Each layer of fabric Compensator shall be checked for thickness, unit weight, tensile strength & elongation, composite layer of the expansion joint shall be tested for temperature withstandability test.

Thermal Insulation shall be checked for thickness, density, thermal conductivity test and all other tests as per IS:8183.

Tests and checks on all other items shall be carried out as per relevant codes.

11.1.16 SLIPFORM SHUTTERING

1. The monitoring of the leveling of the yoke and the platform of the slip form shuttering to be done in each shift to avoid tilt during the casting of the chimney shell.
2. Manning of each shift shall be done by at least two experienced operators and a foreman particularly in night shift.
3. Suitable removal/ reduction of overhung / excess yoke beam length shall be affected with the decrease in the diameter of Chimney shell, as per the approved plan.
4. The laser centering method to be deployed for chimney alignment and Monitoring of chimney centre should be done by laser instruments at least two points. Monitoring/Recording of the same shall be done in each shift of 8 hours
5. Shuttering plates to be used for slip form shall be new and the grade of steel shall conform to the specification requirements.
6. The outage of the alignment of chimney centre shall be prevented by creating a counterbalance for alignment purpose to avoid differential loading, arising out of placement of reinforcement bars at one side or unloading of concrete in a hopper at one side of the platform for slip form shuttering.

11.1.17 DYKE WORK/ IMPERVIOUS SOIL FILL / OTHER FILL WORKS

The suitability of the fill materials from each source using laboratory/ field tests shall be determined / ascertained by the contractor prior to start of filling work and shall be approved by Engineer. The fill material free from shingle, salts, organic matters, roots sod or any other foreign substances shall be used for filling.

11.1.17.1 EMBANKMENT FILLING

The fill materials shall be free from debris, wood, vegetable matter and other deleterious matter. Control tests shall be carried out in laboratory from time to time to determine whether the fill produced by methods employed satisfies the requirements of the specifications. Routine field tests shall also be carried out by the Engineer and the

work shall be inspected regularly. Field density test should be particularly and specially made in the following areas:

a) Where the degree of compaction is doubtful.

b) Where embankment operations are concentrated i.e. where 2 or more layers are placed one over the other on the same day.

c) To represent every 2000 cum in case of earth and/or 1000 cum in case of ash placed in the embankment.

d) Atleast one test for every full or part shift of compaction operations and

e) Atleast one test for every 250 m length of dyke in each layer. The Engineer shall determine whether the desired results are being obtained.

QA&QC test for Embankment Filling shall be carried out in line with the indicative FQP attached at Annexure- V.

11.1.17.2 IMPERVIOUS SOIL FILLING

The suitability of the material from each source shall be determined by laboratory tests and shall be approved by Engineer. QA&QC test for Impervious Soil Filling shall be carried out in line with the indicative FQP attached at Annexure- V. The spreading of the next layer shall be carried out only after the underlying layer has been approved by the Engineer or his authorized representative.

11.1.17.3 SAND BLANKET, CHIMNEY AND FILTER

The material for blanket, chimney and sand filters shall consist of clean sound and well graded coarse sand. The materials shall be free from debris, wood, vegetable matter and other deleterious matter. The gradation of sand material shall meet the requirements as specified. QA&QC test for Sand Blanket, Chimney and Filter shall be carried out in line with the indicative FQP attached at Annexure- V.

11.1.17.4 GRADED COARSE AGGREGATE FILTER

The coarse aggregate material shall consist of durable well graded broken rock of hard stone variety from the specified quarries and shall be approved prior to being transported to the area of deposition. The materials shall range in the size from 10 mm to 75 mm and shall satisfy the specified filter criteria. QA&QC test for Graded Coarse Aggregate Filter shall be carried out in line with the indicative FQP attached at Annexure- V.

11.1.17.5 ROCK-TOE, RIP-RAP WORKS, RR MASONARY

Rock toe shall be formed with rock material consisting of sound, durable and well-graded broken rock obtained from approved quarries and shall be of approved quality. The materials shall range in size from 10 to 45 cm. QA&QC test for rock-toe, rip-rap works shall be carried out in line with the indicative FQP attached at Annexure- V.

11.1.17.6 SLOPE PROTECTION WORKS

Slope protection works with dry brick packing or ash-cement/ soil-cement mortar ash cement concrete on the slopes, confined within brick masonry panel walls shall be constructed with approved quality of materials. Slope protection works with turfing on downstream slope shall be as per IRC standards. Slope protection works with ash cement concrete on the downstream slopes shall be constructed with approved quality of materials. QA&QC tests for slope protection works shall be carried out in line with the indicative FQP attached at Annexure- V.

11.1.17.7 BENTONITE LINER

Construction Quality Control (CQC) tests as indicated in Table shall be performed by the Contractor's Quality Control Team at regular intervals upon completion of the Soil-Bentonite liner.

CQC Requirements for Impervious Liner

Parameter	Test Frequency per layer
Moisture Content	1 per 5,000 Cum
Field Density	1 per 5,000 Cum
Falling Head Permeability	1 per 25,000 Cum

All CQC test results shall achieve the required values as established by the engineer. Failure to achieve these values shall require re-working of the Impervious mixture in the failed areas.

11.1.18 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. 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.

11.1.19 PLASTERING & ALLIED WORKS

1. Materials like sand, lime 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 m length.

5. Check thickness of plaster.

12.0.0 SHOP TEST EOT Cranes, Other cranes & Hoist

1.0 HOOKS

1.01 ALL TESTS INCLUDING PROOF LOAD TEST AS PER RELEVANT IS/BS/DIN SHALL BE CARRIED OUT.
1.02 MPI/DPT SHALL BE CARRIED OUT AFTER PROOF LOAD TEST.

2.0 STEEL CASTING

2.01 DPT ON MACHINED SURFACE SHALL BE CARRIED OUT.

3.0 GIRDERS, END CARRIAGE,CRAB, GEAR BOX AND ROPE DRUM

3.01 THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED.
3.02 NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS:

a) BUTT WELDS IN TENSION:- 100% RT AND 100% DPT
b) BUTT WELDS IN COMPRESSION:- 10% RT AND 100% DPT
c) BUTT WELDS IN ROPE DRUM:- 100% RT AND 100% DPT
d) FILLET WELDS:- RANDOM 10% DPT

4.0 FORGING (WHEEL, GEARS, PINIONS, AXLE, HOOKS & HOOK TRUNION)

4.01 ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE SUBJECTED TO ULTRASONIC TESTING.
4.02 DPT/MPI SHALL BE DONE AFTER HARDFACING AND MACHINING.

5.0 WIRE RPOE SHALL BE TESTED AS PER RELEVANT STANDARD.

6.0 REDUCTION GEARS SHALL BE TESTED FOR REDUCTION RATIO, BACKLASH & CONTACT PATTERN. GEAR BOX SHALL BE SUBJECTED TO

NO-LOAD RUN TEST TO CHECK FOR OIL LEAKAGE, TEMPERATURE RISE, NOISE AND VIBRATION.

7.0 THE CRANES SHALL BE COMPLETELY ASSEMBLED AT SHOP FOR FINAL TESTING. ALL TESTS FOR DIMENSION, DEFLECTION, LOAD, OVERLOAD, HOISTING MOTION, CROSS TRAVEL ETC. AS PER IS-3177 SHALL BE CARRIED OUT AT SHOP.

8.0 ALL ELECTRIC HOISTS SHALL BE TESTED AS PER IS-3938 AND CHAIN PULLEY BLOCKS SHALL BE TESTED AS PER IS-3832.

13.0.0 CATHODIC PROTECTION (If Applicable)

Quality of cathodic protection system shall be as per given table.

IMPRESSED CURRENT CATHODIC PROTECTION

Transformer Rectifier Unit

Attributes/ Characteristics → / Items / Components / Sub- assembly ↓	Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Operational & Functional Checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of TRU as per NTPC specification	Efficiency Test on TRU & Transformer	Heat Run Test	Ratio & Polarity Test on TRU	HV & IR Test
Rectifier Transformer (IS : 2026)	Y				Y			Y			Y
Electronic Components	Y				Y						
PCB & Electronic Cards	Y				Y						
Control & Selector Switches (IS : 6875)	Y			Y	Y						
Indicating Meters (IS : 1248)	Y			Y	Y						
Indicating Lamps (IS: 13947)	Y			Y	Y						
Air Break Switches / Fuses (IS : 13947 / 13703)	Y			Y	Y						
Control Terminal Blocks (IS : 13947)	Y				Y						
Control Transformer (IS : 12021)	Y			Y	Y						
Push Buttons (IS : 4794)	Y			Y	Y						
MCB (IS : 8828)	Y			Y	Y						
PVC insulated Copper control wires (IS : 694)	Y				Y						
Sheet Steel (IS : 513)	Y	Y	Y		Y						
Synthetic Rubber Gaskets	Y	Y			Y						
Annunciator	Y			Y							
Transformer Rectifier Unit	Y					Y	Y	Y	Y	Y	Y

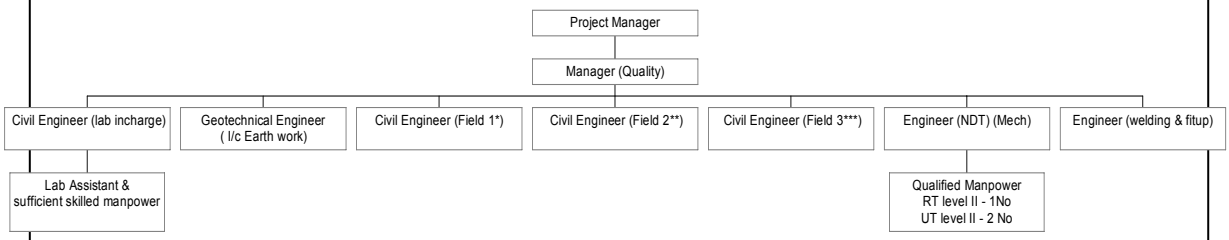
Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Makes of all major Bought Out Items will be subject to NTPC approval.

ANNEXURE-I

QA&QC ORGANISATION SETUP



NOTE:

1. The above organization setup is minimum however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval.
2. The contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work.
3. The contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.
4. * For concrete work 2 Nos (one for foundation work & one for superstructure)
5. ** For lines and levels - 1 No.
6. *** For Finishes and cladding work - 1 No

ANNEXURE-II

TYPICAL QA/QC LAB EQUIPMENT

S.No	Equipment	Nos.
1	Vicat Apparatus with deskpot	2
2	Le chatelier flask	2
3	Le chatelier Mould	2
4	Cube Moulds for cement testing	12
5	Vibration Machine	1
6	Length comparator	2
7	Shrinkage Bar mould	2
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	6 sets
13	Oven	2
14	Physical balance	1
15	Rapid moisture meter	2
16	Thermometer	4
17	Burret	2
18	Measuring cylinders	9
19	Measuring flasks	3
20	Compression testing machine	2 sets of 2000 kN capacity each
21	Cube moulds	30
22	Electronic balance	2 (12 kg capacity), 2 (200 mg capacity)
23	pH balance	As per requirement
24	Radiographic facilities	As per requirement, Party should deploy BARC approved agency for carrying out RT
25	Mechanical weighing machine	1 (100 kg capacity)
26	Ultrasonic testing machine	As per requirement
27	D.P. Test kit	10
28	Vernier 300 mm, 600 mm	2
29	Micrometer (0.25 mm) out side (25.00)	2
30	Radiography film viewer	2
31	Inside Micrometer 25-750 dia	2
32	Digital elcometer for paint thickness	2
33	Baking oven for electrode	3
34	Portable ovens	2
35	Rebar detector to locate the reinforcement before core cutting operation	1
36	Concrete coring machine (55mm, 60mm upto 150 mm dia core bit)	1
37	Rebound hammer	1
38	Ultrasonic pulse velocity tester	May be arranged from specialist laboratory.

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 NTPC
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 NTPC for database and day to day monitoring.

LIST OF SPECIALIST INSTITUTES / ORGANIZATIONS FOR TESTING AND EVALUATION OF BUILDING MATERIALS

Sl No.	Name of the Institute	Contact Person	Test Facilities	Special Studies / Investigation
1	Indian Institute of Technology Bombay, Powai, Mumbai - 400076	Head, Deptt of Civil Engg, Phone : 022 25722545	Mix design and material properties on selective basis	In situ non destructive testing (UPV) of concrete structures, design of mass concrete, temperature studies, distress assessment
2	Indian Institute of Technology Madras, Chennai- 600 036	Head, Deptt of Civil Engg. Phone: 044 22574266/5255	Selective specialised studies such as design of fly ash concrete and special concrete, non destructive testing (UPV) of structures	
3	Indian Institute of Technology Guwahati -781039	Head, Deptt of Civil Engineering, Phone : 0361 2582401, 258 2442, 258 2440	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, steel reinforcement, petrography, alkali aggregate reactivity, mix design	In situ non destructive testing (UPV) of concrete structures (selective basis), design of mass concrete, studies on properties of fly ash concrete
4	Indian Institute of Technology Kanpur (UP) - 208016	Head, Deptt of Civil Engineering, Phone: 0512 2597346	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	Non destructive testing (UPV) on concrete structures, structural health assessment
5	Indian Institute of Technology Kharagpur (WB) -721302	Head, Deptt of Civil Engineering, Phone: 03222 283421	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design, petrography	
6	Indian Institute of Technology Delhi, Hauz Khas, New Delhi - 1100 016	Head, Deptt of Civil Engineering, Phone:01126591191	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	In situ non destructive testing (UPV) of concrete structures (selective basis)
7	Indian Institute of Technology, Roorkee - 247667	Head, Deptt of Civil Engineering, Phone: 01332 285439, 273560	Testing and evaluation of cement(physical and chemical), aggregates (mechanical), fly ash (physical and chemical), admixtures, water, steel reinforcement, mix design, petrography, alkali aggregate reactivity	Various tests on other building materials such as silica fume, mass concrete, steel, bricks, tiles, doors, ferrocement covers, pipes, bridge bearings, PVC water tanks, etc
8	Indian Institute of Science Bangalore 560012	Head, Deptt of Civil Engineering, IISC Bangalore	Design of roller compacted concrete, radiation shield concrete, high volume fly ash concrete, fire bahavior of concrete, micro cracking of concrete, non destructive testing (research & development) activities, behavior of concrete under shrinkage and creep, assessment of fire damaged concrete	IISc basically involved in r&d activities relatred to civil enginnering and may only be contacted in case of specific studies / consultancy.
9	Institute of Technology, Banaras Hindu University (BHU) Varanasi (UP) -221005	Head, Deptt of Civil Engineering, Phone: 0542-2307016	Testing and evaluation of cement physical properties), aggregates (mechanical properties), admixtures, water, mix design, petrography	

LIST OF SPECIALIST INSTITUTES / ORGANIZATIONS FOR TESTING AND EVALUATION OF BUILDING MATERIALS

Sl No.	Name of the Institute	Contact Person	Test Facilities	Special Studies / Investigation
10	Central Building Research Institute (CBRI), Roorkee - 247667	Head, Structural engineering division, Phone: 01332 283382	Testing and evaluation of cement (physical and chemical), aggregates (mechanical), fly ash (physical and chemical), admixtures, water, mix design, alkali aggregate reactivity	Fire rating of doors, non destructive testing of structures, various tests on other building materials such as bricks, steel, tiles,etc
11	Central Soil and Materials Research Station (CSMRS), Near IIT Delhi, Olof Palme Marg, New Delhi - 110016	Joint Director Phone: 011 26962608	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, mix design	Various tests on other building materials such as steel, geotextiles, geomembrane, soil, instrumentation, monitoring, etc
12	National Council for Cement and Building Materials (NCB), 34 KM Stone, Delhi Mathura Road Ballabgarh(Har)	Head, Center for Construction Development & Research Phone : 0129 2246173	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, temperature cycle test, XRD, steel reinforcement, mix design	In situ non destructive testing (UPV) of concrete structures and special studies, testing of bricks, paving blocks, steel bars, silica fume, etc
13	National Council for Cement and Building Materials (NCB), NCB Bhawan, Old Bombay Road Hyderabad 500008	General Manager, Phone 040 23000344, 040-23000343	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties) , fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, steel reinforcement, mix design	In situ Non destructive testing (UPV) of concrete structures (selective basis)
14	National Test House, Taramani Chennai 600 113	S.O.(Civil) Phone:04422432374, Fax:04422433158	Testing and evaluation of cement (physical and chemical) , aggregates (mechanical properties) , fly ash (physical and chemical), admixtures, steel reinforcement, water, mix design	Various tests on other building materials such as paving blocks, Gi pipes, wires, steel plate, flush doors, **salt spray test**, etc
15	National Test House, Block CP Sector V, Salt Lake city Kolkata-700 091	S.O. (Civil), Phone:033 2367 3870	Testing and evaluation of cement(physical and chemical), aggregates (mechanical properties) , fly ash (physical and chemical) , admixtures, water, steel reinforcement, mix design	Various tests on other building materials such as paving blocks, GI pipes, wires, steel plate, flush doors, etc
16	National Test House (NTH), Kamla Nehru Nagar, Ghaziabad (UP)	S.O. (Civil), NTH Ghaziabad	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, stel reinforcement	Timber, clay products, water proofing compound, flush doors, laminated sheets, plywood, etc
17	Structural Engineering Research Centre (SERC), Taramani, Chennai 600 113	Head, Department of Material Testing, Phone: 044 22549152, 22541735	Testing and evaluation of cement (physical and chemical) , aggregates (mechanical properties), fly ash (physical and chemical), admixtures, steel reinforcement water, mix design	In situ Non destructive testing (UPV) of concrete structures (selective basis) and special studies such as cement admixture compatibility, design of special concrete, evaluation of structures

LIST OF SPECIALIST INSTITUTES / ORGANIZATIONS FOR TESTING AND EVALUATION OF BUILDING MATERIALS

Sl No.	Name of the Institute	Contact Person	Test Facilities	Special Studies / Investigation
18	Vishveswaraiya National Institute of Technology(VNIT), Nagpur (MH) - 440010	Director, VNIT Nagpur, Phone:0712 2223710, 2222828	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design, petrography	In situ non destructive testing (UPV) of concrete structures and soil tests
19	Anna University, Department of Structural Engineering, Chennai - 600 025	Head, Deptt of Civil Engineering	Testing and evaluation of cement (physical and chemical) , aggregates (mechanical properties) , fly ash (physical and chemical) , admixtures, water, mix design	
20	Shriram Institute for Industrial Research, 19 University Road, Delhi 110007	Dr (Mrs) Laxmi Rawat, Asstt Director & Chief Phone:011 27667267	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	Various tests on other building materials such as steel, geotextiles, geomembrane, soil, bricks, tiles, etc
21	Spectro Analytical Lab, E-41, Okhla Indl Area, Ph II, New Delhi 110021	Phone: 011 26383048-49 Fax: 40503150, 40503151	Testing of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water	Chemical and physical tests on steel reinforcement
22	Motilal Nehru National Institute of Technology (MNIT), Allahabad - 211004	Director, MNIT Allahabad, Phone: 0532 2271305, Fax: 0532 2545341	Testing and evaluation of cement (physical and chemical) , aggregates (mechanical properties), fly ash (physical and chemical), admixtures, steel reinforcement water, mix design	In situ non destructive testing (UPV) of concrete structures.
23	Govt Enginering College, Jalpaiguri (WB) - 735102	Head Deptt of Civil Engg, Fax: 03561256143	Testing and evaluation of cement (physical), aggregates (mechanical properties), water, mix design	
24	College of Engineering Pune - 411005	Head Deptt of Civil Engg, Phone No : 02025507067, Fax : 02025507299	Testing and evaluation of cement (Physical & Chemical properties), fly ash (Physical & Chemical properties), aggregates (Mechanical properties except alkali aggregate reactivity & Petrography), water, admixtures and mix design	
25	Maulana Azad National Institute of Technology, Bhopal (MP)	Head Deptt of Civil Engg, Phone No : 07554051390	Testing and evaluation of cement (physical), aggregates (mechanical properties),water, mix design	In situ non destructive testing (UPV) of concrete structures and soil tests.
26	National Institute of Technology, Rourkela (Odisha)	Head Deptt of Civil Engg, Phone No : 06612462300	Testing and evaluation of cement (physical), aggregates (mechanical properties), mix design,	In situ non destructive testing (UPV) of concrete structures and soil tests. Test on steel reinforcement, bricks and bitumen

एनटीपीसी NTPC	PROJECT: PATRATU STPS EXPANSION PHASE-I (3 X 800 MW)	LIST AND STATUS OF ITEM REQUIRING QP AND SUB-SUPPLIER APPROVAL	NTPC DOC NO	
	PACKAGE: EPC PACKAGE		REV. NO.	0
	MAIN SUPPLIER:		DATE	
	CONTRACT NO.:			

SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
1	CEMENT						
2	CONSTRUCTION CHEMICALS - ADMIXTURES, PLASTISIZERS, RETARDERS, WATER PROOFING COMPOUNDS, GROUTS, RESINS, EPOXY ETC.						
3	COLOUR COATED SHEET(FOR COIL)						
4	PROFILERS FOR DECKING SHEETS						
5	PROFILERS FOR CLADDING SHEETS						
6	ELECTROFORGED GRATING						
7	PAINT AND PAINTING SYSTEM						
8	GI PIPES						
9	INSULATION WOOL						
10	PVC WATER STOP						
11	PLASTIC/ PVC PIPES						
12	CERAMIC / VITRIFIED TILES						
13	FIRE PROOF DOORS						
14	PARTICLE BOARDS, PLYWOOD, MDF						
15	ALUMINUM SECTIONS						
16	HIGH SOLID CONTENT LIQUID APPLIED URETHANE BASED ELASTOMERIC MEMBRANE FOR WATER PROOFING						
17	ALUMINUM COMPOSITE CLADDING						
18	RCC PIPES						
19	FALSE CEILING - GLASS REINFORCED GYPSUM SYSTEM, MINERAL FIBRE BOARD SYSTEM, PREPAINTED COIL COATED STEEL SYSTEM						
20	BITUMEN ASPHALT						
21	BITUMEN IMPREGNATED FIBER BOARD JOINT FILLER, JOINT SEALING COMPOUND, BITUMINOUS COMPOUND, JOINT SEALANT, BITUMINOUS PAINTS						
22	SANITARY ITEMS						
23	CP BRASS TAP AND OTHER SANITARY FITTINGS						
24	POLYTHENE WATER STORAGE TANKS - IS 12701						
25	POLYCARBONATE SHEETS						
26	PTFE BEARING / ELASTOMERIC BEARING						
27	FOUNDATION BOLTS						
28	ACID / ALKALI RESISTANCE TILES, AR BRICKS(IS 4860), AR CEMENT (POTASSIUM SILICATE BASED CEMENT MORTAR-IS 4832 PART I, PHENOLIC BASED RESIN CEMENT-IS 4832 PART II) AND AR BITUMASTIC (IS 702)						
29	ELECTRICALLY OPERATED HOIST						
30	STOP LOG GATES, TRASH RACK AND LIFTING BEAM						
31	FABRIC EXPANSION COMPENSATOR						
32	THERMAL INSULATION (FOR CHIMNEY WORKS)						

एनटीपीसी NTPC	PROJECT: PATRATU STPS EXPANSION PHASE-I (3 X 800 MW)	LIST AND STATUS OF ITEM REQUIRING QP AND SUB-SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: EPC PACKAGE					REV. NO.	0
	MAIN SUPPLIER:					DATE	
	CONTRACT NO.:						
SR. NO.	**ITEM**	**QAP / INSP. CAT**	**QAP NO.**	**PROPOSED SUB SUPPLIER**	**PLACE OF MANUFACTURING**	**APPROVAL STATUS**	**REMARKS**
33	CHIMNEY ELEVATOR						
34	GEOTEXTILE						
35	GEOMEMBRANE (HDPE LINER)						
36	GALAVANISED STEEL STRUCTURES FOR TRANSMISION LINE						
37	GALVANISED STEEL STRUCTURE (LATTICE & PIPE)						
38	HEXAGONAL BOLTS, NUTS, SPRING WASHERS, PLAIN WASHERS						
39	COAL TAR ANTICORROSIVE COATING						
40	PRE-ENGINEERED BUILDING						
41	ELASTOMERIC POLYURETHANE COATING						
42	HIGH PERFORMANCE MOISTURE COMPATIBLE CORROSION RESISTANT COATING SYSTEM						

LEGENDS:
1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)
A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list along with the condition of approval, if any.
DR – For these items “Details required” for NTPC review. To be identified with letter “DR” in the list.
'N' NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with ‘NOTED.’

2. QP/INSPN CATEGORY:
CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.
CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved
CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.
UNITS/ WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

NOTE: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by NTPC-EIC/ FQA on the basis of certificate of conformance submitted by the main supplier/ main contractor.

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN									ANNEXURE- VA
		ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		QP NO. : REV. NO .: DATE : PAGE :		1 0 Page 1 of 18	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	PATRATU STPS EXPANSION PHASE-I (3 X 800 MW) EPC PACKAGE			
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
1	GENERAL REQUIREMENTS										
A	Setting up of Field QA&QC laboratory		As agreed / required	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings		SR	√	Functioning of laboratory equipment in proper working condition to be verified on monthly basis
B	Avialablility of requisite laboratory set up and equipment in good working condition well before commencement of concerned activity		As agreed / required	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings		SR	√	
C	Submission of QA & QC manpower deployment schedule based on agreed L-2 network .		-	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings			√	
D	Availability of QA& QC manpower based on deployment schedule .		-	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings		SR	√	
E	Sampling for testing of buliding materials, concrete mix design etc.		As agreed / required	A	Physical	Once per each source	Tech Specs and Const. Drawings		SR/TR	√	Test report along with the recommendations from specialist agency to be submitted to NTPC.
F	Submission of schedule of tests to be done monthly / quaterly and maintenace of the same on a computer connected to LAN of NTPC for monitoring		-	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings		SR	√	
G	Stacking and storage of construction materials and components at site		As per IS:4082	B	Physical	Random	Tech Specs and Const. Drawings and IS: 4082		SR	√	
H	All bought out items to be procured from the approved vendor and on approval of Quality plans by NTPC as per inspection Category		-	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 .
I	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	NTPC Tech. Spec. /BOQ		SR/LB		To be submitted to CQA for approval with a copy to site .
2	EXCAVATION AND FILLING IN FOUNDATION WORKS										
	Excavations-										
2.1		Nature, type of soil/rock before and during excavations	As agreed / required	B	Visual	Random in eah shift	Tech Specs and Const. Drawings		SR		
2.2		Initial ground level before start of excavations	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings		SR	√	
2.3		Final shape and Dimensions of excavations.	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings		SR		
2.4		Final excavation lelvels	As agreed / required	B	Measuement	100%	Tech Specs and Const. Drawings		SR	√	
2.5		Side slope of final excavation	As agreed / required	B	Measurement	Random in eah shift	Tech Specs and Const. Drawings		SR		
2.6		Excavation in Hard Rock- If required									
i		Receipt, Storage, accountability of Explosive	As agreed / required	B	Physical	Random in each week	Indian Explosive Act 1940/all statutory norms, Tech Specs and Const. Drawings		SR	√	NTPC approved specialist blasting agency such as CMRI, NIRM shall be deployed at site for trial blasts, design blasts, blast vibration monitoring etc. Seismographs shall be deployed at site for monitoring of blast operation vibrations.
ii		Execution of Blasting Operation	As agreed / required	B	Physical	Random in eah shift	IS:4081, Tech Specs and Const. Drawings		SR	√	
iii		Submission of Blasting report to EIC	As agreed / required	C	Physical	Each blast	Tech Specs and Const. Drawings			√	

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN									ANNEXURE- VA
		ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		QP NO. : REV. NO .: DATE : PAGE :		1 0 Page 2 of 18	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	PATRATU STPS EXPANSION PHASE-I (3 X 800 MW) EPC PACKAGE			
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
2.7		Excavation in Hard Rock (Blasting Prohibited)	As agreed / required	B	Physical	100%	As per approved drawing/ scheme, Tech Specs and Const. Drawings		SR	√	
	Fill/ Backfill -										
2.8	**Suitability of borrow fill material-**										
i		Grain size analysis	Set of Seives, Hydrometer etc.	B	Physical	Once per each type of source or change of source	IS:2720 (Pt.IV), Tech Specs and Const. Drawings		SR/TR	√	The parameters should not be worse than the parameter of the existing soil in plant area
ii		Liquid & plastic limit	Mechanical liquid limit device, grooving tools, Evaporating Disc,Spatula, Palette knives, Balance oven containers, etc.	B	Physical	Once per each type of source or change of source	IS:2720 (Pt.IV) , Tech Specs and Const. Drawings		SR/TR	√	The parameters should not be worse than the parameter of the existing soil in plant area
iii		Shrinkage limit	-do-	B	Physical	Once per each type of source or change of source	IS:2720 (Pt.IV), Tech Specs and Const. Drawings		SR/TR	√	The parameters should not be worse than the parameter of the existing soil in plant area
iv		Free Swell Index	Measuring cylinders, etc.	B	Physical	Once per each type of source or change of source	IS:2720 (Pt.XI), Tech Specs and Const. Drawings		SR/TR	√	The parameters should not be worse than the parameter of the existing soil in plant area
v		**Chemical Analysis**									
a		Organic Matter	Oven chemical balance, volumetric flasks, burettes, pipettes, conical flasks, set of seives, measuring cylinders etc.	B	Physical	Once per each type of source or change of source	IS:2720 Pt.XXII, Tech Specs and Const. Drawings		SR/TR	√	
b		Calcium carbonate	Reagents and indicators,Burette,flasks,funnels etc.	B	Physical	Once per each type of source or change of source	Part XXIII of IS-2720, Tech Specs and Const. Drawings		SR/TR	√	
c		pH value	As agreed / required	B	Physical	Once per each type of source or change of source	Part XXVI of IS-2720, Tech Specs and Const. Drawings		SR/TR	√	
d		Total soluble sulphate	As agreed / required	B	Physical	Once per each type of source or change of source	Part XXVII of IS-2720, Tech Specs and Const. Drawings		SR/TR	√	
2.9	**Standard proctor Test**	Optimum moisture content and max. dry density before fill	As per IS: 2720, Proctor needle apparatus,etc.	A	Physical	One in every 10000 cum for each type and source of fill materials	IS 2720 (Pt.VII), Tech Specs and Const. Drawings		SR/TR	√	
2.10	**Moisture content**	Moisture content of fill before compaction	As per IS: 2720, balance, oven etc.	A	Physical	One in every 10000 cum for each type and source of fill materials	IS 2720 (Pt.II), Tech Specs and Const. Drawings		SR/TR	√	
2.11	**Degree Of Compaction Of Fill / Backfill**										
i		Dry density by core cutter method ---- OR---- Dry density in place by sand displacement method	As per IS: 2720/compaction test (core cutter), balance etc.	A	Physical	i) For foundation fill/ backfill one for every 10 foundations for each compacted layer.	IS 2720 (Pt. XXIX), Tech Specs and Const. Drawings		SR/TR	√	
						ii) For area filling, one every 10000 SQM area for each compacted layer.	IS 2720 (Pt. XXVIII), Tech Specs and Const. Drawings		SR/TR	√	
ii		Relative density (Density Index)	As per IS: 2720, balance oven etc.	A	Physical	----do----- (i) & (ii) above	IS 2720 (Pt. XIV), Tech Specs and Const. Drawings		SR/TR	√	
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	Tech Specs and Const. Drawings		SR/TR	√	
3.0	**MATERIALS**										
	Expert openion regarding suitability of construction materials shall be taken from Specialist Institute (Identified during pre award)										
3.1	**CEMENT**										

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		ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		QP NO. : REV. NO .: DATE : PAGE :		1 0 Page 3 of 18	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	PATRATU STPS EXPANSION PHASE-I (3 X 800 MW) EPC PACKAGE			
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
		Retesting of cement	as per IS:4031	A	Testing	At Random	As per relevant IS Codes		Test Report	√	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. If cement is stored more than 60 days in godown of contractor same shall be retested for comp. Strength & setting time.
3.2	Coarse Aggregate	Moisture content	as per IS:2386	B	Physical	Once for each stack of 100 Cu.M. or part there of	IS : 456 IS : 383/Tech Spec		SR/LB	√	during monsoon when this has to be done every day before start of concreting
ii		Specific gravity, water absorption	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS:456, IS:383/Tech Spec		SR/LB/ Test Report	√	
iii		Sieve analysis, flakiness index, elongation index,	IS:2386	B	Physical	One per 100 cum., or part thereof	IS: 2386 Part-I, IS:383/Tech Spec		SR/LB	√	
iv		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)	IS:2386	A	Physical	Once per source/ on every change of source	IS: 2386 Part-II, IS:383/Tech Spec		SR/LB/ Test Report	√	
v		Soundness	IS:2386	A	Physical	-do-	IS: 2386 Part-V, IS:383		SR/LB/ Test Report	√	
vi		Alkali aggregate reactivity		A	Physical	-do-	IS: 2386 (Part-VII), IS:383 /Tech Spec/ASTM C-1260 / ASTM 1293		SR/LB/ Test Report	√	The aggregate type (deleterious/innocuous result should be supported by petrographic examination
vii		Petrographic examination	IS:2386 Pt VIII	A	Physical	-do-	IS: 2386 Part-VIII, IS:383 /Tech Spec		SR/LB/ Test Report	√	
viii		Crushing value abrasion value and impact value	IS:2386	A	Physical	-do-	IS:383, IS-2386 Part IV/Tech Spec		SR/LB/ Test Report	√	
3.3	Fine Aggregate										
i		Moisture content, water absorption	balance , oven etc	B	Physical	To be done every day before start of work	IS: 2386 Part-III IS:383		SR/LB/ TR	√	
ii		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)	IS:2386	B	Physical	Once per source& for on every change of source	IS: 2386 Part-II, IS:383		SR/LB/ TR	√	
iii		All other tests similar to coarse aggregates as mentioned above.					IS-2386, IS-383		SR/LB/ TR	√	except test for flankiness index,elongation index, abrasion value, impact value
3.4	Water										
i		Complete Testing as per IS:456-2000	Buret, conical flask, pipette etc	B	Testing	One per 3 month for each source.	IS:456-2000		SR/LB/ TR	√	
3.5	CONCRETE										
i		4 Trial mixes to ascertain the workability and cube strength	After receiving the recommended mix design from specialist agency.	A	Physical	One for each mix proportion	NTPC tech specification		SR/LB	√	
ii		Crushing strength (works Tests cubes)	IS:516	A	Physical	One set of 6 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier.	IS:516, IS:456, NTPC Tech. Spec.		SR/LB/ Test Report	√	Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength.
iii		Workability - slump test	IS:1199	B	Physical	At the time of concrete pouring at site every two hrs	IS:456/NTPC Tech. Spec.		SR/LB/ TR	√	

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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		Remarks
1	2	3		4	5	6	7	8	9	D*	10
iv		Water content		B	Physical	Once per shift	As per approved design mix.		SR/LB	√	At batching plant
3.5.1	Admixtures for Concrete	Type of admixture	As per IS:9103	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	Designed mix and IS:9103		Test Report	√	Admixture of appd. Brand and tested quality shall be used (each lot of admixture will included with brochure in which the type of admixture and its properties shall be clearly indicated)
		Suitability	As per IS:9103	B	Physical	For each lot received at site	Designed mix and IS:9103		SR/LB/ TR	√	Relative density, pH and slump retention on each batch / lot of admixture and to compare these properties with MTC
3.6	Concrete conveying, placing& compaction										
i		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 conform to IS:4925	Review of calibration chart/ Certificate, IS 4926			√	
ii		Arrangement for transportation & placement of concrete.	As required	C	Visual	100%	Before clearance for concreting		Inspection Report	√	
iii		Calibration of Batching Plant	batcher should comply with reqirement of IS 4926/IS:4925	A	Physical	To be calibrated at the time of starting and subsequently once in three months, and shall conform to IS:4925	Review of calibration chart/ Certificate		Calibration Certificate	√	Provision of online printer is manadatory
iv		Handling and Transportation of concrete	As required	B	Physical	100%	As per construction/erection methodology (to be approved one week prior to start of work)		SR		
v		Placement of concrete	Visual	B	Physical	100%	As per construction/erection methodology and tech.specs / No segregation		SR	√	
vi		Temperature Control of Concrete for top deck of TG Foundations.	Thermometer	B	Physical	100%	Temperature as per technical specification		SR	√	
viii		Compacting	As required	B	Physical	At Random	IS:456		SR	√	
ix		Curing	As required	B	Physical	At Random	Period of curing as per IS 456 (use gunny bags / curing compound)		SR	√	
3.7	TEST/CHECK ON RCC STRUCTURE IN HARDENDED CONDITIONS										
		Visual inspection of concrete surface of all dynamic foundations just after removal of shuttering	As required	A	Visual	100%	As per Technical Specification		SR	√	
		Embeddment of inserts in concrete shall be checked for gap if any using hammer for all dynamic foundations	Hammer	A	Visual	100%	As per Technical Specification		SR	√	No hollow sound
i		Ultrasonic test on top deck of TG foundation & Other foundations as per technical Specification	IS:13311	A	Physical	As per Technical Specification	IS:13311		Test report	√	
ii		Core Test	IS:516	A	Physical	As required by NTPC Engineer.	As per IS:456, IS 516		SR/LB/ Test Report	√	
iii		Rebound Hammer test	IS:13311	A	physical	as required by the NTPC engineer	As per relevant / tech. Specification.		SR/LB	√	
iv		Dimensional check on finished structures & Dimensional tolerances	As required	B	Measurement	Approved Drawing	As per IS:456/ tech. Specification.		SR/LB	√	

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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		Remarks
1	2	3		4	5	6	7	8	9	D*	10
v		Water Tightness Test of liquid retaining structure/ tanks	As required	A	Test	100%	IS:3370/ Tech. Specification		SR/LB	√	
3.8	REINFORCEMENT STEEL										
i		Physical and Chemical Properties for each lot as per relevant IS codes	As required/ agreed	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings		MTC	√	Applicable if steel is procured by Contractor
ii		Freedom from cracks surface flaws, Lamination.	As agreed / required	B	Visual	Random in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings		SR		To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.
3.9	PLACEMENT OF REINFORCEMENT STEEL										
i		Bar bending schedule with necessary lap, Spacers & Chairs	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502		SR	√	
ii		Bending of bars, cutting tolerance	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502		SR	√	
iii		Acceptance - Cover, spacing of bars, spacers and chairs after the reinforcement cage is put inside the formwork	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings		SR	√	
3.10	STAGING AND FORMS										
i		Materials and accessories	As agreed / required	B	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings		SR		
ii		Soundness of staging, shuttering and scaffolding including application of mould oil / release agent	As agreed / required	B	Visual	Once before start of work	As per manufacturer's spec.and as per 3696,4014, 4990, Tech Specs and Const. Drawings		SR		
iii		Acceptance of formwork before start of concreting		B	Physical / visual	Before start of each concreting	As per provisions and tolerances, Tech Specs and Const. Drawings		SR	√	
3.11	INSPECTION OF CONCRETE SURFACE JUST AFTER REMOVAL OF FORM WORK										
i	Visual inspection jointly with NTPC	Concrete surface, position and alignment of embedded parts and inserts	--	B	Visual	Once for TG, BFP & MILL foundations	As per provisions and tolerances of equipment supplier, Tech Specs and Const. Drawings			√	Inspection protocol shall be signed Jointly by Contractor and NTPC CCD & Erection
ii	Submission of grouting / repair methodology if concrete surface / position and alignment of embedded parts / inserts are found defective		--	B	Review and approval	once for each type of defect	As per provisions and tolerances, Tech Specs and Const. Drawings			√	
3.12	EMBEDDED PART(INCLUDING LAYING OF RAILS & ANCHOR FASTENERS)										
i		Position / alignment / levels of embedded parts / bolt hole / pipe sleeves / rails / PVC pipes / etc	As agreed / required	B	Physical/ measurement	100%	As per drawing, Tech Specs and Const. Drawings		SR/ Protocol	√	Exposed surfsce of the embeded parts other than holding down bolts are to be painted with as per technical specifications
ii		Welding / tieing of embeddment to reinforce-ment	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings		SR		
3.13	PRE-CAST CONCRETE										
i		Crushing strength	compression strength testing machine	A	Physical	one sample of six cubes per 50m m3 or part thereof	IS:516 & IS: 456		SR/LB	√	A minimum of three specimen shall be tested for 7 and 28 days compressive strength
ii		Workmanship and dimentions	Visual	B	Physical	100%	As per IS:456/NTPC Tech. specification.		Register		
iii		Load Test	As required	B	Physical	1% up to 1000 nos. and 0.5% for more than 1000 nos. for each type	IS:456/ As decided by NTPC Site Engr. Incharge.		Inspecti on Report	√	
3.14	JOINTS IN CONCRETE										

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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		Remarks
1	2	3		4	5	6	7	8	9	D*	10
i		Joint material - bitumen impregnated fibre board, PVC water stops, Sealing compound, Expanded polystyrene board, Hydrophillic strip, Acrylic polymer etc.	As per manufacturer Standards	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings, IS 1838, IS 1834, IS12200		MTC	√	
ii		Acceptance of installation	As agreed / required	B	Acceptance	Each installation randomly	Tech Specs and Const. Drawings				
3.15	DAMP PROOF COURSE						Tech Specs and Const. Drawings				
i		Material - Hot bitumen and water proofing materials etc	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery at site	Tech Specs and Const. Drawings, IS 702		SR	√	
ii		Acceptance of damp proof course	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings		SR		
3.16	GROUTING										
i		Material	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR	√	
		Type of mix - fluid mix, plastic mix, stiff mix etc.	As agreed / required	B	Physical	Prior to start of work	Tech Specs and Const. Drawings		SR	√	
ii		Mixing, placement, application and grout pressure	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings		SR		
iii		Compressive strength	As agreed / required	A	Physical	Random in each shift	Tech Specs and Const. Drawings		SR	√	
iv		Acceptance of the grouts	As agreed / required	B	Physical	Each grout section	Tech Specs and Const. Drawings		SR		
3.17	SLIPFORM SHUTTERING										
i		Submission of Slipform Work system to b	-	B	Submission	Before Comencement of work	As per specifications		SR		
ii		Check for the Slipform shutters	As required	B	Physical	Before Comencement of work	As per specifications		SR		Check for water level system, Controls, Walkways etc.
iii		Details Positions and arrangement of Jac	-	B	Approval	Before Comencement of work	As per specifications		SR		Submitted to Engineer for approval
iv		Details of Proposed arrangement for cont	-	B	Approval	Before Comencement of work	As per specifications		SR		Submitted to Engineer for approval
v		Check for All type of openings, Chases, F	As required	B	Physical	100% during execution	Construction Drawings and specifications		SR		No any type of openings ,chases , blocks other than shown in the construction drawings or approved by Engineer shall be executed in the concrete.
vi		Details of proposed method for concrete c	-	B	Approval	Before Comencement of work	Construction Drawings and specifications		SR		Submitted to Engineer for approval
vii		Check of Concrete Curing and Protection	As required	B	Physical	At Random	Construction Drawings and specifications		SR		Concrete shall not remain uncured for period longer than 12 hours
viii		Check for Sliding Operation	As required	B	Physical	Each Sliding	As per specifications		SR		Rate of Sliding, Delays in sliding, Discontunity or stop strat sliding to be checked
		Monitoring of Sliding Portion									
ix		Progress Height	As required	B	Physical	Six hourly intervals	As per specifications		SR		To be recorded in tabular form and on graphs immediately after each monitoring
x		Centre line in relation to the centers at the	As required	A	Physical	Six hourly intervals	As per specifications		SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring
xi		Internal wall faces in relation to the concr	As required	B	Physical	Six hourly intervals	As per specifications		SR		To be recorded in tabular form and on graphs immediately after each monitoring
xii		Wall thickness	As required	B	Physical	Six hourly intervals	As per specifications		SR	✓	To be recorded in tabular form and on graphs immediately after each 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		Remarks
1	2	3		4	5	6	7	8	9	D*	10
xiii		Twist	As required	B	Physical	Six hourly intervals	As per specifications		SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring
xiv		Verticality of the structure	Optical Theodolight	B	Physical	Every day in morning	As per specifications		SR		To be recorded in tabular form and on graphs immediately after each monitoring
xv		Check for Tolerances for chimney constru	As required	B	Physical	For every day monitoring	As per specifications		SR		
4.00	BRICK MASONARY										
4.1	Test on Bricks										
		Dimensions , shape, compressive strength, water absorption, warpage, efflorescence.	As agreed / required	A	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS:13757, IS: 12894 / Tech Specs and const. Drawings		Inspection Report	√	Efflorescence shall be checked at each source.
4.2	Test on Mortar										
i		Compressive strength	As agreed / required	B	Test	At random	IS 2250-1981, Tech Specs and Const. Drawings		LB		
ii	Sand	Grading	As agreed / required	B	Test		IS:2116		SR/LB		
4.3	Masonry construction	Workmanship, verticality and alignment	As agreed / required	B	Visual/ Physical	100%	IS 2212, IS 1905 , Tech Specs and Const. Drawings		SR/LB		
5.00	FINISHING AND ALLIED WORKS								.		
5.1	PLASTERING- MATERIAL										
i	Sand	Deleterious Material	As agreed / required	B	Physical	Once per source	IS : 2386 (Part-I &II) & IS :2116, Tech Specs and Const. Drawings		SR		
ii		Grading	As agreed / required	B	Physical	50 Cum./or part thereof	Tech Specs and Const. Drawings		SR		
iii	Galvanised wire mesh	Galvanized hexagonal wire netting for lath plastering	As agreed / required	B	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR		
5.2	PLASTERING - WORKMANSHIP										
i		Curing	As agreed / required	C	Physical	100%	Tech specifications, construction drawings and agreed methodology		SR		
ii		Thickness and finishing of plaster, grooves etc	As agreed / required	B	Visual/ Measurement	Random in each shift	Tech Specs and Const. Drawings		SR/LB		
iii		Truness of plastering system	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings		SR		
5.3	STONE GRIT PLASTER/ GRANULAR TEXTURED COAT FINISH										
i		Material	As agreed / required	B	Approved source and review of MTC	For each lot received at site	Tech Specs and Const. Drawings		SR	√	
ii		Thickness, finishing and grooves etc	As agreed / required	B	Visual/ Measurement	Random in each shift	Tech Specs and Const. Drawings		SR	√	
6.00	SHEETING AND OTHER WORKS										
6.1	PAINTING SYSTEM - CONCRETE WORKS AND PLASTERED MASONARY SURFACES										
i	Materials and accessories- Oil Bound, Acrylic Emulsion, Chemical Resistant, Oil Resistant Paint etc.	Shade, type from brand and manufacturer as approved by NTPC EIC	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR/MTC	√	
ii	Surface prepration	As required	As agreed / required	C	Physical /visual	Random in each shift	Tech Specs and Const. Drawings		SR		
iii	Acceptance of painted surfaces	As required	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings		SR		
6.1.1	PAINTING SYSTEM - STEEL WORKS (OTHER THAN STRUCTURAL STEEL WORKS)										

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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		Remarks
1	2	3		4	5	6	7	8	9	D*	10
i		Paining Materials and accessories	-	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
ii		Submission of painting methodology	-	B	For Review of painting system	Before start of painting work	Tech Specs and Const. Drawings				
iii		Surface prepration	As agreed / required	B	Physical /visual	Each Erection Mark	Tech Specs and Const. Drawings, Relevant code/ standards		SR	√	
iv		Primer Thickness	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR	√	
v		DFT of paint	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR	√	
vi		Acceptance of painted surfaces	Elcometer	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR		
6.2	**Modular areated panel**	As required	As agreed / required	A	Review of test report	Each batch of delivery	Tech Specs and Const. Drawings		SR/LR	√	
6.3	**Permanently colour coated sheets, metal decking**										
i		Storage	As agreed / required	B	Visual	Random in each shift	Tech Specs and Const. Drawings		SR		Prevention of distortion / blemishing / water staining
ii		Installation, lap alignment & workmanship.	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings		SR		No gas cutting of sheets acceptable . FQP for structural steel shall also be applicable
iii		Finishing and acceptance	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings		SR/LB		
6.4	**INSULATION WORKS**										
i	Material	Insulation material, galvanised wire net, aluminium foil, fasteners	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings		SR / LB	√	All tests as per specification
ii		Acceptance of each type of installation	As agreed / required	B	Visual/ Physical	Each installation	Tech Specs and Const. Drawings		SR/LB		
6.5	**PRE-ENGINEERED BUILDING**	Installation and acceptance	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each building	Tech Specs and Const. Drawings		SR/LB	√	From approved source / fabricated as per MQP
6.6	**CHIMNEY PAINTING**										
i		Requirements for Steel Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		No of Coats applied and DFT/WFT to be
ii		Requirements for Cast Iron Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		No of Coats applied and DFT/WFT to be checked as per specified
iii		Requirements for Concrete Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		No of Coats applied and DFT/WFT to be checked as per specified
iv		Material Requirements	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		Requirement of DFT to be checked as per Specifications. Procurement to be done from approved/acceptable manufacturer/source
v		Preparation of Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		
vi		Application of Paint	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		AS per recommendations by Manufacturer along with Relevant IS Codes and Specification requirements
7.00	**DOORS , WINDOWS VENTILATORS & GRILL**										
7.1	**Steel doors**										
i		Materials (MS sheet, fasteners, hinges, jambs, lock strike plate etc	As agreed / required	A	Visual/ Physical / test report	For each lot received at site	Tech Specs and Const. Drawings		SR / LB	√	Review of test report
ii		Flush Door shutters, teak beading	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	IS 2202, Tech Specs and Const. Drawings		SR	√	Review of test report
iii		Hollow metal doors (material and dimensions)	As agreed / required	A	Visual/ Physical/Test report	For each lot received at site	Tech Specs and Const. Drawings			√	Review of test report
iv		Acceptance	As agreed / required	B	Visual/ Physical	Random	Tech Specs and Const. Drawings		SR/LB		
7.2	**Anodised aluminium works**										
i		Materials- Aluminium sections, alkali resistant paint	As agreed / required	A	Visual/ Physical / test report	For each lot received at site	IS: 1948, IS: 1949, IS:733, IS1285, IS:1868, IS:11857/ Tech Specs and Const. Drawings		SR / LB	√	Review of test report For aluminium door/windows, check for anodisation as per Tech. Spec

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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	Remarks
1	2	3		4	5	6	7	8	9 D*	10
ii		Particle Door	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	IS:12823 (phenol formaldehyde sythentic resin, BWP type), Tech Specs and Const. Drawings		SR √	Review of test report
iii		Acceptance	As agreed / required	B	Visual/ Physical	Random	Tech Specs and Const. Drawings		SR	
7.3	**Fire proof doors**									
i		Source of supply	As agreed / required	A	Review of purchase order (unpriced copy) / drawings of suppliers / certificate of CBRI	For each source	Tech Specs and Const. Drawings		SR √	Procured from Approved parties as per relevant IS/Tech, The door drawing proposed for supply should have been tested and approved by CBRI Roorkee for the similar dimensions for minimum 2 hours fire rating.
ii		Receipt inspection	As agreed / required	A	Visual/ Physical/ Review of MTC	For each lot received at site	Tech Specs and Const. Drawings		SR √	
iii		Finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings		SR	
7.4	**Rolling shutters**									
i		Surface finish and thickness of plate of approved make and DFT	As agreed / required	A	Physical / visual / review of MTC	Random for each lot of delivery	Tech Specs and Const. Drawings		SR √	
ii		Finishing and acceptance	As agreed / required	B	Physical and acceptance	Random	Tech Specs and Const. Drawings		SR	
7.5	**Steel windows / Grills/ Louvre**									
i		Material fabrication and fixtures	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery	IS: 1038 / IS:1361, IS: 7452 and Tech Specs and Const. Drawings		SR √	
ii		Finishing and acceptance	As agreed / required	B	Visual / physical	Random	IS: 1038 / IS:1361, IS: 7452 and Tech Specs and Const. Drawings		SR √	
7.6	**Glass and glazing**									
i	Clear float glass, wired glass, tinted glass, curtain glass, hermetically sealed glass	Material	As agreed / required	B	EIC Approved source and review of MTC/ test reports	For each lot received at site	IS: 14900, IS:1081, IS: 3548, IS:5437 Tech Specs and Const. Drawings		SR √	
ii		Installation finishing and acceptance	As agreed / required	B	Visual/ Physical	Random	Tech Specs and Const. Drawings		SR	Leak proof installation with neoprene gasket
7.7	**Curved dome on roof/ Poly Carbonate Sheet**									
i	Source of supply	Impact strength, K value, light transmission value with class -I fire rating	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings		SR √	
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings		SR	
7.8	**Reflective toughened glass**									
i		Material	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings		SR √	
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings		SR	
7.9	**False Ceiling**									
i		Materials (gypsum glass, glass fibre membrane, fibre board acoustical tiles etc)	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings		SR √	Compare MTC with technical specification and requirement
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings		SR	
7.10	**WATER PROOFING**									

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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**		**Remarks**
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**D***	**10**
		Methodology for the application of water proofing system	As required	B	Review	for each type of treatment	Tech Specs and Const. Drawings		SR	√	
7.10.1	**General Requirement- Water Proofing**										
i	Polyurethene based coating, polyester scrim cloth, extruded HD dimpled polyurethene	Material	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	Tech Specs /Const. Drawings		SR	√	MTC shall contain all the parameters specified in the technical specifications
ii		Acceptance of water proofing work	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings				
7.10.2	**Roof / Basement Treatment**										
i	Graded under bed	Levels / slopes	As required	C	Physical	100%	Tech Specs and Const. Drawings				
ii	Elastomaric coatings	Material- Primer coat, finishing coat	As required	B	EIC Approved source and review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR	√	
iii	Wearing course	Materials - PCC, chicken wire mesh, elastomeric sealant	As required	B	Review of MTC	Each lot of delivery	Tech Specs and Const. Drawings		SR	√	
iv		Acceptance of water proofing work	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings				
7.11	**Fencing and Gates**										
i	PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1566), Reinforced barbed tape galvanised (IS 2629) etc.	Materials	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications
ii	Structural steel, painting system, caster wheel, ball and bearing, fixtures and fasteners	Materials	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications
iii		Alignments, erection painting, DFT etc.	As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings		SR		
iv		Acceptance of the installation and working	As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings		SR		
7.12	**FLOOR FINISHES AND ALIED WORKS**										
7.12.1	**Cement Concrete Flooring**										
i		Glass/ PVC strips in joints	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings		SR		
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
7.12.2	**Tiles**										
i	**Ceramic, vitrified, glass mosaic, acid alkali resistant, heavy duty cement concrete tiles**	Materials	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR	√	MTC shall contain all the parameters specified in the technical specifications
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
7.12.3	**Interlocking Blocks**										
i		Materials	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR	√	MTC shall contain all the parameters specified in the technical specifications
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
7.12.4	**Kota Stone, Granite and Marble**										
i		Quality, texture, thickness, colour for each lot of delivery from approved source	As agreed / required	B	Physical	Each batch of delivery	Tech Specs and Const. Drawings		SR	√	
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
7.12.5	**Metallic / non-metallic hardener**										

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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		Remarks
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i		Material	As agreed / required	B	Physical	Each batch of delivery	Tech Specs and Const. Drawings		SR	√	
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
7.12.6	**Acid / alkali and oil resistant high built seamless epoxy based resin and treatment**										
i	Material	Bricks, vitreous tiles, mortar, sealing, paints, coatings, sheets, fillers etc	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR	√	Experienced workers under supervisors recommended/ appointed by manufacturer to be deployed
ii		Surface preparation	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings, IS				
iii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
7.12.7	**Rubber Flooring**										
i		Material	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR	√	MTC shall contain all the parameters specified in the technical specifications
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
7.13	**Doors/Windows Sections**										
i	Material - Rolled Steel, Z Sections,T-iron frames sections, Plates etc.	Review of MTC/ make / Physical checks, tests (if MTC is not available)	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each batch of delivery	Tech Specs and Const. Drawings		SR	√	
ii		Acceptance of Steel Glazed doors and T-iron frames sections after fixing	As agreed / required	B	Physical and acceptance	Random for each installation	Tech Specs and Const. Drawings		SR		
8.0	**WATER SUPPLY / SANITORY INSTALLATIONS**										
8.1	**Water supply fittings and fixtures**										
i	Materials	GI/ MS pipes and fittings	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings		SR	√	
ii	Disinfection	Before use	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR		
iii	Hydraulic test	Before use / leakage	As agreed / required	A	Physical	Each installation	Tech specs and const drawings		SR	√	
iv		Acceptance and working	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings		SR		
8.2	**Sand cast iron / cast iron pipes**										
i	**Material**	SCI / CI pipes and fittings / joints	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings		SR	√	
ii		Acceptance and leakage	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings		SR		
8.3	**Sanitary fittings and fixtures**										
i	**Material**	Sanitory items and fixtures i.e. water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap containers, geyser, water cooler, etc, water supply / sanitation pipes, manhole cover and frames etc	As agreed / required	B	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings		SR	√	
ii		Acceptance of installations of all sanitory items and fixtures	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings		SR		
8.4	**RCC Pipes**										
i	Material	RCC pipes	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings		SR	√	
ii		Acceptance and leakage	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings		SR		

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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		Remarks
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8.5	**Water Storage Tanks**										
i	Material	Over head / loft type	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings		SR	√	
ii		Aceptance and leakage	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings		SR		
9.0	**SPECIAL ITEMS**										
9.1	**Earthing Mat (Grounding System)**										
i	Material	Earthing mat	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs / Manufacturer's, IS 3043		SR/MTC	√	
ii		Weld sizes & length	Visual/Tape	B	Visual/ Measurement	100%	Tech Specs and Const. Drawings				NTPC approved electrodes shall be used
iii		D P test	DP test Kit	A	Physical	10% at random of the offered lot	Tech Specs and Const. Drawings		TR	√	
iv		Earth test	Earthing test kit	A	Physical	100%	Tech Specs and Const. Drawings,		SR	√	
9.2	**Bitumen layer for tank foundation**										
i	Material	Grade of bitumen	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs /MTC		SR/MTC	√	
ii	Acceptance and workmanship	Application / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings		SR		
9.3	**Composite Aluminium Panels and structural glazing**										
i	Material	Type of aluminium panels / structural glazing / fasteners and fixtures / silicon sealant	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Technical specifications / drawings		SR/MTC	√	MTC shall cover all the properties / parameters as per technical specifications
ii	Acceptance and workmanship	Installation / workmanship	As agreed / required	B	Physical	Random	Technical specifications / drawings		SR		
9.4	**Pressure Release Valves**										
i	Material		As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Technical specifications / drawings		SR/MTC	√	
ii	Acceptance and workmanship	Acceptance / Installation / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings		SR	√	
10.0	**ANTI WEED TREATMENT**										
i		Anti-weed treatment materials	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR	√	
ii		Execution of treatment	As agreed / required	B	Physical	Random check for each treatment	Tech Specs and Const. Drawings		SR		
11.0	**PILING WORK (If Applicable)**										
11.1	**Execution**										
i		Borehole	As required	A	Physical	100%	NTPC Tech. Specs		SR/LB	√	If carried out by the contractor
ii		Pile layout	Total station	B	Measurement	100%	As per appd. Drawings and technical specification		SR/LB	√	
iii		Recording ground level	As required	B	Measurement	Random	IS:2911, as per appd. Drawings and technical specification		SR/LB	√	

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1	2	3		4	5	6	7	8	9	D*	10
iv		Cleaning/Flushing of pile bore	As required	B	Visual	Random	As per appd. Drawings and technical specification		SR/LB	√	
v		Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.	As required	B	Measurement	100%	As per appd. Drawings and technical specification		SR/LB	√	
vi		Trial mix to ascertain the workability and cube strength	After receiving the recommended mix design from specialist agency,	B	Physical	One for each mix proportion	NTPC tech specification		SR/LB	√	Necessary correction for moisture content and water absorption according to mix design recommendation may be carried out during the trial mix
vii		Cement content	As required	B	Physical	Once per shift	As per approved design mix.		SR/LB	√	At batching plant
viii		Pouring of concrete to project above cutoff level.	As required	B	Measurement	100%	As per appd. Drawings and technical specification		SR/LB	√	
ix		Pile termination level	SPT & core recovery	A	Soil data	As per NTPC specifications	As per appd. Drawings and technical specification		SR	√	
11.2	Testing										
i		Bentonite	IS:2720	A	Physical / testing	Once per source	As per IS:2720 / tech. Specs.		SR/LB	√	Review of test report
ii		Density check on sample of mud collected from pile bore bottom	Sample collection	A	Physical	As per Tech. Spec.	As per NTPC Tech Spec.		SR/LB	√	Tests to be done before placing concrete. Samples to be collected from pile bore bottom.
iii		Slump test of concrete	IS:1199	B	Physical	Every 2 hrs at pouring point of concrete	IS:2911, As per appd. Drawings and technical specification		SR/LB	√	
iv		Cube sampling for works cube test	IS:456	B	Physical	One set of 6 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier.	IS:2911, As per appd. Drawings and technical specification		SR/LB	√	
v		Initial pile load test, Vertical (Compression), Lateral (horizontal) and pullout (tension).	IS:2911 / as required	A	Testing	100% for 3 nos. for each type or as specified in BOQ / Tech. Spec.	IS:2911, As per appd. Drawings and technical specification		SR/LB	√	In case of compression test method the loading shall be cyclic.
vi		Routine pile tests, compression and horizontal	Calibrated dial gauges etc. as required.	A	Testing	100% for 0.5% of the total number of piles provided for each type of test/Tech. Spec.	IS:2911, As per appd. Drawings and technical specification		SR/LB	√	Routine Test shall be conducted by direct loading method.
vii		Integrity Tests	PEM	A	Testing	100%	IS:2911, As per appd. Drawings and technical specification and suppliers manual		Test Report	√	CHP
12.0	FOUNDATION SYSTEM										
	SHALLOW FOUNDATIONS										
i		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
ii		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
13.0	ROAD WORKS										
13.1	Construction of Sub-Grade and earthen/hard soulders										
i		Standard proctor Test	As per IS: 2720	A	Physical	One in every 2000 cum for each type and source of fill materials	As per Tech Specs and Const. Drawings,Section 900 of MOSRTH specification, IS 2720 (Pt.VII)		SR/TR	√	In cutting or existing levelled ground - quantum of check shall be one per 1000 SQM
ii		Moisture content of fill before compaction	As per IS: 2720	B	Physical	One in every 2000 cum for each type and source of fill materials	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 2720 (Pt.II)		SR/TR		In cutting or existing levelled ground - quantum of check shall be one per 1000 SQM

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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		Remarks
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iii		Dry density by core cutter method ---- OR---- Dry density in place by sand displacement method	As per IS: 2720	A	Physical	One in every 500 SQM area for each compacted layer.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 2720 (Pt. XXIX)/ IS 2720 (Pt. XXVIII),		SR/TR	√	Both for embankment and cut formation quantum of check - One in every 1000 SQM area for each compacted layer.
iv		Lines, grade and cross section	As required / agreed	B	Physical	One in every 500 SQM area	As per Tech Specs and Const. Drawings		SR		Template, straight edge
13.2	**Water Bound Macadam (Non-Bituminous) for base course and sub-base course**										
i		Aggregate Impact value	Agrregate Impact value Test Apparatus	A	Physical	One test per 200 cum of Test aggregate	As perTech Specs and Const. Drawings, Section 900 of MOSRTH specification,		SR	√	
ii		Grading	Set of IS Sieves	B	Physical	One test per 100 cum of aggregate	As perTech Specs and Const. Drawings, Section 900 of MOSRTH specification,		SR		
iii		Flakiness index and elongation index	Flakiness test gauge	B	Physical	One test per 200cun of agregate	As perTech Specs and Const. Drawings, Section 900 of MOSRTH specification,		SR		
iv		Atterberg Limits of binding material	Atterberg limits determination	A	Physical	One test per 25 cum of binding material	As perTech Specs and Const. Drawings, Section 900 of MOSRTH specification,		SR	√	
v		Atterberg Limits of portion of agreggate passing 425 micron sieve	Atterberg limits determination	A	Physical	One test per 100cum of aggregate	As perTech Specs and Const. Drawings, Section 900 of MOSRTH specification,		SR	√	
vi		Camber, surface, slope	As required / agreed	B	Physical	One in every 500 SQM area	As per Tech Specs and Const. Drawings		SR		Template, straight edge
13.3	**Bituminous Macadam for base and binder course**										
i		Quality of binder	Penetrometre with St. needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 73		SR	√	
ii		Aggregate Impact Value / Los angeles abrasion value	Aggregate Impact ValueTest apparatus	A	Physical	Once per source	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
iii		Flakiness Index and elongation index of aggregates	Flakiness test gauge	B	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
iv		Stripping value of aggregate (Immersion tray test)	As required / agreed	B	Physical	Initialy one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
v		Water sensitivity of mix	As required / agreed	A	Physical	Initialy one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
vi		Grading of aggregates	Set of Sieves	B	Physical	Two test per day per plant both on individual constituents and mixed aggregate from dryer	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
vii		Water absorption of aggregate	As required / agreed			Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
viii		Soundness (Magnesium and Sodium Sulphate)	As required as per IS:2386	A	Physical	Once per source by each method and on every change of source	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
ix		Percentage of fractured faces	As required / agreed	B	Physical	When gravel is used one test per 50cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
x		Binder content and aggregate grading	Bitumen extractor	A	Physical	Periodic, subject to a min of two tests per day per plant	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
xi		Control of Temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling	Thermometer	B	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		

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xii		Rate of spread of mixed materials	As required / agreed	B	Physical	Regular control through checks of layer thickness	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
xiii		Density of compacted Layer	As required / agreed	A	Physical	One test per 250 sqm of area	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
13.4	Bituminous Surfacing - Open graded premix carpet and Seal coat										
i		Quality of binder	Penetrometre with St. needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as	IS 73,Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
ii		Aggregate Impact Value / Los angeles abrasion value	Aggregate Impact ValueTest apparatus	A	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
iii		Flakiness Index and elongation indexof aggregates	Flakiness test gauge	B	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
iv		Stripping value of aggregate (Immersion tray test)	As required / agreed	B	Physical	Initialy one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
v		Water absorption test		A	Physical	Initialy one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
vi		Water sensitivity of mix	As required / agreed	A	Physical	Initialy one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
vii		Grading of aggregates	Set of Sieves	B	Physical	One test per 25 cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
viii		Soundness (Magnesium and Sodium Sulphate)	As required as per IS:2386	A	Physical	Once per source by each method and on every change of source	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
ix		Polished stone value	As required as per BS:812(Part 114)	B	Physical	As required	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
x		Temperature of binder at application	Thermometer	B	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
xi		Binder content	Bitumen extractor	A	Physical	One test per 500 cum& not less than two tests per day	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
xii		Rate of spread of materials	As required / agreed	B	Physical	One test per 500 cum and not less than 2 tests per day	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
xiii		Percentage of fractured faces	Bitumen extractor	A	Physical	When gravel is used one test per 50cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
13.5	Tack Coat/ Prime coat/ fog coat										
i		Quality of binder	Penetrometre with Standard needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as	IS 73,Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
ii		Temperature of binder at application	Thermometer	B	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
iii		Rate of spread of binder	As required / agreed	B	Physical	One test per 500 cum and not less than 2 tests per day	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		

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13.6	RCC Pavements	Concrete - Material, Mix design, Trial Mixes, Production, Transportation, Placement, Compaction, Curing, Test on green concrete, Test on hardened concrete etc.	As required / agreed	-	-	Refer FQP for concrete Works	Refer FQP for concrete Works, , Tech Specs and Const. Drawings, IRC & MOST		-	–	FQP for Concrete Works shall be application for all concrete works
13.7	Alignment, Level, Surface regularity and rectification										
i		Horizontal alignment, Surface levels and Surface regularity	As required / agreed	B	Physical	As per section 900 of MOSRTH specification	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR		
ii		Rectification	As required / agreed	B	Physical	Each rectification	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification		SR	√	
14.0	ASH DYKE										
14.1	Embankment filling works										
i		Core cutter with dolly hammer oven balance with weightIn-situ Dry Density		A	Physical	i) Once for every 3000 cum for earth or part there of	IS: 2720 and Technical Specifications		SR/TR	√	Atleast one test for every full or part shift of compaction operation irrespective of progress
				A	Physical	ii) Once for every 5000 cum for earth or part there of separately for cut off trench, homogeneous embankment and core & outer shells, of zoned embankment	95% of maximum of dry density(standred procter) for homogeneous embankment and outer shells 98% for cut off trench for impervious and 100% for filling in pipe trenches if less additional rolling to be done till specified density is achieved		SR/TR	√	
				A	Physical	iii) Once for every 5000 sqm of area on the trimmed slopes	--------- do ----------		SR/TR	√	
				A	Physical	iv) Once every 250 m length of dyke in each layer separately for cut off trench,embankment and core and outer shells	--------- do ----------		SR/TR	√	
				A	Physical	v) Once for every	--------- do ----------		SR/TR	√	
						50m width or part					
						thereof, in each					
						layer separately					
						for core / shell					
						of the dyke					
ii		Moisture Content	Oven mois-	A	Physical	One test for	IS: 2720 & Tech Spec.		SR/TR	√	
			ture dish,			every sample					
			physical bal.			taken as per 14(i)					
			and weight			above					
iii		Permeability	As per	A	Physical	Once for every	IS: 2720		SR/TR	√	
			relevent IS:			5000 cum for	The coefficient of permability,				
			code			cut off trench	K shall be less than $1x10^{-6}$ cm/sec				
						and core (for					
						clayey soil as well					
						as soil-bentonite					
						mix.)					
iv	Dyke Geometry										
a		Top width	As per	B	Physical	Once for every	Technical Specifications		SR/TR		
			Technical			100m length of	Not less than 6.0 meter				
			Specification			trimmed					

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						completed dyke					
b		Outer Slope	As per	B	Physical		Technical Specifications and construction drawings		SR/TR		
			Technical			---- Do ------					
			Specification								
							Technical Specifications and construction drawings				
c		Inner Slope	As per	B	Physical	---- Do ------			SR/TR		
			Technical								
			Specification								
14.2	Preparation of foundation surface										
		For embankment foundations only visual inspection to see that all voids have been filled up and no cracks are exposed.	Visual	B	Physical	Onces for every 2000 sq.m. of foundation area	IS:2720 & Technical Specifications		SR/TR		The foundation shall be free from all organic material , vegetables and weak layers of compressive materials such as clays and low density sills. For all excavations made for test pits and other sub surface investigations and all other existing cavities found within the zone below the established lines of excavation for embankment foundation.
14.3	Coarse Aggregate for concrete and aggregate filters										
		a) check for gradation	IS:sieves	B	Physical	Once for each stack and each change of source	IS:2386 part I and IS:383 and Technical Specifications		SR/TR		
		b) specific gravity	pycnometer	B	Physical	Once for each stack and each change of source	IS:2386 Part I, and IS:1122 and Technical Specifications		SR/TR		
		c) crushing value (for concrete only)	as required	A	Physical	Once for each source	IS:2386 Part IV Technical Specifications		SR/TR	√	
		d) sulphate soundness	Chemicals, balances etc	A	Physical	Once for each source	IS:2386 Part V , IS:1126 Technical Specifications		SR/TR	√	
		f)impact value	as required	A	Physical	Once for each source	IS:2386 Technical Specifications		SR/TR	√	
		g)water absorption	weight balance etc.	A	Physical	Once for each source	IS:2386 Technical Specifications		SR/TR	√	
		h) slake durability (for filter only)	as required	A	Physical	Once for each source	IS:10050 Technical Specifications		SR/TR	√	
14.4											
i		moisture content (for concrete and mortar only)	as required	B	Physical	Once per week	IS:2386, IS:383 and Technical Specifications		SR/TR		
ii		gradation- grain size analysis	sieve set	A	Physical	Once for each source	IS:2386 Part I, IS:9429 & IS:383 and		SR/TR	√	
iii		specific gravity	pycnometer	A	Physical	Once for each source	IS:2386 part I and Technical		SR/TR	√	
14.5	Rock Material for Rip Rap, Rock Toe and Random Rubble Masonry										
i		Specific gravity	as required	A	Physical	Once for each source	IS:1122 and Technical Specifications		SR/TR	√	
ii		sulphate soundness	Chemicals, oven balance etc.	A	Physical	Once for each source	IS:1126and Technical Specifications		SR/TR	√	
iii		Impact Value	Impact Value testing appratus	A	Physical	Once for each source	IS:2386 and Technical Specifications		SR/TR	√	
iv		Water absorption	Balance, oven	A	Physical	Once for each source	IS:2386 and Technical Specifications		SR/TR	√	
v		slake Durability	as required	A	Physical	Once for each source	IS:10050 and Technical Specifications		SR/TR	√	
vi		placement profile thickness	as required	B	Physical	Random in each shift	IS:8237 and Technical Specifications		SR/TR	√	
15.0	GEOTECHNICAL INVESTIGATION WORK										
i		Deployment of approved Geotechnical Investigation Agency - Equipments, Manpower etc	As required / agreed	A	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes		SR	√	

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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**		**Remarks**
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**D***	**10**
ii		Execution of Geotechnical Investigation locations, type etc as per scheme	As required / agreed	B	Physical	Each Location	As per technical specifications and relevant IS Codes		SR	√	
iii		Collection of disturbed and undisturbed samples , their packing and storage	As required / agreed	B	Physical	each sampling	As per technical specifications and relevant IS Codes		SR		
iv		Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc	As required / agreed	B	Physical	each field test	As per technical specifications and relevant IS Codes		SR		
v		Submittion of Field Borelogs in approved format	As required / agreed	B	Review	Within 24 hours after completion of each BH	As per technical specifications and relevant IS Codes		SR	√	
vi		Submittion of laboratory test schedule and selection of samples for laboratory testing	As required / agreed	A	Review and acceptance	as per consultation with engineer during dispatch of samples to approved laboratory	As per technical specifications and relevant IS Codes		SR	√	
vii		Submission of Final Geotechnical investigation report along with recommendations	As required / agreed	B	Physical	After completion of investigation work and review of draft reports	As per technical specifications and relevant IS Codes		-	√	
		Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB									
Manufacturer/ Sub-supplier	**Main-supplier**	**Categorization Witnessing & Accepting (As per NTPC QA&I System)** **Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer** ;**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						**REVIEWED BY**	**APPROVED BY**		**APPROVAL SEAL**

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I	Carriage of Materials										
1.00		Check of carriage of materials including loading	As agreed/Required	C	Physical	100%	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
2.00		Check of stacking of Materials as directed by EIC	As agreed/Required	B	Physical	Random	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
II	Earthwork										
1.00		Nature, type of soil/rock before and during excavations	As agreed / required	B	Physical /Visual	Random in eah shift	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
2.00		Initial ground level before start of excavations	As agreed / required	B	Physical/Measurement	100%	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR	Ö	
3.00		Final Excavation, size, shape, levels & slope	As agreed/Required	B	Physical/Measurement	100%	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR	Ö	
4.00		Backfilling, watering, Ramming, Consolidation / compaction and dressing	As agreed/Required	B	Physical	100%	CPWD/Tech Spec/Construction Drawing	CPWD/Tech Spec/Construction Drawing	SR		
5.00		Acceptance of Site clearance including jungle cutting	As agreed/Required	B	Physical	Random	CPWD/Tech Spec/Construction Drawing	CPWD/Tech Spec/Construction Drawing	SR		
6.00		Check for the chemical for Anti-termite treatment procured from sources approved by NTPC / EIC	As agreed/Required	A	Physical/MTC Review	each delivary	CPWD/Tech Spec/Construction Drawing	CPWD/Tech Spec/Construction Drawing	SR/MTC	√	
7.00		Acceptance for Antitermite Treatment	As agreed/Required	B	Physical	100%	CPWD/Tech Spec/Construction Drawing	CPWD/Tech Spec/Construction Drawing	SR	√	
8.00	Compaction Tests										
(i)	Check for the standard proctor tests	MDD & OMC	As agreed/required	A	Physical	One in every 2000 cum of earth or part there of and change in source of material	Tech Spec/Const Drg/IS 2720	Tech Spec/Const Drg / IS 2720	SR/TR	√	Suitability of the borrow/earth/ fill material also to be ascertained as specified in CPWD / Tech. Specs.
(ii)	Moisture content	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), Tech Specs and Const. Drawings		SR/TR	Ö	
(iii)	Degree of compaction of fill / backfill	Dry density by core cutter method ---- OR---- Dry density in place by sand displacement method	As per IS 2720	A	Physical	For area filling: One for every 1000 Sqm for each compacted layer or for a smaller area as decided by the EIC. For foundation fill / backfilling : One for every 10 foundations for each compacted layer	Tech.Spec. and cons. Drawings, CPWD, Relevant IS:2720	Tech.Spec. and cons. Drawings, CPWD, Relevant IS:2720	SR/TR	√	

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III	Reinforced Cement Concrete & PCC										
1.00	Cement, and Admixture for concrete works										
i		Submission of MTC for each lot of delivery procured from source acceptable /approved by NTPC	As agreed/required	A	Review of MTC	Each batch of delivery at site	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR/MTC	√	
ii		Setting time, Compressive strength of Cement	As per IS 4031	A	Physical	One sample per lot	CPWD/Tech Spec/IS 4031	CPWD/Tech Spec/IS 4031	SR/LB/TR	√	
iii		Check for the storage of Cement	As required	B	Physical	Monthly	CPWD/Tech Spec	CPWD/Tech Spec	SR		If Cement is stored more than 90 days in godown of contractor same shall be retested for comp. Strength & setting time.
iv		Check for storage of Admixture	As agreed/Required	B	Physical	Monthly	CPWD/Tech.Spec. and cons. Drawings, BOQ, Manufacturers recommendations, approved design mix, IS: 9103, IS: 456	CPWD/Tech.Spec. and cons. Drawings, BOQ, Manufacturers recommendations, approved design mix, IS: 9103, IS: 456	SR		
v		Check for admixture	As agreed/required	A	Review of MTC / TR	For each lot received at site	Design mix and IS:9103	Design mix and IS:9103	SR/MTC/TR	√	Admixture of approved brand / make and tested shall be used (each lot of admixture procured shall have brochure in the type of admixture and its properties shall be clearly indicated).
vi		Check for admixture properties at site	As agreed/required	B	Physical	Randomly For each lot received at site	Design mix and IS:9103	Design mix and IS:9103	SR/TR	√	Test for Relative density, pH on each batch / lot of admixture and to compare these properties with MTC.
2.00	Coarse Aggregate										
i		Percentage of soft & deleterious materials, Elongation index, Flakiness index,	As agreed/required	B	Physical	Once for each source & for every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
ii		Specific Gravity, Water absorption		A	Physical	Once for each source & for every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
iii		Moisture Content	As per IS Code	B	Physical	Once for each stack of 100 Cum or Part thereof except in monsoon it has to be done every day before start of concrete	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	in case of requirement, Water Content will be adjusted based on Moisture Content

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iv		Particle size distribution(Sieve analysis), determination of materials finer than 75 micron,	Sieves, balance, Oven, Thickness gauge, Length Gauge, Metal Scoop etc	B	Physical	Once per 100 Cum or Part thereof or on every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
v		Ten percent fine value		B	Physical	Once per source or as required	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
vi		Soundness	Reagent sodium sulphate or magnesium sulphate	A	Physical	Once per source or every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
vii		Alkali aggregate reactivity	Scales, weights, glass graduates, mixing bowl, trovel container, length comparator etc	A	Physical	Once per source or every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
viii		Petrographic examination	Screens, hand lens, microscope etc	A	Physical	Once per source or every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
ix		Aggregate Crushing value	As agreed/required	A	Physical	Once per source or every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
x		Aggregate Abrasion value		A						√	
xi		Aggregate Impact Value		A						√	
3.00	**Fine Aggregates**										
i		Bulking of sand	As agreed/required	B	Physical	Every 100 cum of RCC work	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	In case of volumetric mixing only and when permitted / envisaged in Tech. Specs.
ii		Silt content	As agreed/required	B	Physical	Every 100cum	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383		√	
iii		Particle size distribution(Sieve analysis), determination of materials finer than 75 micron,	As agreed/required	B	Physical	One per Every 50 cum or part thereof for RCC work, and One per Every 100cum or part thereof for other works	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383		√	
iv		Moisture Content	As agreed/required	B	Physical	Once for each stack of 100 Cum Or part thereof. Every day before start of concreting during monsoon.	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	Weight of sand and weight of water will be adjusted as per moisture content.
		water absorption	As agreed/required	B	Physical	Once per source or every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	
v		Soundness, alkali aggregate reactivity, Petrographic examination	As agreed/required	A	Physical	Once per source or every change of source	CPWD/Tech Spec/IS 2386/IS 456/IS 383	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√	

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4.00	**Construction Water**	Harmful substances, PH value, Alkalinity, Solids as per IS:3025	As agreed/required	B	Physical	Once for each source and on every Seasonal change in case of water collected from open well or on change in source or as instructed by EIC.	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. Drawings	SR/TR	√	

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5.00	**REINFORCEMENT STEEL**										
i		Physical and Chemical Properties for each lot as per relevant IS codes, Submission of MTC for each batch of delivery from NTPC approved source	-	A	Physical /Review of MTC/ Test Report	Each batch of delivery at site	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR	√	Correlated MTC shall be verified. In the event of non submission of MTC or descripancy in MTC , samples shall be selected by FQA for testing for PHYSICAL AND CHEMICAL properties.
ii		Tensile test	As agreed/required	A	Review of TC	Each batch of delivery at site or as instructed by EIC in writing.	CPWD/Tech.Spec. and cons. Drawings, Relevent IS Codes	CPWD/Tech.Spec. and cons. Drawings, Relevent IS Codes	MTC/TR	√	
iii		Bend test and rebend test	As agreed/required	A	Physical	Each batch of delivery at site	CPWD/Tech.Spec. and cons. Drawings, relevant IS code	CPWD/Tech.Spec.and cons.Drawings, relevant IS code	SR/TR	√	
iv		Freedom form cracks surface flaws, Lamination. (Visual Examination).	As required	B	Physical / Visual	Random	IS: 1852, IS:432, IS:1786,IS:432 & NTPC Technical Specifications		SR/LB		To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.
v		Check for bar bending schedule with necessary laps. Spacers & Chairs	As required	B	Physical	Random	Approved Drawings		SR	√	
vi		Check for cover, spacing of bars	As required	B	Physical	Random	Approved Drawings		SR		
vii		Check for bending of bars	As required	B	Physical	Random	Approved Drawings		SR		
viii		Check for spacers and chairs after the reinforcement cage is put inside the formwork	As required	B	Physical	Random	Approved Drawings		SR		
ix		Lapping of bars	As required	B	Physical	Random	IS : 456/ Drawings & approved bar bending schedule		SR		
x		Check all joints, Crossing	As required	B	Physical/visual	Random	Approved drawing/bar bending schedule		SR		
xi		Check for the transportation and storage of steel as accepted by EIC	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
6.00	**FORM WORK**										
i		Check for form work condition, size, shapes,strengths,rigidity, tigthness and smoothness of surface	As agreed/required	C	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. Drawings	SR	√	Site Register / Pour card etc
ii		Inspection and acceptance of form work before concreting	As agreed/required	B	Physical/visual	100 % Prior to each concreting	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
7.00	**TESTINGS FOR ALL TYPES OF DESIGN MIX CONCRETE AND VOLUMETRIC MIXER CONCRETE INCLUDING DESIGN MIX CONCRETE FOR ROAD WORKS**										

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i		Submission of concrete mix-design report	As agreed/required	A	Review	Once per source	CPWD/Tech.Spec. and cons. Drawings IS 10262, IS 456	CPWD/Tech.Spec. and cons. Drawings IS 10262, IS 456	SR	√	
ii		Approval of the concrete mix report	As agreed/required	A	Acceptance	Once per source	CPWD/Tech.Spec. and cons. Drawings IS 10262, IS 456	CPWD/Tech.Spec. and cons. Drawings IS 10262, IS 456	SR	√	
iii		Approval of the concrete mix report as per site trials & checking of slump & compressive strength witnessed by NTPC Representative	As agreed/required	A	Physical	Minimum 4 trials with each source or on every change of source	CPWD/Tech.Spec. and cons. Drawings, IS 10262, IS 456 and other relevant IS codes	CPWD/Tech.Spec. and cons. Drawings, IS 10262, IS 456 and other relevant IS codes	SR	√	
8.00	**Calibration of Batching Plant**										
i		Calibration of measuring device for cement & water scales	As agreed/required	A	Calibration	At starting and thereafter every three months	Tech.Spec. and cons. drawings IS:4925	Tech.Spec. and cons. drawings IS:4925	SR	√	
ii		Calibration of measuring device for other than cement bag & water scales	As agreed/required	A	Calibration	At starting and thereafter every three months	Tech.Spec. and cons. drawings IS:4926	Tech.Spec. and cons. drawings IS:4926	SR	√	
9.00	**Execution of all concrete works**										
i		Check of Batching mixing, conveying, placing, Compaction and curing of concrete.	As agreed/required	B	Physical	Randomly in each shift of concreting	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. Drawings	SR	√	Batch report, Curing register etc
ii		Check for formwork condition, size, shapes, strengths,rigidity, tightness and smoothness of surface.	As agreed/required	B	Physical	Randomly prior to each concrete	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
iii	Workability Test	Slump Test	As agreed/required	B	Physical	One test every 2 hrs. from each mixing plant	CPWD/Tech.Spec. and cons. Drawings & relevent IS Codes	CPWD/Tech.Spec. and cons. Drawings & relevent IS Codes	SR	√	
10.00	**Works Cube for testing 7 days/28 days compressive strength report**	Works Cube test for 7 days/28 days compressive strength report	As agreed/required	A	Physical	One set of 6 cubes per 50cum concrete or part thereof for each grade of concrete	CPWD/Tech.Spec. and cons. Drawings & relevent IS Codes	CPWD/Tech.Spec. and cons. Drawings & relevent IS Codes	SR/TR	√	
11.00	**Precast Cement Concrete**										
i		Check of Batching mixing, conveying placing, compaction of concrete	As agreed/required	B	Physical	Randomly in each shift of concreting	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. Drawings	SR		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 Same as applicable to cast in situ concrete. The grade of concrete
ii		Dimension of finish structure	As required	B	Measurement	100%	As per IS:456/CPWD/ NTPC Tech. specification.		SR		
iii		Check surface finish cracks, rusting of steel marking storage etc.	As agreed/required	B	Visual	Randomly or more frequently as directed by EIC	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. Drawings	SR		

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v		Acceptance of erection of precast RCC element	As agreed/required	B	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		used shall be as per the technical specification. If the material of the cast-in-situ concrete is already tested 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.
12.00	**Precast Cement Concrete Jali**	Acceptance of erection of precast cement concrete jali	As agreed/required	B	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
13.00	**Damp Proof Course**										
i		Check for the materials of bitumen and water proofing materials	As agreed/required	A	Review of MTC / TR	Each batch of delivery at site	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR/MTC	√	
ii		Acceptance of damp proof course	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
14.00	**Expansion Joints**										
i		Check for the materials for expansion joints	-	A	Review of MTC	Each batch of delivery at site	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR/MTC	√	
ii		Acceptance of expansion joints including covering	As agreed/required	B	Acceptance	Randomly for each joints	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
IV	**Brick work/Brick Tiles/Ash Bricks**										
1.00		Dimensions	As agreed/required	B	Physical	Random	As per constr drawing	As per constr drawing	SR	√	
2.00		Compressive strength	As agreed/required	A	Physical	As per relevent IS code/ One sample for 30,000 nos. or part thereof	CPWD/Tech.Spec. and cons. Drawings/IS:12894/Relevant IS Code	CPWD/Tech.Spec. and cons. Drawings/IS:12894/Relevant IS Code	SR/TR	√	
3.00		Water absorption								√	
4.00		Efflorescence								√	
5.00		Check for mortar mixing and placing	As agreed/required	B	Physical	Random in each shift	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
6.00		Check for finishing of joints vertically and curing during execution	As agreed/required	B	Physical	Random in each shift	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
V	**Precast Flyash/Cement concrete tiles/CC kerb stones and interlocking**										
1.00		Check for compressive strength	As agreed/required	A	Review of MTC / Test report	Each batch of delivery at site	CPWD/Tech.Spec. and cons. Drawings, relevant IS code	CPWD/Tech.Spec. and cons. Drawings, relevant IS code	SR/MTC	√	
2.00		Check for the surface finish, colour for each lot of delivery from approved source	As agreed/required	B	Physical / Acceptance	Random as per Tech. Spec.	CPWD/Tech.Spec. and cons. Drawings, relevant IS code	CPWD/Tech.Spec. and cons. Drawings, relevant IS code	SR		
3.00		Acceptance for laying and finishing	As agreed/required	B	Physical / Acceptance	Random	CPWD/Tech.Spec. and cons. Drawings, relevant IS code	CPWD/Tech.Spec. and cons. Drawings, relevant IS code	SR		

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VI	**Door, Windows, ventilator & grill**										
1.00	Check for the materials/items for all types of Timber, flush door, particle doors, Aluminum doors, Fire proof doors, window fittings, Anodized aluminum works, Mortice locks, Automatic operating systems etc received at site	Review of MTC/Make or/and Physical checks, test reports, Factory inspections	As agreed/required	A	Review of MTC/Physical	For each batch of delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC/TR	√	Factory Inspection-PDI is to be done by FQA where ever applicable
2.00	**Wood Work**										
i	Timber	Moisture content	Electrical Moisture meter as per IS 287	A	Physical	Every 1 cum or part thereof	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR	√	
ii	Wood work in frames	Check for dimensions, surface finish	As agreed/required	B	Physical	Random for each installation	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
iii	Flush Door shutter	End emersion test, knife test, adhesion test	As agreed/required	A	Lab	As per CPWD specifications	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR	√	PDI is to be done by FQA
3.0O	**Shelves of Wardrobes and showcases**										
i		Check for the material is as per Tech Spec and from NTPC approved source	As agreed/required	A	Physical	One sample for each section for each lot of delivery	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec.and cons.drawings	SR	√	
ii		Acceptance of fixing after completion	As agreed/required	B	Acceptance	100%	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec.and cons.drawings	SR		
4.00	**Pelmets**										
i		Check for the material is as per Tech Spec, Drawing and from NTPC approved source	As agreed/required	A	Visual and Physical	Once sample for each section for each lot of delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR	√	
ii		Acceptance of fixing after completion	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
5.00	**M.S. Grills**										
i		Check for material for section and weight is as per Tech Spec and procured from NTPC /EIC approved source	As agreed/required	A	Physical	One sample for each section for each lot of delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR	√	
ii		Check for fabrication works and is done at approved workshop	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
iii		Acceptance of fixing of MS-grill	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		

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6.00	**Fitting and fixtures- Aluminum or Mild Steel, Stainless Steel sliding door bolts,tower bolts, pull bolts lock, MS handles, Safety chains,Brass locks, Brass Latch, Hydraulic floor spring and door stopper/closer etc.**	Check for conformance with relevent IS Code/Tech Spec/BOQ/ CPWD Specs and are from NTPC approved source	As agreed/required	A	Physical and acceptance	As per CPWD Spec/IS Code	CPWD/Tech.Spec. and cons. Drawings/IS Code	CPWD/Tech.Spec. and cons. Drawings/IS Code	SR/MTC/TR	√	
7.00	**Mortice Locks**	Testing of spring	As agreed/required	B	Lab	100 nos or part thereof	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR	√	
8.00	**Float/Frosted glass**										
i		Check for Material	As agreed/required	A	Physical and Review of MTC	Each lot of delivery at site	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons. drawings	SR/MTC	√	
ii		Check for the dimension and Thickness of glass	As agreed/required	B	Physical	Each lot of delivery at site	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons. drawings	SR	√	
VII	**STEEL WORKS**										
1.00	**Structural steel works in Built up sections for Trusses and framed work**										
i	Check for Materials	Check for source as per NTPC approved vendor list, Mechanical & chemical properties	As agreed/required	A	Physical and MTC Review	Each lot of delivery	Technical Specification and Construction Drawings /Relevent IS	Technical Specification and Construction Drawings /Relevent IS	MTC	√	
ii		Check for dimension, Thickness, welding and finishing of sections	As agreed/required	A	Physical & visual	Random	CPWD/Tech.Spec. and cons. drawings/Relevent IS	CPWD/Tech.Spec. and cons. drawings/Relevent IS	SR	√	Welding Process shall be as per CPWD or approved NTPC / LLOYODS / BVQI / TUV APPROVED WPS / PQR that are meeting the technical specification requirements are also acceptable.
iii		Acceptance after erection	As agreed/required	B	Physical & acceptance	100%	CPWD/Tech.Spec. and cons. drawings/Relevent IS	CPWD/Tech.Spec. and cons. drawings/Relevent IS	SR		
2.00	**Rolling Shutters**										
i		Check for surface finish and thickness of plate of rolling shutters of approved make.	As agreed/required	B	Physical	Random for each batch of delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR	√	PDI is to be done by FQA
ii		Acceptance for Rolling Shutters after fixing	As agreed/required	B	Physical & acceptance	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		

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3.00	**Steel / Glazed Doors, windows and T-Iron Frames Sections**										
i	Check for materials	Tensile strength and Bend test		A	Review of MTC for each delivery	20 MT or part thereof	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec.and cons.drawings	SR/MTC	√	
ii		Check for shape tolerences thickness, welding & finishing of sections	As agreed/required	A	Review of MTC for each delivery	Random for each delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	
iii	Checking of works	Acceptance of steel glazed doors, windows and T-iron shapes sections after fixing	As agreed/required	B	Physical & acceptance	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
iv		Acceptance of fixing after completion	As agreed/required	B	Acceptance	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
4.00	**Pressed Steel doors and frames**										
i		Check for shape, tolerances, thickness, welding & finishing of sections	As agreed/required	A	Review of MTC for each delivery	Random for each delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	
ii		Acceptance of pressed steel glazed doors after fixing	As agreed/required	B	Physical & acceptance	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
5.00	**Welded builtup sections for Hand rails using MS Tubular/ERW tubular pipes and GI Pipes**										
i		Check for material is as per Technical specification / BOQ and from NTPC approved sources	As agreed/required	A	Review of MTC for each delivery	Random for each delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	Welding process shall be as per CPWD specification. Galvanizing shall be as per the technical specification requirement.
ii		Tensile strength and Bend test, Flattening Test	As agreed/required	A	Review of MTC / TC for each delivery	10MT and part thereof	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR / MTC	√	
iii		Acceptance of welded builtup sections/framed work after fixing/erection	As agreed/required	B	Physical & acceptance	Random for each type of sections/framed work	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
6.00	**Fire Resistance Doors**	Check for material as per IS:3614(II)	As agreed/required	A	Acceptance	Random for each delivery as per IS:3614(II)	Tech.Spec. and cons.drawings	Tech.Spec. and cons.drawings	SR / MTC / TR	√	PDI to be done by FQA
7.00	**Fencing and Gates**										
i	Check for Materials for fencing and gates	PVC coated chain link fencing , Welded wire mesh, Reinforced barbed tape	As agreed / required	A	Review of MTC	Each batch of delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
ii	Check for alignments, erection painting, DFT etc		As agreed/required	B	Physical	Random for Each installation	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		

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iii	Acceptance of the installation and working		As agreed/required	B	Physical	Random for Each installation	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
8.00	**Galvanized Chicken Wire Mash**	Check for guage and dimensions and procured from NTPC approved source	As agreed/required	A	Acceptance	Random for each delivery	Tech.Spec. and cons. drawings	Tech.Spec. and cons. drawings	SR		
9.00	**Circular / Hexagonal Cast Iron or M.S. Steel Box for Ceiling Fan Clamp**	Check for fixing circular cast iron box for ceiling fan clamps	As agreed/required	C	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
10.00	**Painting of Steel works**										
i	Check for the Materials and accessories	Synthetic enamel and all types of primer and paints, check for shade,type from brand and manufacturers approved by NTPC/EIC	As agreed/required	A	Physical/ Review of MTC	Each delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	
ii		Preparation of surfaces, application of paint and finishing as per approved painting scheme	As agreed/required	B	Physical	100%	CPWD/Tech.Spec. and cons. Drawings, approved painting scheme	CPWD/Tech.Spec. and cons. Drawings, approved painting scheme	SR	√	Painting scheme of steel structures shall be submitted and got approved by EIC.
iii		Acceptance of finishing	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. Drawings, approved painting scheme	CPWD/Tech.Spec. and cons. Drawings, approved painting scheme	SR		
VIII	**FLOORING & ALLIED WORKS**										
1.00	**Cement Concrete Flooring**										
i		Check for execution of concreting	As agreed/required	B	Physical	Random in each shift	Tech.Spec. and cons. drawings	Tech.Spec. and cons. drawings	SR		
ii		Check for providing and fixing glass/PVC stops rejoints	As agreed/required	B	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
iii		Check for laying polishing, cutting, finishing to terezzo marble clip flooring	As agreed/required	B	Physical	Random in each shift	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
iv		Acceptance of lines, levels and finishing	As agreed/required	B	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
2.00	**Acid and or Alkali Resistance tile**										
i		Check for lines and alkalis resistance cement as per IS:4457 / Tech. Specs	As agreed/required	A	Review of MTC for each delivery	Each delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	
ii		Acceptance of lines, alkalis and finishing	As agreed/required	B	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		

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3.00	Kota stone, Granite & Marble Work & other stone work										
i	Checking of materials	Check for dimensions, quality, texture thickness colour, strains,cracks	As agreed/required	B	Visual & Physical	Random for each batch of delivery received at site	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
ii		Moisture absorption	As agreed/required	A	Physical	Every 50 sqm or part thereof	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR	√	
iii	Checking of works	Check for mortar mixing laying, jointing and finishing	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec.and cons.drawings	SR		
iv		Check for prepared surface, laying and joints	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
v		Acceptance for cutting, polishing and finishing	As agreed/required	B	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
4.00	Ceramic Glazed Wall and Floor Tiles, Polished vitrified floor tiles										
i		Check for the tiles from NTPC approved sources and are as per specification	As agreed/required	A	Physical & review of MTC	Each batch of delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR	√	
ii		Water absorption test, impact strength, chemical resistance test, crazing test	As agreed/required	A	Review of MTC/TR for each delivery	3000 nos. or part thereof.	CPWD/Tech.Spec. and cons. Drawings/ Relevent IS Codes	CPWD/Tech.Spec. and cons. Drawings/ Relevent IS Codes	SR/TR	√	In case of non submission of MTC, tests specified in CPWD Specs to be done in Third party Lab
iii		Check for prepared surface, laying and joints	As agreed/required	C	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
iv		Acceptance for curing and finishing	As agreed/required	B	Acceptance	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
IX	ROOFING										
1.00	Painting of roof with hot bitumen										
i		Check for the material	As agreed/required	A	Review of MTC for each delivery	Each delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	
ii		Acceptance for the execution of painting of roof with hot bitumen	As agreed/required	B	Acceptance	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
2.00	Paving over Mumty Roofs with Brick Tiles										
i		Mandatory Test for brickwork on as specified at Chapter -6 of CPWD Specifications	As agreed/required	A	Physical	Each lot of delivery as specified at Chapter -12 of CPWD Specifications	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
ii		Mortars - Mandatory Test on as specified at Chapter -3 of CPWD Specifications	As agreed/required	A	Physical	As specified at Chapter -12 of CPWD Specifications	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		

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iii		Check for Mortar mixing and placing	As agreed/required	B	Physical	Random in each shifts	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
iv		Check for finishing of joints verticality and curing during execution	As agreed/required	B	Acceptance	Random in each shifts	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
3.00	Rain Water Spouts (GI/CI/PVC)										
i		Making of khurras-Check for the thickness of PVC sheet	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
ii		Check for rain Water pipes, fitting/accessories, pipes confirming to Relevent IS/BOQ, clips sealing ring and material from NTPC aproved source/brand	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. Drawings/BOQ/ Relevent IS	CPWD/Tech.Spec. and cons. Drawings/BOQ/ Relevent IS	SR	√	
iii		Check for rain water pipe GI/caste iron grating diameter and weight	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR	√	
X	FINISHING AND ALLIED WORKS										
1.00	PLASTERING										
(i)	MATERIALS- SAND FOR PLASTERING										
a	Check for Materials- Sand, Wire net	Mortars - Mandatory Test on as specified at Chapter -3 of CPWD Specifications	As agreed/required	A	Physical	As specified at Chapter -3 of CPWD Specifications	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/TR		
b		Deleterious Material	As agreed / required	B	Physical	Once per source	CPWD/Tech.Spec. and cons. Drawings/ Relevent IS Code	CPWD/Tech.Spec. and cons. Drawings/ Relevent IS Code	SR		
c		Grading	As agreed / required	B	Physical	50 Cum./or part thereof	CPWD/Tech.Spec. and cons. Drawings/ Relevent IS Code	CPWD/Tech.Spec. and cons. Drawings/ Relevent IS Code	SR		Table -I of IS:1542
d		Galvanized hexagonal wire netting for lath plastering	As agreed / required	A	Review of MTC	Each batch of delivery	CPWD/Tech.Spec. and cons. Drawings/ Relevent IS Code	CPWD/Tech.Spec. and cons. Drawings/ Relevent IS Code	SR/MTC		
(ii)	Checks for Plastering Works										
a		Check for Mortar mixing and placing	As agreed/required	B	Physical	Random in each shifts	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
b		Check for finishing of joints verticality curing and thickness during execution	As agreed/required	B	Physical	Random in each shifts	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		

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c		Check for defects and the remedial measure for bond filler , blistering , cracking and crazing , efflorescence and irregularity of surface	As agreed / required	B	Visual / Physical	Random in each shift	CPWD/Tech.Spec. and cons. Drawings, IS: 1661	CPWD/Tech.Spec. and cons. Drawings, IS: 1661	SR		
d		Trueness of plastering system	As agreed/required	B	Visual/Physical	Random in each shifts	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
e		Acceptance of Grooves and finishing	As agreed/required	B	Acceptance	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
2.00	**FALSE CEILING**										
i		Check for the Materials - Glass Reinforced Gypsum (GRG), Pre-painted coil coated steel false ceiling system etc from NTPC approved Sources	As agreed / required	A	Physical and Review of MTC	Each batch of delivery	As per relevant IS and Tech. Specs, CPWD / Manufacturer's TC	As per relevant IS and Tech. Specs, CPWD / Manufacturer's TC	SR/MTC	√	All supports , hangers , accessories shall be as per Tech. Specifications/ approved manufacturer's recommendations
ii		Fixing and erection	As agreed / required	B	Physical / visual	Random	As per relevant IS and Tech. Specs, CPWD / Manufacturer's TC	As per relevant IS and Tech. Specs, CPWD / Manufacturer's TC			
3.00	**Painting System**										
i	Check for the Materials and accessories	White wash, distemper and all types of primer and paints, check for shade,type from brand and manufacturers approved by NTPC/EIC	As agreed/required	A	Review of MTC	Randomly for Each batch of delivery.	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
ii		Preparation of surfaces, application of paint and finishing	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
iii		Acceptance of finishing	As agreed/required	B	Acceptance	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
5.00	**Resin bonded Decorative Textured coating**	Check for material from NTPC approved source	As agreed/required	A	Physical & review of MTC	Random in each delivery	CPWD/Tech.Spec. and cons. drawings and BOQ	CPWD/Tech.Spec. and cons. drawings and BOQ	SR/MTC	√	
XI	**ROAD WORKS**										
1.00	Mandatory Test for Road Work	Mandatory Test for Road Work on as specified at Chapter -16 of CPWD Specifications	Lab	A	Physical	CPWD Spec	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/TR		
2.00	Sub-Grade Preparation	Check for consolidation and surface regularity	As agreed/required	B	Physical	CPWD Spec.	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons.drawings	SR	√	
3.00	Water Bound Macadam										

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i		Check for spreading of aggregates, screening, rolling, watering and consolidation	As agreed/required	B	Physical	Random in each shift as per CPWD Spec.	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
ii		Acceptance for surfaces eveness after laying each grade.	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
3.00	WMM & GSB	Tests specified in Section 900 of MOSRTH Specs	As agreed/required	A	Physical	As per Section 900 of MOSRTH specification	Tech Specs and Const. Drawings, Section 900 of MOSRTH specification,	Tech Specs and Const. Drawings, Section 900 of MOSRTH specification,	SR / TR	√	
4.00	**Cement Concrete Pavements**										
4.10	Levels, alignment & texture	Check for Levels, Width of pavement & position of paving edges, Pavement thickness, Alignment of joints, width, depth of dowel grooves, Surface accuracy, Alignment of Dowel bars & their accuracy / tie bars, Texture Depth.	As agreed/required	B	Physical	Random in each shift	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR	√	
4.20	**Quality of material and concrete**										
i	**Cement** [Refer checks of cement as per S. No.(B).(III). (1)]										
ii	**Coarse & fine aggregate** [Refer checks of coarse & fine aggregate as per S.										
iii	**Water** [Refer checks of water as per S. No..(B).(III). (4)]										
iv	**Concrete**										
a		Submission & Approval of Design mix concrete and volumetric mixer concrete [Refer checks as per S. No.(B)(III).)									

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b		Strength of concrete	As agreed/required	A	Physical	I) For Flexural Strength of Concrete: One test of sample consisting of eight specimen for every 30 cum of concrete as specified at chapter 16 of CPWD Spec. or as directed by EIC. II)Compressive strength: [Refer checks as per S. No.(B)(III).(8)(iii)]	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec . and cons. drawings	SR/TR	√	
c		Workability - Slump test	As agreed/required	B	Physical	One TEST every 2 hrs. from each mixing plant or directed by the Engineer-in-Charge.	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR	√	
d	**Execution of concrete for road work** [Refer checks as per S. No..(B).(III). (9)]										
XII	**SANITARY INSTALLATION**										
1.00		Check for size and surfaces, finish of all sanitary items and fixtures from NTPC approved sources	As agreed/required	B	Physical	100% after delivery as per CPWD spec.	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR	√	
2.00		Acceptance of installations of all sanitory items and fixtures, Grooves and finishing	As agreed/required	B	Physical	Randomly for Each type of Installation	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
3.00	**SCI, S&S, PVC Pipes, appliances & Fittings**										
i		Check for material from NTPC approved source, Check for size and surface,finish of pipes, Workmenship and finish	As agreed/required	B	Visual	Random in each shift as per CPWD spec.	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
ii		Unit weight and dimension	As agreed/required	B	Physical	Random in each shift as per CPWD spec.	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR	√	
iii		Leakage checking	As agreed/required	C	Physical	Randomly for Each type of Installation	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR	√	

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4.00	**Water Supply, GI Pipes and all types of fittings**										
i		Check for size and surfaces, finish of all water supply, GI pipes and fittings from NTPC approved source	As agreed/required	B	Physical / MTC Review	Make verification for each consignment delivery / as specified in CPWD spec.	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR / MTC	√	Galvanizing shall be as per the technical specification / BOQ
ii		Acceptance of installation of all water supply GI pipes and fittings	As agreed/required	B	Acceptance	Random for each set	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
5.00	**Polyethylene water storage tank.**										
i		Check for material of tanks from NTPC aproved sources	As agreed/required	A	Review of MTC for each delivery	Each lot of delivery as per CPWD spec.	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR	√	
ii		Acceptance of installation and fittings	As agreed/required	B	Acceptance	100%	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR		
XIII	**DRAINAGE**										
1.00	**SW Pipes & RCC Pipes**										
i		Check for material from NTPC approved source, Check for size and surface,finish of pipes	As agreed/required	A	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
ii		Testing of joints	As agreed/required	B	Physical	100%	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. & cons. drawings	SR	√	
iii		Acceptance of installation of pipes	As agreed/required	B	Acceptance	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. & cons. drawings	SR		
2.00	**CI cover & Frames/SFRC Covers**										
i		Check for CI and SFRC covers and frames as per IS:1726 and IS:12592 from NTPC approved sources	As agreed/required	A	Review of MTC for each delivery	Each lot of delivery as per CPWD spec.	CPWD/Tech.Spec. and cons. Drawings	CPWD/Tech.Spec. and cons. Drawings	SR	√	
ii		Acceptance of installation of CI covers and frame	As agreed/required	B	Acceptance	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
XIV	**Aluminum Work**										
1.00		Check for section/fixtures, dimensions and material is from NTPC approved source	As agreed/required	A	Physical and review of MTC for each delivery	Once for each section of each lot of delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR	√	
2.00		Acceptance of using after completion	As agreed/required	B	Acceptence	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		

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XV	Water Proofing										
1.00		Check for water proofing compound/blown/residual bitumen PVC sheet, PVC water proofing from NTPC approved source	As agreed/required	A	Physical and review of MTC for each delivery	Once sample from each section for each lot of delivery	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR/MTC	√	
2.00		Acceptance of water proofing system - Application, fixing, laying	As agreed/required	B	Physical	Random	CPWD/Tech.Spec. and cons. drawings	CPWD/Tech.Spec. and cons. drawings	SR		
NOTE: THIS FIELD QUALITY PLAN SHALL BE READ IN CONJUNCTION WITH THE REQUIREMENTS OF NTPC TECHNICAL SPECIFICATIONS, BOQ AND CONSTRUCTION DRAWINGS.											
		LEGEND: D * Records, identified with "Tick" (√) shall be essentially included by supplier in QA documentation.					DOC. NO.:				
							REV No:	00			
		Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB				For NTPC USE					
Sub-supplier	Main-supplier	Categorization Witnessing & Accepting (As per NTPC QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer; SR = Site Register , TR= Test Report, MfrTC = Manufacturer's Test Certificate					REVIEWED BY	APPROVED BY	APPROVAL SEAL		
Signature											

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1.00	STRUCTURAL STEEL MATERIAL										
i		Material- Visual Examination, Identification and marking for grade/ type of steel		B	Visual	Each plate/ Section	Tech Specs and Const. Drawings				MS steel conforming to IS 2062
ii		Structural steel procured from NTPC approved sources- Mechanical (YS, UTS, Elg, UT if specified),,and Chemical properties (CE as per IS)		A	Review	For each batch of each section delivered at site	Technical Specification and Construction Drawings, IS 2062		SR	√	Correlated MTC shall be verified. In the event of non submission of MTC , sample shall be selected by FQA for testing
1.01	PRE-WELDING REQUIREMENTS										
i		Welding Procedure Specification * (WPS*)	-	A	Review	Each Welding Process	Technical Specification and Construction Drawings, ASME-IX/ AWS D 1.1		WPS	√	*To be approved by CQA
ii		PQR and Welder's Qualification	-	A	Physical	Each welder	PQR/ WQR, AWS-D1.1/ASME-IX, Technical Specifi- cation and Construction Drawings		Test Report	√	
iii		Welding consumables	-	B	Physical	Random in each shift	Approved WPS, Latest NTPC Rationalized list of Electrodes.		SR	√	
1.02	FIT-UP										
i		Marking and Cutting	Tape, ruler etc	B	Visual & Measurement	Each plate/ Section	Technical Specification and Construction Drawings/ Approved cutting plan		SR		
ii		Match markings for trial assembled components	-	B	Physical	Each fit-up	Technical Specification and Construction Drawings		SR		
iii		Weld Fit Up- Edge Preparation/ Gap/ Alignment	Tape, ruler etc	B	Physical	Each fit-up	Technical Specification and Construction Drawings, IS 7215		SR	√	If required suitable stiffners shall be provided to prevent deflection.
1.03	PRE HEATING (wherever applicable)										
i		Pre-Heating Temperature	Thermal chalk	B	Measurement	Each pre-heating	Technical Specification and Construction Drawings, Approved WPS		SR	√	
ii		Post Weld Heat Treatment (PWHT), if required	Thermo couple with time temperature recorder	A	Time & Temperature	Each PWHT	Technical Specification and Construction Drawings, Approved WPS		SR	√	
1.04	WELDING REQUIREMENTS										
i		Sequence of welding	-	B	Physical	Random in each shift	Technical Specification and Construction Drawings, Agreed scheme		SR		
ii		Removal/ grinding of temporary attachments	-	B	Measurement	All cleats/ attachments	Technical Specification and Construction Drawings, Approved Drg.		SR		
iii		Completeness after welding- Dimensions/ distortion	Weld gauge	B	Visual	Each structure component	Technical Specification and Construction Drawings, IS 822		SR	√	
iv		Completeness of welding (each butt & fillet weld)		B	Visual	Each structure component	Technical Specification and Construction Drawings, Approved Drg.		SR	√	

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2.00	NON DESTRUCTIVE AND DESTRUCTIVE TESTING										
2.1	FILLET WELDS										
i		size and visual examination	As required/ agreed	B	Visual/ Measurement	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR		As per requirement of NTPC Engineer
ii		Macro-etch Examination on production test coupons	As required/ agreed	B	Physical	Main fillet weld with min one joint per built up beam, columns and crane girders	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR	√	
iii		Dye Penetration Test	As required/ agreed	B	Physical	25% weld length of tension member of crane girder and 5% of Weld length with min. 300mm at each loaction except crane girder to all other fillet welds	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR		
2.2	BUTT WELDS										
i		Visual examination	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR		As per requirement of NTPC Engineer
ii		DPT	As required/ agreed	B	Physical	100% on all butt welds after back gouging on root run and 10% on final weld.	As per technical specifications and construction drawings, IS 822, AWS D 1.1		IR		All butt welds to be back gouged before DPT
iii		Mechanical testing on production test coupons	As required/ agreed	B	Physical	Min. one joint per built up beams, coloums and crane girder.	As per technical specifications and construction drawings, IS 822, AWS D 1.1		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, IS 822, AWS D 1.1		IR	√	Wherever RT is not feasible UT to be carried out. 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.
2.3	COAL BUNKER / BINS										
		i) DPT	As required/ agreed	B	Physical	10% DPT after back gouging.	As per technical specifications and construction drawings		IR		
		ii) Spot radiography test on butt welds	As required/ agreed	A	Physical	5% spot RT on butt welds	As per technical specifications and construction drawings		IR	√	Where access not available, UT shall be carried out with prior approval of Engineer incharge
2.4	FULL PENETRATION WELDS (OTHER THAN BUTT WELDS)										
		Ultrasonic Testing	As required/ agreed	A	Physical	i) 100% UT on the web to flange joint of crane girder ii) 10% UT on other full penetration joints	As per technical specifications and construction drawings, IS 822, AWS D 1.1		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.

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		ITEM : STRUCTURAL STEEL WORK		QP NO. :			PROJECT:	PATRATU STPS EXPANSION PHASE-I (3 X 800 MW)			
				REV. NO .:		0	PACKAGE:	EPC PACKAGE			
		SUB-SYSTEM : FABRICATION & ERECTION		DATE :			CONTRACT NO.				
				PAGE :		3 of 6	MAIN CONTRACTOR				
Sl. No	**Activity and operation**	**Characteristics / instruments**		**Class# of check**	**Type of Check**	**Quantum Of check**	**Reference Document**	**Acceptance Norms**	**Format of Record**		**Remarks**
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**D***	**10**
2.5	**NON DESTRUCTIVE AND DESTRUCTIVE TESTING FOR CHIMNEY STEEL LINER**										
i		Visual examination	As required/ agreed	B	Visual	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR	√	As per requirement of NTPC Engineer
ii		DPT	As required/ agreed	B	Physical	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		IR	√	
iii		RT	As required/ agreed	A	Physical	10% FOR SHOP BUTT WELD AND 15% FOR SITE BUTT WELDS	As per technical specifications and construction drawings, IS 822, AWS D 1.1				
3.00	**FOUNDATION CHECKS**										
i		Dimensions and levels- Shape, lines (including diagonal checks)	Theodolite, Tape etc	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings		SR	√	
ii		Foundation Bolts and Embedments- Verticality, Levels, pitch distance	Theodolite, Tape, Piano wires etc	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings		SR	√	
4.00	**PAINTING SYSTEM**										
i		Paining Materials and accessories	-	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings		SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
ii		Submission of painting methodology	-	B	For Review of painting system	Before start of painting work	Tech Specs and Const. Drawings				
iii		Surface prepration	As agreed / required	B	Physical /visual	Each Erection Mark	Tech Specs and Const. Drawings, Relevant code/ standards		SR	√	
iv		Primer Thickness	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR	√	
v		DFT of paint	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR	√	
vi		Acceptance of painted surfaces	Elcometer	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR		
5.00	**PRE-ASSEMBLY CHECKS**										
i		Punch Erection marks and match marks on members	-	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				Markings for - Assembly designation, Part number, Weight, Any other important identifications.
ii		Pre-assembly as per match mark	-	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				
iii		Camber, sweep and total length after trial assembly of structure.	Theodolite, Tape, plumb, piano wires etc	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		SR	√	
iv		Control assembly check at shop	Theodolite, Tape, plumb, piano wires etc	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings				
V		Completion of primer & intermediate coat of paint		B	Visual / Physical	Random	Tech Specs and Const. Drawings		SR		
5.10	**INSTALLATION AND ALIGNMENT OF STEEL LINER**										
i		Submission of Installation/ Erection Scheme/ methodology for all structures	-	B	Approval	Once prior to erection of each structure	Approved drawings and Technical Specifications		SR	√	
ii		Check for Erection Marks	-	B	Visual	100%	Approved drawings and Technical		SR		

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN									ANNEXURE VI
		ITEM : STRUCTURAL STEEL WORK		QP NO. :			PROJECT:	PATRATU STPS EXPANSION PHASE-I (3 X 800 MW)			
				REV. NO .:		0	PACKAGE:	EPC PACKAGE			
		SUB-SYSTEM : FABRICATION & ERECTION		DATE :			CONTRACT NO.				
				PAGE :		4 of 6	MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
iii		Check for Installation of Steel Liners	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
iv		Check for Site Joints	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
v		Check for Installation of Inlet Transition Ducts	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
vi		Check for Installation of Insulations and Expansion Compensators	As required	B	Visual, Physical, Acceptance	100%	Approved drawings and Technical Specifications		SR		Each layer of expansion Compensator tobe checked at shop for thickness, unit weight, tensile strength & elongation along with temp. withstandability for composite joints
vii		Ensure the Erection of all steel structures along with permissible tolerances and their acceptance	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
viii		Check and approval for Dismantling, Modification and Re-erection, if required for any reason	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
6.00	ERECTION CHECKS										
i		Alignment, slopes, level, tolerances of erected member	Theodolite, Tape, plumb, piano wires etc	B	Measurement	Each structural member	Tech Specs and Const. Drawings		SR	√	
ii		Tightening of bolts/ Torque including foundation bolts with lock nuts	Wrench/ Torque wrench if specified	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		SR	√	
iii		Completion of all erection fillet & butt welds		B	Visual	Each structural member	Tech Specs and Const. Drawings		SR	√	
iv		Acceptance of erected structure	Theodolite, Tape, plumb, piano wires etc	B	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843		SR	√	
7.00	PERMANENT BOLTS AND NUTS AND WASHERS										
i		Material- Permanent mild steel Bolts, mild steel Nuts, High strength structural Bolts, Washers- Dimensions, properties, Class, storage along with MTC	Screw gauge, Vernier, Tape etc.	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	
ii		Contact surfaces before bolting	-	B	Physical	Random before asembly for bolting	Tech Specs and Const. Drawings, IS 4000		SR		
iii		Inspection of the assembled bolts	-	B	Physical	Randomly in each shift for assembeled bolts	Tech Specs and Const. Drawings, IS 4000		SR		
iv		Tensioning	As agreed / required	B	Physical	Randomly during snug tight test and after full tensinoning	Tech Specs and Const. Drawings, IS 4000		SR	√	
v		Acceptance of installed bolts	-	B	Physical	Each bolt	Tech Specs and Const. Drawings		SR		
8.00	ELECTROFORGED GRATINGS										
i		Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	Also refer the approved MQP
ii		Acceptance of Erection, alignment and each Installation	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
9.00	GALVANISED STEEL HAND RAILS										
i		Material		A	Physical	Once per lot	Grade IS:2062, Technical specifications,Galvanised as per IS 4736		SR/LB	√	Galvanising shall be carried out as per the technical specifications.
ii		DPT	As required	A	Physical	Random	AWS D1.1 / Technical specifications		SR/LB	√	

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN									ANNEXURE VI
		ITEM : STRUCTURAL STEEL WORK		QP NO. :			PROJECT:	PATRATU STPS EXPANSION PHASE-I (3 X 800 MW)			
				REV. NO .:		0	PACKAGE:	EPC PACKAGE			
		SUB-SYSTEM : FABRICATION & ERECTION		DATE :			CONTRACT NO.				
				PAGE :		5 of 6	MAIN CONTRACTOR				
Sl. No	**Activity and operation**	**Characteristics / instruments**		**Class# of check**	**Type of Check**	**Quantum Of check**	**Reference Document**	**Acceptance Norms**	**Format of Record**		**Remarks**
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**D***	**10**
10.00	**FLEXIBLE OPEN ENDED BELLOW STRAP**										
i		Check for the Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	
ii		Acceptance of installation of Strap	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR		
11.00	**PTFE SLIDING BEARINGS AND ELASTOMERIC BEARINGS**										
i		Check for the Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	
ii		Acceptance of installation of bearings	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR		
12.00	**HEADED SHEAR STUDS FOR METAL DECK SHEETS**										
i		Procurement of material from approved source	As agreed / required	A	MTC Review	Each lot	Tech Specs and Const. Drawings / ASTM A 29 / AWS D 1.1		SR/MTC	√	
ii		Approval of welding procedures/specification and welding procedure qualification	As agreed / required	A	Visual and destructive as per ASME-IX	100%	ASME sec.IX/ AWS D 1.1/Approved WPS		Test Report	√	
iii		Welders Qualification test	As agreed / required	A	Visual and destructive as per ASME-IX	100%	ASME sec.IX/ AWS D 1.1/Approved WPS		Test Report	√	
iv	Workmanship	Studs shall be free from rust, oil, moisture etc		C	VISUAL	100%	Tech Specs and Const. Drawings		SR		
V	Pre Production Testing	Visual & Bend Test	As agreed / required	B	Visual & Physical	first two studs before start of work for each day or shift	Tech Specs and Const. Drawings		SR	√	Testing shall be repeated whenever there is a change in the essential variables or shift operator change
13.00	**STOP LOG GATE, TRASH RACK AND LIFTING BEAM**										
13.1	**MATERIAL**										
		Check Quantity (in case of receipt) and completeness and damage, surface defects		C	Visual	100%	Challan / Release No damage, surface defectnote		SR	√	
13.2	**ERECTION**										
		Alignment levellling	Plumb, Piano wire,water level	C	Measurement	100%	Specfication/ Approved drawing		Inspect-ion Report		Welding ,if any, involved at site will be done by welders and procedure qualified as per ASME-IX in presence of NTPC(FQA)
13.3	**PAINTING / SURFACE PREPARATION**										
i		Shade	-	B	Visual	100%	Specfication/ Approved drawing		Inspect-ion Report		The type of painting/ surface treatment of parts shall be as per Technical specification
ii		DFT	Elcometer	A	Measurement	Random	Specfication/ Approved drawing		-do-	√	
13.4	**TESTING**										
i	Free movement of stop log / trash rack in guides under dry and under full water condition	Lowering or raising for full length for 2/3 times		A	Physical	100%	Smooth operation, NTPC Tech. Specification, IS:4622		-do-		
ii	Leakage for stop Log	Measurement of leakage	As reqd.	A	Physical	100%	Leakage rate within limit		-do-	√	Maximum leakage rate 5 litre/minute/metre length of seal under max.head as per IS:4622
iii	Load test for lifting beam	Load Test	As reqd.	A	Physical	100%	No deflection /No Deformation		-do-	√	
		LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA						**DOC. NO.:** CS - Project Code - XXX-XX-QVC-G-002		**REV:** 0	
		Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB									

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN								ANNEXURE VI
		ITEM : STRUCTURAL STEEL WORK	QP NO. :			PROJECT:	PATRATU STPS EXPANSION PHASE-I (3 X 800 MW)			
			REV. NO .:		0	PACKAGE:	EPC PACKAGE			
		SUB-SYSTEM : FABRICATION & ERECTION	DATE :			CONTRACT NO.				
			PAGE :		6 of 6	MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3	4	5	6	7	8	9	D*	10
Manufacturer/ Sub-supplier	Main-supplier	Categorization Witnessing & Accepting (As per owner QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report,MfrTC = Manufacturer's Test Certificate				For NTPC use				
Signature		This document shall be read in conjunction with owner Tech. Specifications, BOQ, Drawings					REVIEWED BY	APPROVED BY		APPROVAL SEAL

ANNEXURE – 2F

APPROVED VENDOR LIST

NTPC	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: EPC					REV. NO.	0
	MAIN SUPPLIER: BHEL	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
1.	**CEMENT**	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
2.	**CONSTRUCTION CHEMICALS - ADMIXTURES, PLASTISIZERS, RETARDERS WATER PROOFING COMPOUNDS GROUTS**	III	-	SIKA INDIA LTD	-	N	
				CICO TECHONOLOGIES LTD	-	N	
				FOSROC CHEMICALS (I) PVT LTD	-	N	
				BASF	-	N	
3.	**FALSE CEILING - GLASS REINFORCED GYPSUM SYSTEM, MINERAL FIBRE BOARD SYSTEM, PREPAINTED COIL COATED STEEL SYSTEM**	III	-	SAINT GOBAIN	NEW DELHI	N	
				HUNTER DOUGLOUS	MUMBAI	N	
				TIGER STEEL	PUNE/MUMBAI	N	
				INTERARCH	NOIDA	N	
				LLOYD INSULATION	-	N	
				MG INDUSTRIES	FARIDABAD	N	
				ARM STRONG	NEW DELHI	N	
4.	**PAINT AND PAINTING SYSTEM**	III	-	BERGER	-	N	
				SHALIMAR PAINTS	-	N	
				JENSON AND NICHOLSON	-	N	
				KANSAI NEROLAC	-	N	
				AKZO NOBEL	-	N	
				ASIAN PAINTS	-	N	
5.	**COLOUR COATED SHEET (FOR COIL)**	I	-	UNION STEEL	KOREA	A	
				DONGBU STEEL	KOREA	A	
				BHUSHAN STEEL AND STRIPS LTD.	RAIGAD	A	
				ESSAR STEEL LTD	PUNE	A	
				NATIONAL STEEL AND AGRO	DHAR	A	

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05/04/17

	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
एनटीपीसी NTPC	PACKAGE: EPC					REV. NO.	0
	MAIN SUPPLIER: BHEL	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
				JSW STEEL COATED PRODUCTS LTD	KAMLESHWAR	A	Formerly JSW ISPAT Steel Ltd
				BHUSHAN STEEL LTD.	SAHIBABAD	A	
				JSW LTD	THANE	A	
				BHUSHAN POWER & STEEL LTD	SAMBALPUR (ODISHA)	A	
				TATA BLUESCOPE STEEL LTD	JAMSHEDPUR	A	*AL-ZN COIL FOR CLADDING
6.	**PROFILERS FOR DECKING/ CLADDING SHEETS**	I		UNIMET PROFILES LIMITED	DHARUHERA	A	
				MULTICOLOUR STEEL INDIA LIMITED	GURGAON	A	
				ISOLLOYD	SOLAN	A	
				NATIONAL STEEL AND AGRO	DHAR	A	
				ERA BUILD SYS	RUDRAPUR	A	
				TATA BLUE SCOPE	PUNE	A	HINJEWARI WORKS
				TATA BLUE SCOPE	BHIWADI	A	
				PENNAR INDUSTRIES	ISNAPUR	A	FOR DECKING
				PENNAR INDUSTRIES	TARAPUR	A	FOR CLADDING
				METALKRAFT FORMING INDUSTRIES PVT. LTD.	MEDAK (AP)	A	
				BHUSHAN POWER & STEEL LTD	SAMBALPUR (ODISHA)	A	
				ALFA STEEL BUILDING SOLUTIONS	HOSUR	A	
7.	**ELECTROFORGED GRATING**	II		INDIANA GRATING	PUNE	A	
				PREMIER POWER PRODUCTS (CALCUTTA) PVT LTD	HOWRAH	A	

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05/04/17

	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
						REV. NO.	0
एनटीपीसी NTPC	PACKAGE: EPC	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	MAIN SUPPLIER: BHEL						
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
				GREATWELD	PUNE	A	
				BHOLA RAM STEELS	PATNA	A	
				ANKIT ELECTROGRATING	RAIPUR	A	
				KANADE ANAND UDYOG	THANE	A	
				SUTTATTI ENTERPRISES	PUNE	A	
				PINAX STEEL INDUSTRIES	PATNA	A	
8.	GI PIPES	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
9.	PVC WATER STOP	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
10.	BITUMEN ASPHALT	III	-	ALL GOVERNMENT REFIINARIES	-	-	
11.	PLASTIC/ PVC PIPES	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
12.	BITUMEN IMPREGNATED FIBER BOARD JOINT FILLER , BITUMEN SEALING COMPOUND	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
13.	CERAMIC / VITRIFIED TILES	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
14.	ACID / ALKALI RESISTANCE TILES, AR BRICKS, AR CEMENT (POTASSIUM SILICATE BASED CEMENT MORTAR, PHENOLIC BASED RESIN CEMENT) AR BITUMASTIC	III	-	CARBORANDUM UNIVERSAL	CHENNAI	N	
				GOOD EARTH MINERALS	MORBI	N	
				PELICAN	BHIWADI	N	
				CAMBRIAN	ALWAR	N	
				KERATECH	VADODARA	N	
				CHAMPION CERAMICS	CHAMPA	N	
				SUNSHINE CERAMICS	CHAMPA	N	
				MAHAKOSHAL POTTRIES	KATNI	N	

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05/04/17

NTPC	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: EPC					REV. NO.	0
	MAIN SUPPLIER: BHEL	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
				PERFECT ACID WARE	JABALPUR	N	
				BABA BAIDNATH REFRACTORIES	PURULIA	N	
15.	FIRE PROOF DOORS	III	-	NAVAIR INTERNATIONAL LTD.	NEW DELHI	N	Prototype tested from CBRI/CPRI
				SHAKTI MET DOOR	HYDERABAD	N	
				SUPER STEEL	DELHI	N	
				SIGNUM FIRE PROTECTION	NAGPUR	N	
				RADIANT SAFE DOORS	AHMEDABAD	N	
16.	PARTICLE BOARDS, PLYWOOD, MDF	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
17.	ALUMINUM SECTIONS	III	-	HINDALCO	-	N	
				INDALCO	-	N	
				BALCO (VEDANTA)	-	N	
				NALCO	-	N	
				ALOM EXTRUSIONS LTD	-	N	
				JINDAL	-	N	
18.	HIGH SOLID CONTENT LIQUID APPLIED URETHANE BASED ELASTOMERIC MEMBRANE FOR WATER PROOFING	III	-	STP	-	N	
				IWL INDIA LTD	-	N	
				LLOYDS	-	N	
				CICO TECHONOLOGIES LTD	-	N	
19.	SANITARY ITEMS	III		MK PETRO	-	N	
				PARRYWARE	-	N	
				HINDWARE	-	N	
				SEABIRD	-	N	
				ORIENT	-	N	

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C & M Deptt. Patratu Vidyut Utpadan Nigam Limited Dist-Ramgarh (Jharkhand)

G.V. Rao 05/04/17

	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
एनटीपीसी NTPC	PACKAGE: EPC					REV. NO.	0
	MAIN SUPPLIER: BHEL	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
				HINDUSTAN	-	N	
				CERA	-	N	
20.	**CP BRASS TAP AND OTHER SANITARY FITTINGS**	III	-	GEM	-	N	
				PARKO	-	N	
				JAQUAR	-	N	
				MARC	-	N	
21.	**POLYTHENE WATER STORAGE TANKS**	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
22.	**RCC PIPES**	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
23.	**STOP LOG GATES, TRASH RACK AND LIFTING BEAM**	I		GENERAL MECHANICAL WORKS	BARODA	A	
				TRIVENI	NOIDA	A	
				MACMET	KOLKATA	A	
				PRADEEP STRUCTURES	HOWRAH	A	
				RED FAB	HYDERABAD	A	
				L&T	KANCHIPURAM	A	
				BSBK ENGG	NOIDA	A	
24.	**PTFE BEARING / ELASTOMERIC BEARING**	III		ALL CURRENT MORTH / RDSO APPROVED VENDORS		-	
25.	**FABRIC EXPANSION COMPENSATOR**	I		KELD ELLENTOFT INDIA LTD	CHENNAI	A	
				EAGLE BURGMANN KE PRIVATE LTD	CHENNAI	A	
				FRENZELIT EXPANSION JOINT PVT. LTD	BANGALORE	A	
26.	**MINERAL WOOL FOR THERMAL**	I		ROCKWOOL INDIA LTD.	HYDERABAD	A*	A*: subject to

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एनटीपीसी NTPC	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: EPC					REV. NO.	0
	MAIN SUPPLIER: BHEL	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
	INSULATION			PUNJSTAR INSULATION FIBRE COMPANY	BHILAI	A	carrying out K-value test at CBRI Roorkee / NTPC approved lab.
				LAPINUS	MALANPUR (MP)	A*	
				MINWOOL	RAJANANDGAON	A*	
				LLOYD INSULATION	BHILAI	A*	
				SHREERAM EQUITECH PVT. LTD.	DURG	A	
				GOENKA ROOKWOOL (I) PVT, LTD.	RAIPUR	A	
				U.P. TWIGA	BULENDSHAHAR	A	
27.	**CHIMNEY ELEVATOR***	I		MEKASTER ENGG. & EQPT (P) LTD.,	HALOL, GUJARAT	A	
				ALIKRAFT ENGINEERS PVT. LTD.	SAVIL (VADODARA)	A	
				UNIVERSAL CONSTRUCTION MACHINARY & EQUIPMENTS	PUNE	A	
28.	**GEOTEXTILE**	III		GARWARE WALL ROPES Ltd	PUNE	N	
				TENCATE GEOSYNTHETICS ASIA	MALAYSIA	N	NON WOVEN
29.	**GEOMEMBRANE (HDPE LINER)**	II		D P WIRES PVT. LTD	RATLAM	A	
				CLIMAX SYTHETICS PVT. LTD	VADODARA	A	
				SHIVALIK AGROPOLY	PARWANOO	A	
30.	**CI PIPES**	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE			

Patratu Vidyut Utpadan Nigam Limited C & M Deptt. Distt-Ramgarh (Jharkhand)

Bharat Heavy Electricals Limited PS-MKTG Delhi

05/04/17

ANNEXURE-I

	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
NTPC	PACKAGE: EPC					REV. NO.	0
	MAIN SUPPLIER: BHEL	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
31.	**GALAVANISED STEEL STRUCTURES (FOR TRANSMISION LINE, LATTICE & PIPE)**	I		VIJAY TRANSMISSION LTD	RAIPUR	A	Subject to clearance of Provenness criteria for Transmission Line Structures
				UNITECH POWER TRANSMISSION LTD	NAGPUR	A	
				ASSOCIATED POWER STRUCTURES	VADODARA	A	
				R.S. INFRAPROJECTS PVT. LTD	SURAJPUR	A	
				NEW MODERN TECHNOMECH	MAYURBHANJ (ORRISA)	A	
				GOOD LUCK STEEL TUBES	SIKANDRABAD	A	
				UNIQUE STRUCTURES & TOWERS LTD.	RAIPUR	A	
				VATCO ELEC-POWER PVT. LTD.	NAVIMUMBAI (GALVANISING AT SIGMA GALVANISER NAVI MUMBAI)	A	
				R.S. INFRAPROJECTS PVT. LTD	GHAZIABAD	A	
				ADVANCE STEEL TUBE ,	SAHIBABAD	A	
				SANGAM STRUCTURES LTD.	ALLAHABAD	A	
				RICHARDSON & CRUDDAS (1972) LTD	NAGPUR	A	
32.	**HIGH PERFORMANCE MOISTURE COMPATIBLE CORROSION RESISTANT COATING SYSTEM**	III		CECRI LICENSED SOURCES		-	
33.	**MS PIPES (IS:3589, WELDED PIPES)**	III		BIS APPROVED SOURCES HAVING VALID BIS LICENCE		-	

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Patratu Vidyut Utpadan Nigam Limited Distt-Ramgarh (Jharkhand) C & M Deptt.

G.V. Rao 05/04/17

	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
एनटीपीसी NTPC	PACKAGE: EPC					REV. NO.	0
	MAIN SUPPLIER: BHEL	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
34.	**Factory Fabricated Steel Structure** (Subject to clearance of Provenness criteria)	I		JSW SEVERFIELD	BELLARY	A	
				CAPACITE STRUCTURES Ltd.	Palghar	A	
				ATMASTCO PVT LTD	DURG	A	
				Corefab Projects Pvt Ltd	Bhilai	A	
				Indiana Gratings Pvt Ltd	PURANDAR	A	Acceptable for Columns & Beams (maximum single piece size up to 15 MT)
				JINDAL STEEL & POWER LTD.	RAIGARH	A	
				JINDAL STEEL & POWER LTD.	Angul	A	
				ALLIANCE INTEGRATED METALIKS LTD	RAJPURA	A	
				MIURA INFTASTRUCTURE LTD.	BHILAI	A	Acceptable upto maximum single piece weight of 30 MT
				BHEL	RANIPET	DR	
35.	**PRE ENGINEERED BUILDINGS**	I		INTERARCH	PANT NAGAR	A	
				DEVASHISH INFRASTRUCTURE PVT. LTD	VADODARA	A	
				EVEREST STEEL	ROORKEE	A	

Bharat Heavy Electricals Limited PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited C & M Deptt. Distt-Ramgarh (Jharkhand)

G.V. Patel 05/04/17 (B.H.E.L)

ANNEXURE-I

	PROJECT: PATRATU STPP-I (3X800 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
एनटीपीसी NTPC	PACKAGE: EPC					REV. NO.	0
	MAIN SUPPLIER: BHEL	SUB SYSTEM: CIVIL WORKS				DATE	05.04.2017
	CONTRACT NO.: CS-9585-001-2						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS

LEGENDS:

1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list along with the condition of approval, if any.

DR – For these items "Details required" for NTPC review. To be identified with letter "DR" in the list.

'N' NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with 'NOTED.'

2. QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved quality plan.

CAT-III : For these items Main Supplier approves the Quality Plans.

UNITS/ WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

NOTE 1: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by NTPC-EIC/ FQA on the basis of MTC / certificate of conformance in line with Indicative FQP / Technical Specifications.

Maidasani
(Ajay Maidasani)
NTPC

Bharat Heavy Electricals Limited * PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Ltd. * Distt-Ramgarh(Jharkhand) C & M Deptt.

G.V.Rajs. 05/04/17.
(G.V.RAJASEKHAR)
MANAGER – COMMERCIAL
BHEL – PSWR.

	PROJECT: PATRATU STPS EXPANSION PHASE - I (3X800MW) Package: EPC Sub Package : Switchyard No.: CS-9585-601-2		Contract	ANNEXURE - LIST OF ITEMS REQUIRING QUALITY PLAN APPROVAL AND ACCEPTABLE SUB-VENDOR AS PROPOSED BY M/S. BHEL					DOC.NO. : 9585-601-2 REV.NO. : 0 DATE : 03.04.2017	
S.No.	Item Description	QP/Insp Cat	QP#9591-001C QVE-Q	QP Sub-schedule	QP Approval Schedule	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks
1	400 kV Gas Insulated Switchyard	I	10			GE T&D	CHENNAI	A		
	(Item subject to Sub QR approval)					HYOSUNG	KOREA	A		
						XIAN	CHINA	A		
						ABB	VADODARA	DR		
						SIEMENS	AURANGABAD	DR		
2	400kV Capacitor Voltage Transformers	I	50			GE	Hosur	A		
	(Item subject to Sub QR approval)					ABB	Vadodara	A		
						BHEL	Bhopal	A		
						CGL	Nasik	A		
3	400 kV Surge Arrestors	I	60			OBLUM	Hyderabad	A		
	(Item subject to Sub QR approval)					CGL	Nasik	A		
						LAMCO	Hyderabad	A		
4	400 kV Wave Trap	I	70			GE	Hosur	A		
						BPL	Palghat	A		
						BPEG	CHINA	A		
						QUALITY POWER	SANGLI	DR		
5	Bus Post Insulator	I	80			ADITYA BIRLA	Halol	A		
						IEC	Bhopal	A		
						MODERN INSULATORS	Abu Road	A		
						WSI	Chennai	A		
6	Disc Insulator	I	90			ADITYA BIRLA	RISHRA (WB)	A		
						BHEL	Bhopal	A		
						IEC	Bhopal	A		
						MODERN INSULATOR	ABU ROAD	A		
						WSI	Chennai	A		
7	Aluminium Tube	I	100			Alom Extrusions	Kolkatta	A		
						HINDALCO	ALUPURAM	A		
						HINDALCO	Renukut	A		
						Jindal AL Tube	Bangalore	A		
						SUDAL	Nasik	A		
8	ACSR Conductor	I	110			APAR	Silvassa	A		
						DIAMOND	Vadodra	A		
						GUPTA POWER INFRA	Bhubaneshwar	A		

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C & M Deptt. Patratu Vidyut Utpadan Nigam Ltd. Distt-Ramgarh (Jharkhand)

(Meneer Kashyap) NTPC

S.No.	Item Description	QP/Insp Cat	QP#9591-001C QVE-Q	QP Sub-schedule	QP Approval Schedule	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks
						ANVIL CABLES	JAMSHEDPUR	A		
						JSK	Silvassa	A		
						SHARAVATHY	Bangalore	A		
						DYNAMIC CABLES PVT LTD	JAIPUR	A		
						HUIL	GUWAHATI	DR		
						HUIL	GWALIOR	A		
						SHASHI CABLES	LUCKNOW	A		
9	1.1kV Grade Power, Control Cables	I	120							Refer Cabling List
10	Substation Automation System BCU, GRP, Energy Meter, Numerical Relays Switchyard Protection	I	130			ABB	Peenya	A		
	(Item subject to Sub QR approval)					SIEMENS	Kalwa	A		
						SCHNEIDER	Noida	A		
						GE	Chennai	A		
						BHEL	Bhopal	A*		* Approved only for C&R panel
11	Components for Control & Relay Panels, Protection Panels, Islanding Scheme & Bay Control Unit									* : Inspection category of the item shall be same as mentioned in MQP of SAS
a	Energy Meter	*				Conzerv	Bangalore	A		
	(Item subject to Sub QR approval)					Elster	Mumbai	A		
						GEC Meters	UK	A		
						Landis & GYR	Switzerland	A		
						SEMS	Udaipur	A		
b	EVENT LOGGER	*				GE T&D	UK / FRANCE	A		
						HATHWAY	UK	A		
c	TIME SYNCHRONIZING EQUIPMENT	*				ARBITER	USA	A		
						HOPF	GERMANY	A		
						HATHWAY	UK / USA	A		
						SERTEL	CHENNAI	A		
						SIEMENS	GERMANY	A		
						Masibus	Gandhinagar	A		
d	RELAY TEST KIT	*				OMICRON	USA/AUSTRALIA	A		
						DOBBLE	USA	A		
						MEGGER	UK	A		
e	DISTURBANCE RECORDER	*				GE T&D	USA	A		
						SIEMENS	GERMANY	A		
						ABB	FINLAND	A		

Bharat Heavy Electricals Limited PS-MKTG Delhi

C & M Deptt. Engg. Div./QAI

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S.No.	Item Description	QP/Insp Cat	QP#9591-001C-QVE-Q	QP Sub-schedule	QP Approval Schedule	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks
						HATHWAY	UK	A		
f	LARGE VIDEO SCREEN (LVS)	*				DELTA	Gurgaon	A		
						BARCO	Noida	A		
						Planner	USA	A		
g	RELAYS	*				ABB	Sweden / Bangalore	A		
	(Item subject to Sub QR approval)					GE T&D	UK/CHENNAI	A		
	(NUMERICAL AND AUXILLARY)					SCHNEIDER	UK/France	A		
						SIEMENS	GERMANY	A		
						SCHNEIDER	Noida/Chennai	DR		
12	Instrumentation Cable	I	140							Refer C&I List
13	BMK	I	150			BCH	FARIDABAD	A		
						C&S	Noida	A		
						Jakson	Noida	A		
						MAKTEL	VADODARA	A		
						Pyrotech	Udaipur	A		
						Schneider	Nashik	A		
						Spaceage Switchgear	Gurgaon	A		
						Unilec Switchgear	Gurgaon	A		
						Industrial Switchgear & controls	Thane	DR		
						MILESTONES	GURGAON	DR		
						ULTIMA SWITCHGEARS	ROORKEE	DR		
						Samcom Industrial Controls	Thane	DR		
						RST Electricals	Sahibabad	DR		
						Nitya Electrocontrols Pvt Ld	Noida	A		
						ENTERPRISING ENGINEERS	BHOPAL	DR		
						VIKAS POWER EQUIPMENTS PVT. LTD.	LUCKNOW	DR		
14	Lighting Pole	III	160							Refer Elect. Eq. List
15	Clamps & Connectors and Welding Sleeves	III				EMTT	Kolkata	A		
						EXALT	MUMBAI	A		
						KLEMMEN	Chennai	A		
						PEE VEE ENGG	Bangalore	A		
						Raychem	Vadodara	A		
						Vensun Techo Links	Chennai	DR		
						Premier Power Products	Chennai	DR		
						Deccan Engg Works	Bangalore	A		
16	Insulator Hardware	II	170			EMI	Mumbai	A		
						EMTT	Kolkatta	A		

Bharat Heavy Electricals Limited PS-MKTG Delhi

Bharat Vidyut Nigam Deccan Limited (Distt-Ramgarh/Jharkhand) C & M Engg. Div./QAI

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S.No.	Item Description	QP/Insp Cat	QP#9591-001C-QVE-Q	QP Sub-schedule	QP Approval Schedule	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks
						IAC	Kolkatta	A		
						ITPL	Mumbai	A		
						RUL	Kolkatta	A		
						TAG CORPORATION	CHENNAI	A		
						Raychem (Tyco)	Bangalore	DR		
17	LIGHTING MAST	III						A		Refer Elect. Eq. List
18	AC KIOSK	I	180			I COMM TEL	HYDERABAD	A		
						Isolloyd	Baddi	A		
						JINDAL MECTEC	GURGAON	A		
						U-FOAM	HYDERABAD	A		
						SVARN TELECOM	HARDWAR	A		
19	JB (All Types) / Lighting Panel	II	190			C&S	Noida	A		
						Jakson	Greader Noida	A		
						MAKTEL	BARODA	A		
						Pyrotech	Udaipur	A		
						Schneider	Nashik	A		
						Space Switchgear	Gurgaon	A		
						TRICOLITE	SAHIBABAD	A		
						Unilec Switchgear	Gurgaon	A		
						DANISH	JAIPUR	DR		
						Nitya Electrocontrols	Noida	DR		
						MILESTONES	GURGAON	DR		
						ULTIMA SWITCHGEARS	ROORKEE	DR		
						ENTERPRISING ENGINEERS	BHOPAL	DR		
						VIKAS POWER EQUIPMENTS PVT. LTD.	LUCKNOW	DR		
20	OPGW CABLE	I	200			SUZHOU FURUKAWA	NOIDA	A		Accessories under CAT-III from
						STERLITE TECHNOLOGIES	SILVASSA	A		
21	Leakage Current Analyser	III				ISA	ITALY	A		
						APPLIED TECHNO PRODUCTS PVT. LTD.	GURGAON	DR		
						Scope T&M	Pune	A		
						DOBLE ENGG	USA	A		
						JOSTS ENGINEERING CO. LTD.	DELHI	DR		
						HI-TECH SYSTEMS & SERVICES LTD.	KOLKATA	DR		
22	SF6 GAS FILLING AND EVACUATING PLANT, GAS RECYCLING & PURIFYING PLANT, GAS LEAKAGE DETECTOR	III				AI QUALITEK	USA	A		
						DILO	GERMANY	A		
						ENERVAC	CANADA	A		
						VACCUUM PLANT INDUSTRIES	PUNE			

Bharat Heavy Electricals Limited PS-MKTG Delhi

Bharat Heavy Electricals Limited C&M Department Hazaribagh Dist-Ramgarh (Jharkhand)

S.No.	Item Description	QP/Insp Cat	QP#9591-001C QVE-Q	QP Sub-schedule	QP Approval Schedule	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks
						WIKA	USA	A		
						Manik Motors	Hyderabad	DR		
23	OPERATIONAL ANALYSER WITH DCRM KIT	III				OMICRON	USA	A		
						DOBBLE	USA	A		
						SCOPE	PUNE	A		
						VIC	USA	A		
24	GS Flat / MS Flat / 40 MM Dia. M.S. Rod / M.S. Earth Rods/U Clamp / GI Earth Pipe / GI Pipe / GI Conduit (Including Bends) / PVC Pipes	III				Main Contractor Approved Sources				
25	Cable Tray, Bends, Coupler Plates	III								Refer Cabling List
26	Cable glands	III								Refer Cabling List
27	Cable Lugs	III								Refer Cabling List
28	Lighting Fixtures & Luminaries	III								Refer Elect. Eq. List
29	Industrial Receptacles	III								Refer Elect. Eq. List
30	GS Earthwire / Lighting Wire	III				Main Contractor Approved Sources				
31	Transmission Line Tower Accessories (Danger Plate, Vibration Dampers, Number Plate, Phase Plate, Circuit Plate,Hanger Rod, ACD, Bird Guard, J Bolt, U Bolt, D Shackle, Barbed Wire, etc.)	III				Main Contractor Approved Sources				
32	EOT Crane	I								Refer CHP List
33	Air Conditioning and Ventillation System	III								Refer AC Ventilation List
34	Fire Protection System	III								Refer Fire Protection List
35	AC for AC Kiosk	III								Refer AC Ventilation List

Note

1 SYSTEM SUPPLIERS/SUB-SUPPLIERS APPROVAL STATUS CATEGORY(SHALL BE FILLED BY NTPC)
A-For this items proposed vendor is acceptable to NTPC.To be indicated with letter "A" in the list along with condition of approval,if any
DR-For those items "Detailed required for NTPC review.To be identified with letter "DR" in the list.

Bharat Heavy Electricals Limited PS-MKTG Delhi

Bharatiya Vidyut Vikas Nigam Limited C & M Deptt Distt-Ramgarh(Jharkhand)

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S.No.	Item Description	QP/Insp Cat	QP#9591-001C-QVE-Q	QP Sub-schedule	QP Approval Schedule	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks
	NOTED- For these items vendors are approved by Main Supplier & accepted by NTPC without specific vendor approval from NTPC. To be identified with "NOTED"									
2	QP / INSPN CATEGORY CAT-I : For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection witness by NTPC CAT-II For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on basis of documents as approved QP CAT-III For these items Main supplier approves the Quality Plans. The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.									
3	UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.									
4	For GIS at Sr. No. 1 above, BHEL will follow their Standard procedures & Corporate guidelines and shall comply with circulars / Instructions etc. issued by GOVT. / Relevent statutary bodies while tendering. However, for new vendors, BHEL shall take approval from NTPC prior to order placement.									

(ABHINAV GUPTA, BHEL) (DIPTOJIT, BHEL) (SOVHIK, BHEL) (Munesh Kathyep) NTPC

Bharat Heavy Electricals Limited PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited Distt-Ramgarh(Jharkhand) C & M Deptt.

ATTACHMENT-1 OF ANNEXURE-Q1

EPC PACKAGE FOR PATRATU STPS (3X800 MW)

VENDOR LIST FOR ITEMS COVERED UNDER PROVENNESS CLAUSE AS PER SPECIFICATION

DOC# CS-9585-001-02

LEGENDS: A : ACCEPTABLE.
DR : DETAILS REQUIRED.

(VENDOR PROPOSALS IN COLUMN "....ATT 5" IN THIS LIST ARE AS AUGMENTED BY BHEL BY ADDITION/ DELETION IN POST BID STAGE)

SL. NO	NAME OF THE EQUIPMENT	VENDOR PROPOSAL IN ATT.5	PLACE	REMARKS		PROVENESS CLAUSE NO
				ON PROVENNESS / QUALIFYING EXPERIENCE	ON VENDOR DETAIL.	
1)	TURBINE SET	BHEL	HARDWAR	A	A	1.0
		SIEMENS	GERMANY	A	A	1.0
2)	GENERATOR	BHEL	HARDWAR	A	A	2.0
		SIEMENS	GERMANY	A	A	2.0
3)	AIR COOLED CONDENSER	SPX DRY COOLING	BELGIUM	DR	A	3.1/3.2
		SPIG SPA	ITALY	DR	DR	3.1/3.2
		SHUANG LIANG ECO SYSTEM CO. LTD.	CHINA	DR	A	3.1/3.2
		BEIJING SHOUHANG IHW RESOURCES SAVING CO. LTD.	CHINA	DR	A	3.1/3.2
		INNOSPIN AG	SWITZERLAND	DR	DR	3.1/3.2
		HARBIN AIR CONDITIONING CO. LTD.	CHINA	DR	A	3.1/3.2
		ENEXIO GERMANY GMBH	GERMANY	DR	A	3.1/3.2
		ENEXIO COOLING TOWER TECHNOLOGY (INDIA) PVT. LTD.	INDIA	DR	DR	3.1/3.2
		BEIJING LONGYUAN COOLNG TECHNOLOGIES	CHINA	DR	DR	3.1/3.2
		HAMON SHRIRAM COTTRELL	INDIA	DR	DR	3.1/3.2
		HAMON COOLING SYSTEM (TIANJIN) COMPANY LTD.	CHINA	DR	DR	3.1/3.2
		LUOYANG LONGHUA HEAT TRANSFER & ENERGY SAVING CONV.	CHINA	DR	DR	3.1/3.2
		HHI CHINA	CHINA	DR	DR	3.1/3.2
		PAHARPUR COOLING TOWER	INDIA	DR	DR	3.1/3.2
4)	HP HEATERS	BHEL	HYDERABAD	DR	DR	3.1
		SPX	USA	A	A	3.1
		BHI	S. KOREA	A	A	3.1
		THERMAL ENGINNERING INTERNATIONAL (TEI)	USA	A	A	3.1
		SHANGHAI ELECTRIC POWER EQUIPMENT CO. LTD.	CHINA	DR	A	3.1
		HOLTEC	USA	A	A	3.1
5)	LP HEATERS	BHEL	HEEP, HARDWAR	DR	DR	3.1
		BHEL	HYDERABAD	A	A	3.1
6)	CONDENSATE EXTRACTION PUMP	MHI	JAPAN	A	A	3.1
		BHEL	HYDERABAD	DR	A	3.2
7)	CONDENSER AIR EVACUATION PUMP	EDWARDS	UK/CHINA	DR	A	3.1
		GARDNER DENVER	CHINA	DR	A	3.1

Bharat Heavy Electricals Limited PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited C & M Deptt. Distt-Ramgarh(Jharkhand)

Vikas Sisodiya/Rudra

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SL. NO	NAME OF THE EQUIPMENT	VENDOR PROPOSAL IN ATT.5	PLACE	REMARKS ON PROVENNESS / QUALIFYING EXPERIENCE	REMARKS ON VENDOR DETAIL.	PROVENESS CLAUSE NO
		MACHINERY CHINA LTD				
		TSURMI MANUFACTURING CO. LTD.	JAPAN	DR	A	3.1
		GUANGDONG FOSHAN PUMP FACTORY CO LTD (KENFLO)	CHINA	DR	A	3.1
		UNIQUE SYSTEM	USA	DR	DR	3.1
8)	DEAERATOR	BHEL	HYDERABAD	A	A	3.1
9)	BOILER FEED PUMP	MHI	JAPAN	A	A	3.1
		BHEL	HYDERABAD	DR	A	3.2
.0)	HP BYPASS VALVE	BHEL	TRICHY	DR	DR	3.1
		CCI	SWITZERLAND	DR	A	3.1
		SEMPELL AG	GERMANY	DR	A	3.1
		HORA	GERMANY	DR	A	3.1
		WELLAND & TUXHORN	GERMANY	DR	DR	3.1
		BOPP & REUTHER	GERMANY	DR	A	3.1
11)	LP BYPASS VALVE	CONTROL COMPONENT INDIA PRIVATE LIMITED.	SRICITY, AP	DR	A	3.1
		BOMAFA	GERMANY	DR	A	3.1
		PARCAL S.P.A.	ITALY	DR	DR	3.1
		WELLAND & TUXHORN	GERMANY	DR	A	3.1
12)	HYDROGEN GENERATION PLANT	ELECTROLYSER CORP	CANADA	DR	DR	4.17
		HYDROGENICS EUROPE	BELGIUM	DR	DR	4.17
		EASTERNELECTROLYSER	NOIDA	DR	DR	4.17
		TINAJIN MAINLAND	CHINA	A	A	4.17
		TELEDYNE	USA	A	A	4.17
		MVS	DELHI	DR	DR	4.17
13)	COAL HANDLING PLANT	BHEL – ISG	BANGALORE	~~A~~ DR	A	4.20.1, 4.20.2
14)	ASH HANDLING SYSTEM	DCIPS	KOLKATA	DR	A	4.19
		MBE	KOLKATA	DR	A	4.19
		MACAWBER BEEKAY	DELHI	DR ~~A~~	A	4.19
		UCC	USA/INDIA	DR	DR	4.19
		BHEL – ISG	BANGALORE	DR	DR	4.19
		MCGALE PNEUMATIC	NAGPUR	DR	DR	4.19
		MAGALDI SYSTEM	ITALY	DR	DR	4.19
		CLYDE BERGMAN	INDIA	DR	DR	4.19
		CHINA DATANG TECHNOLOGICAL & ENGINEERING CO.	CHINA	DR	DR	4.19
		NARI FUTONG SCIENCE & TECNOLOGY DEVELOPMENT CO. LTD.	CHINA	DR	DR	4.19
		INDURE	DELHI	DR	A	4.19
15)	MILL REJECT HANDLING SYSTEM	MACAWBER BEEKAY	DELHI	DR ~~A~~	A	4.13
		XIAMEN LONGKING	CHINA	DR ~~A~~	A	4.13
		SHANGHAI SINOFIN NEW ENERGY INVESTMENT CO.	CHINA	DR	DR	4.13
		HV EQUIPMENTS	NOIDA	~~DR A~~	A	4.13
16)	FIRE PROTECTION & DETECTION SYSTEM	LLOYD INSULATIONS	DELHI		A	4.5
		UNITECH MACHINES	GURGAON		A	4.5

Bharat Heavy Electricals Limited PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited C & M Deptt. Distt-Ramgarh (Jharkhand)

SL. NO	NAME OF THE EQUIPMENT	VENDOR PROPOSAL IN ATT.5	PLACE	REMARKS		PROVENESS CLAUSE NO
				ON PROVENNESS / QUALIFYING EXPERIENCE	ON VENDOR DETAIL.	
		HITEK ENGG.	MUMBAI	DR	A	4.5
		CONSILIUM MIDDLE EAST	UAE	DR	A	4.5
		STERLING & WILSON	KOLKATA	DR	A	4.5
		AGNICE FIRE PROTECTION	CHENNAI	DR	DR	4.5
		THERMOSYSTEMS	HYDERABAD	DR	DR	4.5
		BHEL – HYDERABAD	HYDERABAD	A	A	4.5
17)	TG HALL EOT CRANES	MUKAND	THANE	A	A	4.15
		WMI	MUMBAI	A	A	4.15
		ANUPAM INDUSTRIES	V U NAGAR	A	A	4.15
		UNIQUE INDUSTRIES HANDLERS	NASIK	A	A	4.15
		HEC	RANCHI	A	A	4.15
18)	AIR CONDITIONING SYSTEM	VOLTAS	MUMBAI	A	A	4.6
		STERLING & WILSON	KOLKATA	A	A	4.6
		GEMINI SHREEWAS (ENGRS) PVT. LTD.	CHENNAI	DR	DR	4.6
		INDUSTRIAL PROJECT & PRODUCTS LTD.	BAWAL	A	DR	4.6
		ADVANCE VENTILATION	DELHI	DR	A	4.6
19)	VENTILATION SYSTEM	C DOCTOR	KOLKATA	A	A	4.7
		S K SYSTEM PVT. LTD.	DELHI	DR	DR	4.7
		ADVANCE VENTILLATION	DELHI	A	A	4.7
		STERLING & WILSON	KOLKATA	A	A	4.7
		HYDERABAD POLLUTION	HYDERABAD	DR	A	4.7
		PACK PLAST ENGG.	KOTA	DR	DR	4.7
		INDUSTRIAL PROJECT & PRODUCTS LTD.	BAWAL	DR	DR	4.7
		TAP ENGG.	CHENNAI	DR	DR	4.7
		VOLTAS LIMITED	MUMBAI	A	A	4.7
20)	FUEL OIL SYSTEM	RAUNAQ INTERNATIONAL LTD	FARIDABAD	DR A	A	4.21
		GMW	VADODRA	DR A	A	4.21
		UNITECH MACHINES LTD	GURGAON	DR A	A	4.21
		TECHNOELECTRIC ENGG	KOLKATA	DR A	A	4.21
		XICON INTERNATIONAL	THANE	DR	DR	4.21
		NEW FIRE ENGINEERS	NEW DELHI	DR	DR	4.21
		SHALCOT	NOIDA	DR	A	4.21
		THERMOSYSTEMS	HYDERABAD	DR	A	4.21
		XICON INTERNATIONAL	THANE	DR	DR	4.21
		NEW FIRE ENGINEERS	NEW DELHI	DR	DR	4.21
21)	COMPRESSED AIR SYSTEM	ATLAS COPCO	PUNE	A	A	4.8 A
		ELGI EQUIPMENTS	COIMBATORE	A	A	4.8 A
		INGERSOLL RAND	AHMEDABAD	A	A	4.8 A
22)	WATER PRE TREATMENT PLANT & LIQUID EFFLUENT TREATMENT PLANT	DRIPLEX	NEW DELHI	A	A	4.10
		TRIVENI	NOIDA	A	A	4.10
		GEO MILLER	NEW DELHI	A	A	4.10
		VA TECH WABAG	PUNE	DR	A	4.10
		ION EXCHANGE	MUMBAI	A	A	4.10
		THERMAX	PUNE	A	DR	4.10
		PARAMOUNT	VADODARA	DR	DR	4.10
		BRIDGE & ROOF	KOLKATA	A	A	4.10

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				ON PROVENNESS / QUALIFYING EXPERIENCE	ON VENDOR DETAIL.	
		MCNALLY BHARAT	KOLKATA	A	A	4.10
		GANNON DUNKERLEY	NEW DELHI	A	A	4.10
		UEM INDIA	INDIA	A	A	4.10
		PBI ASSOCIATES	PUNE	DR	DR	4.10
		CLEAR WATER	NEW DELHI	DR	DR	4.10
		VEOLIA INDIA PVT. LTD	CHENNAI.	DR	DR	4.10
		SHRIRAM EPC	CHENNAI	DR	DR	4.10
23)	DM PLANT (CONVENTIONAL ION EXCHANGE BASED)	THERMAX	PUNE	A	A	4.11
		ION EXCHANGE	MUMBAI	A	A	4.11
		DRIPLEX	NEW DELHI	A	A	4.11
		AQUATECH SYSTEMS	PUNE	DR	DR	4.11
		DOSHION	AHMEDABAD	DR	DR	4.11
		TRIVENI	NOIDA	DR	DR	4.11
		WIPRO	MUMBAI	DR	DR	4.11
		VA TECH WABAG	PUNE	A	DR	4.11
		PARAMOUNT	VADODARA	A	DR	4.11
24)	DM PLANT (RO+MB PLANT)	TRIVENI	NOIDA	A	A	4.12
		ION EXCHANGE	MUMBAI	A	A	4.12
		THERMAX	PUNE	A	DR	4.12
		DRIPLEX	NEW DELHI	A	A	4.12
25)	CONDENSATE POLISHING PLANT	DRIPLEX	HARIDWAR	A	A	4.14
		ION EXCHANGE	MUMBAI	A	A	4.14
		BGR ENERGY	CHENNAI	A	A	4.14
		THERMAX	PUNE	DR	A	4.14
26)	COOLING TOWER: IDCT	HAMMON SHRIRAM	UMBERGAON	A	A	4.21
		L&T	CHENNAI	A	A	4.21
		NBCC	NEW DELHI	*DR	A	4.21
		PAHARPUR COOLING TOWERS	NEW DELHI	A	A	4.21
		FANS AS	CZECK	A	A	4.21
		PALTECH COOLING TOWER	GURGAON	A	A	4.21
		HAMMON THERMAL	BELGIUM	A	DR	4.21
		GEA COOLING TOWER	CHENNAI	A	A	4.21
27)	CW TREATMENT SYSTEMT	DRIPLEX	NEW DELHI	DR	A	4.4
		THERMAX	PUNE	DR	A	4.4
		ION EXCHANGE	MUMBAI	DR	A	4.4
		TRIVENI ENGG.	NOIDA	DR	A	4.4
		VASU CHEMICALS	MUMBAI	DR	DR	4.4
		CHEMBOND ASHLAND WATER TECHNOLOGY LTD	INDIA	DR	DR	4.4
28)	PA FANS	TLT	GERMANY	A	A	3.1
		BHEL	RANIPET	A	A	3.2
29)	ID FANS	TLT	GERMANY	A	A	3.1
		BHEL	RANIPET		A	3.2
30)	FD FANS	TLT	GERMANY	A	A	3.1

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				ON PROVENNESS / QUALIFYING EXPERIENCE	ON VENDOR DETAIL.	
		BHEL	RANIPET	A	A	3.2
31)	COAL PULVERISERS	BHEL	HYDERABAD	A	A	3.1
32)	RAW COAL FEEDERS	BHEL	TRICHY	A	A	3.1
33)	BOILER START UP DRAIN RE-CIRCULATION PUMP	TORISHIMA	JAPAN	DR	A	3.1
		HAYWARD TAYLOR	UK	DR	A	3.1
		KSB AG	GERMANY	DR	A	3.1
34)	AIR PRE-HEATERS	BHEL	RANIPET	A	A	3.1
35)	AUXILIARY BOILER	BHEL	HPVP	# DR	DR	3.1
36)	ESP	BHEL	RANIPET	A	A	4.1.1
37)	HT MOTOR FOR ID FAN & BFP	BHEL	BHOPAL	A	A	5.8 #
38)	HT SWITCHGEAR (3.3KV,11KV)	SIEMENS	MUMBAI	A	A	5.6
		MEGAWIN	SALEM	A	A	5.6
		BHEL	BHOPAL	A	A	5.6
		JYOTI	VADODRA	A	A	5.6
		ABB	NASIK	A	A	5.6
		L&T	AHMEDNAGAR	A	A	5.6
		SCHNEIDER	KOLKATA	A	A	5.6
39)	NUMERICAL RELAY NETWORK SYSTEM INTEGRATION	MAIN CONTRACTOR APPROVED SOURCES WHICH MEETS NTPC SUB-QR REQUIREMENT OF NETWORKING				5.7.2
40)	IEC 61850 COMPLAINT NUMERICAL RELAYS (APPROVAL FOR SPECIFIC MODEL/SERIES)	SCHNEIDER	STONE, UK	A	A	5.7.1
		ALSTOM T&D	CHENNAI	A	A	5.7.1
		ALSTOM T&D	STAFFORD,UK	A	A	5.7.1
		SEL	PULLMAN, USA	A	A	5.7.1
		ABB	FINLAND	A	A	5.7.1
		GE MULTILIN	CANADA/SPAIN	A	A	5.7.1
		ABB	VADODARA	A	A	5.7.1
		SIEMENS	GERMANY	A	A	5.7.1
		SIEMENS	GOA	A	A	5.7.1
41)	LT SWITCHGEAR	C&S ELECTRIC	NOIDA/ HARIDWAR	A	A	5.5
		GE	BANGALORE	A	A	5.5
		L&T	MUMBAI/COIMBATORE	A	A	5.5
		SIEMENS	MUMBAI	A	A	5.5
		UNILEC	GURGAON	DR	A	5.5
		ABB	BANGALORE	A	DR	5.5
		SCHNEIDER	NASIK	A	A	5.5
42)	HT CABLE	UNIVERSAL CABLE LTD.	SATNA	A	A	5.11

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Patratu Vidyut Utpadan Nigam Limited C & M Dept Distt-Ramgarh(Jharkhand)

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				ON PROVENNESS / QUALIFYING EXPERIENCE	ON VENDOR DETAIL.	
	UPTO 11KV	TORRENT CABLE LTD	NADIAD	DR	A	5.11
		POLYCAB WIRES PVT. LTD	DAMAN	A	A	5.11
		KEI INDUSTRIES	BHIWADI	A	A	5.11
		HAVELLS INDIA LTD.	ALWAR	A	A	5.11
		FINOLEX	PUNE	DR	A	5.11
		NICCO	SHAMNAGAR , KOLKATA	DR	A	5.11
		INCAB	PUNE	DR	A	5.11
		SRI RAM CABLES	BHIWADI	A	A	5.11
		APAR	VALSAD	DR	A	5.11
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	A	A	5.11
		KEC INTERNATIONAL	VADODRA	DR	A	5.11
		PARAMOUNT	BHIWADI	DR	A	5.11
		DIAMOND POWER	VADODRA	DR	DR	5.11
		CRYSTAL CABLES	KOLKATA	DR	DR	5.11
		GEM CABLES	BHIWADI	DR	A	5.11
		CCI	NASIK	DR	DR	5.11
		TIRUPATI PLASTOMATICS	JAIPUR	DR	DR	5.11
		DYNAMIC CABLES	JAIPUR	DR	DR	5.11
		STERLITE TECHNOLOGY	HARIDWAR	DR	DR	5.11
		RAVIN CABLES	MUMBAI	DR	DR	5.11
		GUPTA POWER	BHUBANESWAR	DR	DR	5.11
		GEMS CABLES	MEDAK, TELANGANA	DR	DR	5.11
43)	1.1 KV POWER CABLE (PVC & XLPE)	UNIVERSAL CABLE LTD.	SATNA	DR	A	5.10
		NICCO	SHAMNAGAR , KOLKATA	DR	A	5.10
		TORRENT CABLE LTD	NADIAD	DR	A	5.10
		INCAB	PUNE	DR	A	5.10
		HINDUSTAN VIDYUT PRODUCTS LTD	FARIDABAD	DR	A	5.10
		KEI INDUSTRIES	BHIWADI	A	A	5.10
		DELTON CABLE LTD	FARIDABAD	A	A	5.10
		PARAMOUNT CABLE	KHUSHKHERA	A	A	5.10
		POLYCAB WIRES PVT. LTD	DAMAN	A	A	5.10
		GEMSCABS INDUSTRIES	BHIWADI	A	A	5.10
		CORDS CABLES	BHIWADI	A	A	5.10
		HAVELLS INDIA LTD.	ALWAR	A	A	5.10
		SRI RAM CABLES	BHIWADI	A	A	5.10
		RAVIN CABLES	PUNE	A	A	5.10
		THERMOCABLES	HYDERABAD	A	A	5.10
		SBEE CABLES	BANGALORE	DR	A	5.10
		SUYOG CABLES	VADODARA	DR	A	5.10
		GUPTA POWER CABLES	BHUBANESWAR	A	A	5.10
		FINOLEX	PUNE	DR	A	5.10
		KEC INTERNATIONAL LTD,	VADODRA	DR	DR	5.10
		KRISHNA ELECTRICAL INDUSTRIES LIMITED	GWALIOR	DR	DR	5.10
		SPECIAL CABLES PVT LTD	NEW DELHI	DR	A	5.10
		GOVIND CABLE INDUSTRIES	KOLKATA	DR	DR	5.10

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Patratu Vidyut Utpadan Nigam Limited Distt-Ramgarh (Jharkhand) C & M Deptt.

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				ON PROVENNESS / QUALIFYING EXPERIENCE	ON VENDOR DETAIL.	
		SCOT INNOVATION WIRES & CABLES	DADDI	DR	A	5.10
		ANHUIHUALING	CHINA	DR	A	5.10
		LS CABLES	KOREA	DR	A	5.10
		RADIANT CABLES	HYDERABAD	DR	A	5.10
		MANISFIELD CABLES	G. NOIDA	DR	DR	5.10
		DIAMOND POWER	VADODRA	DR	DR	5.10
		CRYSTAL CABLE	KOLKATA	DR	DR	5.10
		APAR INDUSTRIES	UMBERGAON	DR	A	5.10
		DYNAMIC	JAIPUR	DR	DR	5.10
		TIRUPATI PLASTOMATICS	JAIPUR	DR	DR	5.10
		GOYOLENE FIBRE	DAMAN	DR	DR	5.10
		CHANDRESH CABLES	GANDHINAGAR	DR	DR	5.10
44)	1.1 KV CONTROL CABLE	NICCO	SHAMNAGAR , KOLKATA	DR	A	5.9
		TORRENT CABLE LTD	NADIAD	DR	A	5.9
		INCAB	PUNE	DR	A	5.9
		POLYCAB WIRESPVT. LTD	DAMAN	A	A	5.9
		HINDUSTAN VIDYUT PRODUCTS LTD	FARIDABAD	DR	A	5.9
		KEI INDUSTRIES	BHIWADI	A	A	5.9
		DELTON CABLE LTD	FARIDABAD	A	A	5.9
		PARAMOUNT CABLE	KHUSHKHERA	A	A	5.9
		GEMS CABS INDUSTRIES	BHIWADI	A	A	5.9
		CORDS CABLES	BHIWADI	A	A	5.9
		SPM CABLES	HYDERABAD	DR	A	5.9
		ELKAY TELELINK	FARIDABAD	A	A	5.9
		HAVELLS INDIA LTD.	ALWAR	A	A	5.9
		R.R. KABEL	SILVASA	DR	A	5.9
		RAVIN CABLES	PUNE	A	A	5.9
		GUPTA POWER CABLE	BHUBANESWAR	A	A	5.9
		THERMOCABLES	HYDERABAD	A	A	5.9
		FINOLEX	PUNE	DR	A	5.9
		SBEE CABLES	BANGALORE	DR	A	5.9
		SUYOG CABLES	VADODARA	DR	A	5.9
		UNIVERSAL CABLES	SATNA	DR	A	5.9
		KEC INTERNATIONAL LTD,	VADODRA	DR	DR	5.9
		KRISHNA ELECTRICAL INDUSTRIES LIMITED	GWALIOR	DR	DR	5.9
		ADVANCE CABLE	BENGALURU	DR	DR	5.9
		GOVIND CABLE INDUSTRIES	KOLKATA	DR	DR	5.9
		SCOT INNOVATION WIRES & CABLES	DADDI	DR	A	5.9
		ANHUIHUALING	CHINA	DR	A	5.9
		LS CABLES	KOREA	DR	A	5.9
		RADIANT CABLES	HYDERABAD	DR	A	5.9
		MANISFIELD CABLES	G. NOIDA	DR	DR	5.9
		DIAMOND POWER	VADODRA	DR	DR	5.9
		CRYSTAL CABLE	KOLKATA	DR	DR	5.9
		APAR INDUSTRIES	VADODRA	DR	DR	5.9

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Pakraru Vidyut Pradan Nigam Limited C & M Deptt. Distt-Ramgarh(Jharkhand)

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				ON PROVENNESS / QUALIFYING EXPERIENCE	ON VENDOR DETAIL.	
		SPECIAL CABLES	RUDRAPUR	DR	A	5.9
		INCOM	DELHI	DR	DR	5.9
		SAM CABLES	RUDRAPUR	DR	DR	5.9
		TIRUPATI PLASTOMATICS	JAIPUR	DR	DR	5.9
		CMI	FARIDABAD	DR	A	5.9
		SERVAL INDIA	NEEMRANA	DR	DR	5.9
		ADVANCE CABLE	BANGLORE	DR	DR	5.9
		GOYOLENE FIBRE	DAMAN	DR	DR	5.9
		SRIRAM CABLES	ALWAR	DR	DR	5.9
		DYNAMIC CABLES	JAIPUR	DR	DR	5.9
45)	D G SET (ASSEMBLY & TESTING)	M/S POWERICA	SILVASA	A	A	5.12
		M/S JAKSON	KATHUA	A	A	5.12
		M/S TIL	GHAZIABAD	DR	A	5.12
		M/S. KOHLER	SINGAPORE	A	A	5.12
		M/S STERLING GENERATORS PVT LTD	SILVASA	DR	A	5.12
		M/S CLLS	SINGAPORE	A	A	5.12
		SUPER NOVA	RAIPUR	A	A	5.12
46)	BATTERY CHARGER (110V/220V)	M/S AMARARAJA	TIRUPATI	DR	A	5.14
		M/S HBL- POWER SYSTEM	HYDERABAD	A	A	5.14
		M/S CHHABI ELECTRICAL	JALGAON	A	A	5.14
		M/S. CHLORIDE POWER	KOLKATTA	A	A	5.14
		M/S STATCON	HAPUR	A	A	5.14
		SAFT NIFE POWER SYSTEMS	SINGAPORE	DR	A	5.14
		MASSTECH	JALGAON	DR	A	5.14
		EMERSON NETWORK	THANE	DR	DR	5.14
		JEMA ENERGY	SPAIN	DR	DR	5.14
		M/S DUBAS	BANGALORE	A	A	5.14
47)	BATTERY (110V/ 220V)	HBL-POWER SYSTEM	HYDERABAD	A	A (Ni-Cd)	5.13
		M/S HOPPEKE	GERMANY	DR	A (PLANTE)	5.13
		M/S EXIDE	KOLKATA	A	A (PLANTE)	5.13
		AMCO SAFT	BANGALORE	A	A (Ni-Cd)	5.13
48)	GCB	GRID SOLUTION SAS	FRANCE	DR	DR	5.23
		ABB SWITZERLAND LTD.	SWITZERLAND	DR	A	5.23
49)	400 KV CVT	GE	HOSUR	~~DR~~ A	A	5.19 I.
		ABB	VADODARA	~~DR~~ A	A	5.19 I.
		BHEL	BHOPAL	~~DR~~ A	A	5.19 I.
		CGL	NASIK	~~DR~~ A	A	5.19 I.
50)	400 KV SURGE ARRESTOR	LAMCO	HYDERABAD	DR	A	5.19 II.
		OBLUM	HYDERABAD	~~DR~~ A	A	5.19 II.
		CGL	NASHIK	~~DR~~ A	A	5.19 II.
51)	GENERATOR TRANSFORMER	BHEL	BHOPAL	A	A	5.2B.1
52)	STATION TRANSFORMER	BHEL	BHOPAL		A	5.2B.1

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Patratu Vidyut Utpadan Nigam Ltd. C & M Deptt. Distt-Ramgarh (Jharkhand)

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53)	Auxiliary Transformer	KIRLOSKER	MYSORE	A	A	5.4
		TOSHIBA	HYDERABAD	A	A	5.4
		PROLEC GE (INDOTECH)	CHENNAI	A	A	5.4
		T & R	AHMEDABAD	A	A	5.4
		SCHNEIDER	BARODA	A	A	5.4
		KANOHAR	MEERUT	A	A	5.4
		BHEL	JHANSI	~~DR~~ A	A	5.4
54)	IPBD	BHEL	RUDRAPUR	A	A	5.1.1
55)	HT MOTOR	BHEL	BHOPAL		A	5.8
56)	C&I SYSTEM FOR SG, TG AND BOP	FOR SUB-QR RELATED C&I ITEMS, REFER C&I VENDER LIST. RESIDUAL CHLORINE ANALYZER IS ALSO CONSIDERED IN SUB-QR ITEM. FOR VENDORS REFER C&I VENDOR LIST.				6.0
57)	BOOSTER FAN	BHEL	RANIPET	DR	A	3.2
		TLT	GERMANY	DR	A	3.1
58)	SCR	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
59)	AMMONIA HANDLING AND STORAGE SYSTEM FOR SCR	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
60)	CATALYST FOR SCR SYSTEM	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
61)	UREA HANDLING AND STORAGE SYSTEM	NOT APPLICABLE				
62)	FGD	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
63)	SLURRY RECIRCULATION PUMPS	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
64)	OXIDATION BLOWERS	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
65)	WET LIMESTONE GRINDING MILLS	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
66)	SLURRY PUMPS	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
67)	AGITATORS	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
68)	VACUUM BELT FILTERS	SUITABLE VENDOR SHALL BE PROPOSED TO NTPC FOR ACCEPTANCE BEFORE PLACEMNET OF AWAD				
69)	SHUNT REACTOR	BHEL	BHOPAL	A	A	5.3B.1
70)	400 KV GIS SWITCHYARD/ AIS	GE T&D	CHENNAI	~~DR~~	A	5.16
		HYOSUNG	KOREA	A	A	5.16
		XIAN	CHINA	~~DR~~	A	5.16
		ABB	VADODRA	DR	DR	5.16
		SIEMENS	AURANGABAD	DR	DR	5.16
71)	PV ROOF TOP	BHEL	BANGALORE	A		9.0

Bharat Heavy Electricals Limited * PS-MKTG Delhi

Paschim Vidyut Utpadan Nigam Limited * Distt-Ramgarh (Jharkhand) C & M Deptt.

SL. NO	NAME OF THE EQUIPMENT	VENDOR PROPOSAL IN ATT.5	PLACE	REMARKS		PROVENESS CLAUSE NO
				ON PROVENNESS / QUALIFYING EXPERIENCE	ON VENDOR DETAIL.	
		BHEL	RUDRAPUR	DR	--	9.0
72)	SUBSTATION AUTOMATION SYSTEM	ABB	PEENYA	A	A	5.21
		SIEMENS	KALWA	A	A	5.21
		SCHNEIDER	NOIDA	A	A	5.21
		GE	CHENNAI	DR	A	5.21
		BHEL	BHOPAL	DR	A	5.21 FOR CR PANEL ONLY
73)	ENERGY METER	CONZERV	BANGALORE	DR	A	5.21
		ELSTER	MUMBAI	A	A	5.21
		GEC METERS	UK	DR	A	5.21
		LANDIS & GYR	SWITZERLAND	DR	A	5.21
		SEMS	UDAIPUR	A	A	5.21
74)	NUMERICAL RELAY FOR SWITCHYARD	ABB	SWEDEN	A	A	5.21
		ABB	BANGLORE	~~DR~~ A	A	5.21
		SIEMENS	GERMANY	A	A	5.21
		SCHNEIDER	UK/ FRANCE	A	A	5.21
		GE T&D	UK/CHENNAI	DR	A	5.21
		SCHNEIDER	NOIDA/ CHENNAI	DR	DR	5.21

NOTE:

1. FOR THE PURPOSE OF QUALIFICATION OF BIDDERS / SUB-VENDOR(S), EXPERIENCE SHALL BE RECKONED AS ON THE DATE OF CONSIDERATION FOR APPROVAL BUT NOT LATER THAN SIX MONTHS AFTER AWARD DATE OF EPC PACKAGE UNLESS OTHERWISE SPECIFIED IN THE RESPECTIVE CLAUSES. WITHIN THIS STIPULATED TIME, BHEL MAY ALSO PROPOSE ADDITIONAL VENDOR/AGENCIES MEETING NTPC PROVENNESS CRITERIA.
2. THE AGENCIES/SUB-CONTRACTORS FOR CIVIL WORKS WILL BE SUBMITTED TO NTPC BEFORE PLACEMENT OF ORDER FOR RESPECTIVE SUB-PACKAGE MEETING AGREED WORK SCHEDULE REQUIREMENTS.
3. BHEL SHALL FURNISH SUB-VENDOR LIST FOR REMAINING EQUIPMENTS FOR WHICH PROVENNESS CRITERIA IS APPLICABLE BUT ARE NOT COVERED IN THIS DOCUMENT WITHIN 06 MONTHS OF AWARD OF EPC PACKAGE.
4. '*' NTPC INFORMED THAT WITH THE DETAILS AVAILABLE WITH NTPC FOR PAST PROJECTS, SUB-VENDOR IS UNLIKELY TO MEET PROVENNESS WHICH BHEL MAY FURNISH LATER.

Bharat Heavy Electricals Limited PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited Distt-Ramgarh(Jharkhand) C & M Deptt.

SECTION - 3

GENERAL TECHNICAL REQUIREMENT

ANNEXURE – 3A

NTPC SPECIFICATION: GENERAL TECHNICAL REQUIREMENT PART C

NTPC Limited

(A Government of IndiaEnterprise)

PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3x800 MW)

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

BIDDING DOCUMENT NO.: CS-9585-001-2

NTPC Limited

(A Government of IndiaEnterprise)

PATRATU SUPER THERMAL POWER STATION EXPANSION
PHASE -I (3x800 MW)

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

BIDDING DOCUMENT NO.: CS-9585-001-2

(This document is meant for the exclusive purpose of bidding against this Package and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued).

PART - C

GENERAL TECHNICAL REQUIREMENTS

GENERAL TECHNICAL REQUIREMENTS

PART - C

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1.00.00 **INTRODUCTION**

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.

2.00.00 **BRAND NAME**

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.00.00 **BASE OFFER & ALTERNATE PROPOSALS**

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.

4.00.00 **COMPLETENESS OF FACILITIES**

4.01.00 Bidders may note that this is a turnkey contract. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All same standard components/ parts of same equipment provided, shall be interchangeable with one another.

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 **CODES & STANDARDS**

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following :

a) Indian Electricity Act

b) Indian Electricity Rules

c) Indian Explosives Act

d) Indian Factories Act and State Factories Act

e) Indian Boiler Regulations (IBR)

f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

h) Pollution Control Regulations of Department of Environment, Government of India

i) State Pollution Control Board.

(j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m.) Explosive Rules, 1983

(n.) Petroleum Act, 1984

(o.) Petroleum Rules, 1976,

(p.) Gas Cylinder Rules, 1981

(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981

(r.) Workmen's Compensation Act, 1923

(s.) Workmen's Compensation Rules, 1924

(t.) NTPC Safety Rules for Construction and Erection

(u.) NTPC Safety Policy

(v.) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply :

a) Bureau of Indian standards (BIS)

b) Japanese Industrial Standards (JIS)

c) American National Standards Institute (ANSI)

d) American Society of Testing and Materials (ASTM)

e) American Society of Mechanical Engineers (ASME)

f) American Petroleum Institute (API)

g) Standards of the Hydraulic Institute , U.S.A.

h) International Organization for Standardization (ISO)

i) Tubular Exchanger Manufacturer's Association (TEMA)

j) American Welding Society (AWS)

k) National Electrical Manufacturers Association (NEMA)

l) National Fire Protection Association (NFPA)

m) International Electro-Technical Commission (IEC)

n) Expansion Joint Manufacturers Association (EJMA)

o) Heat Exchange Institute (HEI)

p) IEEE standard

q) JEC standard

5.03.00 Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

5.04.00 As regards highly standardised equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.

5.05.00 In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

5.06.00 Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.

5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.

5.08.00 A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.

6.00.00 **EQUIPMENT FUNCTIONAL GUARANTEE**

6.01.00 The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.

6.02.00 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

7.00.00 **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**

7.01.00 **DESIGN OF FACILITIES**

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best coordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 **MAINTENANCE AND AVILABILITY CONSIDERATIONS**

Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.

8.00.00 **DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**

8.01.00 Bidders may note that this is a turnkey contract. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works.

The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.

A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this Part-C, Section-VI of the Technical Specification.

8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:

8.03.01 A) **BASIC ENGINEERING DOCUMENTATION**

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i) System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii) Technology scan for each system / sub-system & equipment.

iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv) Optimisation studies including thermal cycle optimisation.

v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.

vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii) Water Balance diagram.

viii) Operation Philosophy and the control philosophy of the Main Plant and other plants.

ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area, transformer yard, switchyard and other areas included in the scope of the bidder.

xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) **DETAILED ENGINEERING DOCUMENTS**

i) General layout plan of the station.

ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii) Flow diagram, process and instrumentation diagrams along with write up and system description.

iv) Start up curves for boiler and both turbines and boiler combined together as a unit for various start ups, viz. cold, warm and hot start up.

v) Piping isometric, composite layout and fabrication drawings.

vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.

vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.

viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans, BFPs, CEPs, Heaters/ Deaerators, Condensers, vacuum pumps etc.

ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.

x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes..

xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.).

xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.

xiii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiv) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xv) Protection system diagrams and relay settings.

xvi) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.

xx) Sequence and protection interlock schemes.

xxi) Type test reports, insulation co-ordination study report and power system stability study report.

xxii) Control system configuration diagrams and card circuit diagrams and maintenance details.

xxiii) Detailed DDCMIS system manuals.

xxiv) Detailed flow chart for digital control system.

xv) Mimic diagram layout, Assignment for other application engg.

xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.

xxvii) Underground facilities, levelling ,sanitary, land scaping drawings.

xxviii) Geotechnical investigation and site survey reports (if and as applicable).

xxix) Model study reports wherever applicable.

xxx) Functional & guarantee test procedures and test reports.

xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

The Contractor's while sumitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.02 **INSTRUCTION MANUALS**

The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-IV.** The Contract shall not be considered to be completed

for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the

manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows :

1) Chapter 1 - Plant Description : To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (The is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement..

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by

the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

8.03.03.01 **PLANT HANDBOOK**

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 **PROJECT COMPLETION REPORT**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **DRAWINGS**

a) i) All the plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering.The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per **Annexure-VI** of Part-C.The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.

The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI** of Part-C.

iv) Contractor shall prepare the model of all the facilities located in Main Power Block area, covering Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area and any other facility located in Main Plant Block area in an integrated & intelligent 3D software solution using rule based, data centric 3D design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model.

All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer’s review along with the 3D review model to enable NTPC to review and approve these drawings.

Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer.

After the completion of engineering of respective area i.e. TG building/ Boiler/ ESP etc., the corresponding complete 3D review model shall be handed over to the employer for its reference.

b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project . The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or

approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer piror to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this turnkey package.

Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to “as built” conditions and submit no. of copies as per **Annexure VI**.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout

completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

8.04.00 **ENGINEERING INFORMATION SUBMISSION SCHEDULE**

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

i) Information that shall be submitted for the approval to the Employer before proceeding further, and

ii) Information that would be submitted for Employer's information only.

The Master Drawing List(MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 **Engineering Co-ordination Procedure**

8.05.01 The following principal coordinators will be identified by respective organizations at time of award of contract :

NTPC Engineering Coordinator (NTPC EC) :

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

8.05.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

8.05.03 Contractor's/Vendor's Drawing Submission and Approval Procedure :

a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".

b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.

d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor, thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number.

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) **Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.**

g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :

CATEGORY- I:	Approved
CATEGORY- II	Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.
CATEGORY –III	Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.
CATEGORY -IV	For information and records.

h) Contractor shall resubmit the drawings approved under Category II, III & IVR within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

8.06.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.06.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

b) Drawings which were not submitted as per agreed schedule.

8.06.02 The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

9.00.00 **TECHNICAL CO-ORDINATION MEETING**

9.01.00 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

9.02.00 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule.The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks_from the date of receipt of the drawing .The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.

9.02.01 The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

9.02.02 Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

9.03.0 Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.

10.00.00 **DESIGN IMPROVEMENTS**

The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change.

Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

11.00.00 **EQUIPMENT BASES**

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

12.00.00 **PROTECTIVE GUARDS**

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

13.00.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

13.01.00 All the first fill and one year's topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids, gases (excluding H_2, CO_2 and N_2 for generator) and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion of facilities shall be supplied by the contractor. Suitable standard lubricants as available in india are desired.Efforts should be made to limit the variety of lubricants to minimum.

Bidder scope shall also include supply of H_2,CO_2 and N_2 as applicable for the generator till successful commissioning of generator.

Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.

13.02.00 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.

Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.

14.00.00 **LUBRICATION**

14.01.00 Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

15.00.00 **MATERIAL OF CONSTRUCTION**

15.01.00 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.

16.00.00 **RATING PLATES, NAME PLATES & LABELS**

16.01.00 Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.

16.02.00 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.

16.03.00 Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.

16.04.00 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

16.05.00 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support.

16.06.00 Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire.

16.07.00 Safety and relief valves shall be provided with the following:

a) Manufacturer's identification.

b) Nominal inlet and outlet sizes in mm.

c) Set pressure in Kg/cm^2 (abs).

d) Blowdown and accumulation as percentage of set pressure.

e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

16.08.00 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.09.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

17.00.00 **TOOLS AND TACKLES**

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.

18.00.00 **WELDING**

18.01.00 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.

19.00.00 **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**

19.01.00 All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

20.00.00 **PROTECTION AND PRESERVATIVE SHOP COATING**

20.01.00 **PROTECTION**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.

20.02.00 **PRESERVATIVE SHOP COATING**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.

Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

20.03.00 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

20.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

20.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

20.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.

21.00.00 **QUALITY ASSURANCE PROGRAMME**

21.01.00 To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following:

a) His organisation structure for the management and implementation of the proposed quality assurance programme

b) Quality System Manual

c) Design Control System

d) Documentation Control System

e) Qualification data for Bidder's key Personnel.

f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

h) Control of non-conforming items and system for corrective actions.

i) Inspection and test procedure both for manufacture and field activities.

j) Control of calibration and testing of measuring testing equipments.

k) System for Quality Audits.

l) System for indication and appraisal of inspection status.

m) System for authorising release of manufactured product to the Employer.

n) System for handling storage and delivery.

o) System for maintenance of records, and

p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as **Annexure-I** and **Annexure-II** respectively.

22.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

22.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.

22.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)

22.03.00 Field Quality Plans will detail out for 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 (As per format at Annexure – II).

22.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the

Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.

22.05.00 The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at **Annexure-V.** The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.

22.06.00 The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.

22.07.00 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).

22.08.00 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details

22.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.

22.10.00 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

22.11.00 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified

as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer..

22.12.00 For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping shall be as per relevant code. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding

22.13.00 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

22.14.00 No welding shall be carried out on cast iron components for repair.

22.15.00 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

22.16.00 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested..

22.17.00 The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at **Annexure-IV.** Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

22.18.00 For components/equipment procured by the contractors for the purpose of the

contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.

22.19.00 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

22.20.00 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

22.21.00 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

22.22.00 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

22.23.00 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

22.24.00 **Environmental Stress Screening**

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the

contractor / sub – contractor should meet the following.

1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

Or

In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

2) **Burn in Test Cycle**

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall

be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.

22.25.00 The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

23.00.00 **QUALITY ASSURANCE DOCUMENTS**

23.01.00 The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓)mark.

23.01.01 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.

23.02.00 Typical contents of QA Documentation is as below:-

(a.) Quality Plan

(b.) Material mill test reports on components as specified by the specification and approved Quality Plans.

(c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

(d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

(e.) Heat Treatment Certificate/Record (Time- temperature Chart)

(f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure).

(g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

23.03.00 Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

23.04.00 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.

23.05.00 **TRANSMISSION OF QA DOCUMENTATION**

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.

24.00.00 **PROJECT MANAGER'S SUPERVISION**

24.01.00 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.

24.02.00 The work shall be performed under the supervision of the Project Manager.

The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications:

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc:

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :

(d.) Inspect, accept or reject any equipment, material and work under the contract :

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

25.00.00	**INSPECTION, TESTING AND INSPECTION CERTIFICATES**
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
25.04.00	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
25.05.00	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
25.06.00	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise

specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

25.07.00 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.

25.08.00 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

25.09.00 All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

25.10.00 **Associated document for Quality Assurance programme**

25.10.01 Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at **Annexure-I.**

25.10.02 Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at **Annexure-II.**

25.10.03 List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 **(Annexure-III).**

25.10.04 Status of items requiring Quality Plan and sub supplier approval. Format enclosed at **Annexure-IV.**

25.10.05 Field Welding Schedule Format enclosed at **Annexure-V.**

25.11.00 **TESTING OF MAJOR DESIGN FEATURES:**

The major design features of the system shall be demonstrated by the Contractor at the Contractor's works or any other place mutually agreed within Six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like

configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following.

a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B.

b) Loop reaction time for sample loops/ logics.

c) SOE functionality tests.

d) Server changeover.

e) Various response times, having serious implication on operation & maintenance philosophy.

f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load.

g) Unified HMI for DDCMIS.

The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer.

If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report.

25.12.00 **DEMONSTRATION OF APPLICATION ENGINEERING**

25.12.01 Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following.

(i) Logics/Loops:

a) Drive logics implementation for each type of binary drive along with its display in HMI.

b) Sequence implementation along with its display in HMI.

c) Single non-cascade controller implementation.

d) Cascade loop implementation.

e) Master slave implementation with different slave combination.

f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.

(ii) HMI Functions:

a) LVS Annunciation.

b) Graphics.

c) HSR

d) Logs/Reports.

e) Calculations (Basic & Performance Calculations).

25.12.02 The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.

After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.

25.12.03 During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.

26.00.00 **PRE-COMMISSIONING AND COMMISSIONING FACILITIES**

26.01.00 (a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-

commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.

(b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

(c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.

(d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer.

(f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

26.01.00 Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain :

(1.) Biodata including experience of the Commissioning Engineers.

(2.) Role and responsibilities of the Commissioning Organisation members.

(3.) Expected duration of posting of the above Commissioning Engineers at site.

26.02.00 **Initial Operation**

(a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

(b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.

The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

(c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation.

(d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.

26.03.00 **Guarantee Tests**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up and initial operation shall make the unit ready to

conduct such test. Such test will be commenced, within a period of **three (3) months** after the successful completion of Initial Operations. Any extension of time beyond the above **three (3) months** shall be mutually agreed upon.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.

27.00.00 **TAKING OVER**

Upon successful completion of Initial Operations and all the tests,other than Guarantee Tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be with held nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

28.00.00 **TRAINING OF EMPLOYER'S PERSONNEL**

28.01.00 The scope of service under training of Employer’s engineers shall include a training module covering the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer:

(a) Training for Steam Generator & ESP Equipment, TG & Auxiliaries and related equipments.

(b) Training for Electric Systems including VFD and Electric power supply system.

(c) Training for other SG/TG related C&I systems/equipments including training on Flame Monitoring System, Furnace and Flame Viewing System , Turbine Supervisory System (TSS) including vibration analyzer, vibration monitoring system axial shift, eccentricity measurements etc. for Main Turbine, BFP Turbine etc. Burner management study, control loop study, misc system for SG C&I, EHTC, Turbine stress control system, Turbine protection system, ATRS, instrumentation etc.

(d) Training for special packages for various PC based systems specified elsewhere in Part-B of Technical Specification, Section-VI.

(e) Training for various C&I systems/equipment supplied includes the following:

i) DDCMIS - Human Machine Interface – Hardware & Operating System

ii) DDCMIS-Human Machine Interface System Engineering & Application Software.

iii) DDCMIS – Control System Hardware and Control system Application Software.

iv) DDCMIS – Operator Training : Use of the system at Works + at site.

v) DDCMIS – Specialized Network security.

(f) Training for power cycle piping/critical piping.

(g) Training for UPS systems Annunciation system, SWAS, PA system, flue gas analyzers, CCTV and 24 VDC system.

(h) Training for numerical relays & networking systems supplied under MV & LT switchgear system.

(i) Training for Simulator System

(j) Details of training modules for SG, TG, Electrical, C&I systems and Simulator System are given at **Annexure – VII, VIII, IX, X, XI & XII.**

The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval.

28.03.00 The scope of services under training shall also necessarily include training of Employer’s Engineering personnel covering a training module as indicated in **Annexure – VII, VIII, IX, X, XI & XII** . This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product deign software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer’s works, exposure to various kinds of

problems which may be encountered in fabrication, manufacturing erection, welding etc.

28.04.00 Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.

28.05.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above [i.e. **Annexure – VII, VIII, IX, X, XI & XII** for O&M and Engineering] is indicative only. Employer reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.

28.06.00 Exact details, extent of training and the training schedule shall be finalized based on the Bidder's proposal within two (2) months from placement of award.

28.07.00 In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.

28.08.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.

Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.

29.00.00 **SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION**

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

i) Working platforms should be fenced and shall have means of access.

ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

30.00.00 **NOISE LEVEL**

The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

i) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA.

ii) Regulating drain valves in which case it shall be limited to 90 dBA-115 dBA.

iii) Mill noise which will be limited to 85-90 dBA.

iv) TG unit in which case it shall not exceed 90 dBA.

v) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 90 dBA.

vi) For BFP Motor Noise level shall be with in the limit of 90 dBA.

31.00.00 **PACKAGING AND TRANSPORTATION**

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

32.00.00 **ELECTRICAL EQUIPMENTS/ENCLOSURES**

32.01.00 All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.

33.00.00 **INSTRUMENTATION AND CONTROL**

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

33.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

1 Temperature	-	Degree centigrade (deg C)
2. Pressure	-	Kilograms per square centimetre (Kg/cm^2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
3. Draught	-	Millimetres of water column (mm wc).
4. Vacuum	-	Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).
5. Flow (Gas)	-	Tonnes/ hour
6. Flow (Steam)	-	Tonnes/ hour
7. Flow (Liquid)	-	Tonnes / hour
8. Flow base	-	760 mm Hg. 15 deg.C
9. Density	-	Grams per cubic centimetre.

33.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.

33.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.

34.00.00 **ELECTRICAL NOISE CONTROL**

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).

35.00.00 **SURGE PROTECTION FOR SOLID STATE EQUIPMENT**

All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.

36.00.00 **INSTRUMENT AIR SYSTEM**

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

37.00.00 **TAPPING POINTS FOR MEASUREMENTS**

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.

i) Temperature test pockets with stub and thermowell

ii) Pressure test pockets

38.00.00 **SYSTEM DOCUMENTATION**

The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum

documentation requirements for C&I systems shall be as stipulated under C&I "Techncial Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification.

The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

38.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.

39.00.00 **MAINTENANCE MANUALS OF ELECTRONIC MODULES**

The Contractor shall have to furnish two(2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him.The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further , the contractor shall furnish a set of operating manuals which should include block diagrams ,make, model/type ,details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules.

LIST OF CODES AND STANDARDS

Indian Standards	Title	International and Internationally recognised standards
IS:277	Galvanised steel sheets (plain or corrugated)	
IS:655	Specification for metal air duct	
IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952
IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Associa-tion of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev
IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1
IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958)

		(ISO/R-65-1958) (BS 1387 : 1957)
IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965
IS:2825	Code for unfired vessels	
IS:1520	Horizontal centrifugal pumps for clear cold and fresh water	
IS:1600	Code for practice for performance of constant speed IC Engines for general purpose	
IS:1601	Specification for perform-ance of constant speed IC Engines for general Purpose	
IS:1893	Criteria for earthquake resistant design of structures	
IS1978-1971	Line Pipe April 1969.	API Standards 5L
IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954
IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968
IS:2312	Propellant type Ventilation fans	
IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957
IS:3346	Method for the determin-ation of thermal	DIN 52612 (Deutscher Normenausschuss)

	conductivity of thermal insulation materials (two slab guarded hot plate method)	ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963
IS:3354	Outline dimensions for electric lifts.	
IS:3401	Silica gel	
IS:3588	Specification for electrical axial flow fans	
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)	
IS:3677	Unbonded rock and slag wool for thermal insulation	
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
IS:3895	Specification for monocry-stallines semiconductor rectifier cells and stacks	
IS:3963	Roof extractor unit	
IS:3975	Mild steel wires, strips and tapes for armouring cables	
IS:4503	Shell and tube type heat Exchanger	
IS:4540	Specification for monory-stallines rectifire assembly	

	equipment	
IS:4671	Expanded polystyrene for thermal insulation purpose	
IS:4736	Hot dip zinc coating on steel tubes	
IS:4894	Centrifugal fans	
IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958
IS:6392	Steel pipe flanges	BS 4504 : 1969
IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956
IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524
IS:7373	Specification for wrought aluminium and aluminium sheet and strips	
IS:7938	Air receivers for compressed air installation	
ISO:1217	Displacement compressor-Acceplance test	
ASHRAE-33	Methods of testing for rating of forced circulation air cooling and air heating coils.	
ASHRAE-52-76	Air cleaning device used in general ventilation for removing particle matter.	

ASHRAE-22-72	Method of testing for rating of water cooled refrigerant condensers.
ASHRAE 23-67	Methods of testing for rating of positive displacement refrigerant compressors.
ARI-450-6	Standard for water cooled refrigerant condensers.
ARI-550	Standard for centrifugal water chilling packages.
ARI-410	Standard for forced circulation air cooling and air heating coils
ARI-430/435	Central station AHU/Application of Central Station AHU
BS:848 (Part-1,2)	Fans
BS:400	Low carbon steel cylinders for the storage & transport of permanent gases.
BS:401	Low carbon steel cylinders for the storage & transport of liquified gases.
CTI Code ACT-105	Acceptance test code for Water Cooling Tower.
ANSI-31.5	Refrigerant piping
ASME-PTC-23-1958	Atmospheric Water Cooling Equipment
AMCA A-21C	Test Code for air moving devices
API:618	Reciprocating Compressor for general refinary services.

HYDRAULIC INSTITUTE STANDARDS.

HYDRANT SYSTEM MANUALS OF TAC.

TAC MANUALS OF SPRAY SYSTEM

NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.

CODE AND STANDARD FOR CIVIL WORKS

Some of the applicable Standards, Codes and references are as follows:

Excavation & 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.

Properties, Storage and Handling of Common Building Materials

IS: 269 Specification for ordinary Portland cement, 33 grade.

IS: 383 Specification for coarse and fine aggregates from natural sources for concrete.

IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.

IS: 455 Specification for Portland slag cement.

IS: 702 Specification for Industrial bitumen.

IS: 712 Specification for building limes.

IS: 808 Rolled steel Beam channel and angle sections.

IS: 1077 Specification for common burnt clay building bricks.

IS: 1161 Specification of steel tubes for structural purposes.

IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C.

IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B.

IS: 1367 Technical supply conditions for Threaded fasteners.

IS: 1489 Specification for Portland-pozzolana cement:

(Part-I) Fly ash based.

(Part-II)	Calcined clay based.
IS: 1542	Specification for sand for plaster.
IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS: 1786	Specification for high strength deformed bars for concrete reinforcement.
IS: 2062	Specification for steel for general structural purposes.
IS: 2116	Specification for sand for masonry mortars.
IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.
IS: 3150	Hexagonal wire netting for general purpose.
IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.
IS: 3812	Specification for fly ash, for use as pozzolana and admixture.
IS: 4031	Methods of physical tests for hydraulic cement.
IS: 4032	Methods of chemical analysis of hydraulic cement.
IS: 4082	Recommendations on stacking and storage of construction materials at site.
IS: 8112	Specification for 43 grade ordinary portland cement.
IS: 8500	Medium and high strength structural steel.
IS: 12269	53 grade ordinary portland cement.
IS: 12894	Specification for Fly ash lime bricks.

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: 2204	Code of practice for construction of reinforced concrete shell roof.
	IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
	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	Code of practice for concrete structures for the storage of

(Part I to IV)	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: 4461	Code of practice for joints in surface hydro-electric power stations.
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: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.
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: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.
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.

Precast Concrete Works

SP: 7(PartVI/	National Building Code- Structural design of prefabrication and Sec.7) 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.

Masonary 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.

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 polyster resin (glass fibre reinforced).
IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.

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: 9178	Criteria for Design of steel bins for storage of Bulk Materials.
IS: 9006	Recommended Practice for Welding of Clad Steel.
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 : 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.

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.

Acid and Alkali Resistant Lining

IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS : 412	Specification for expanded metal steel sheets for general purpose.

IS : 4441	Code of practice for use of silicate type chemical resistant mortars.
IS : 4443	Code of practice for use of resin type chemical resistant mortars.
IS : 4456	Method of test for chemical resistant tiles. (Part I & II)
IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.
IS : 4832	Specification for chemical resistant mortars.
	Part I Silicate type
	Part II Resin type
	Part III Sulphur type
IS : 4860	Specification for acid resistant bricks.
IS : 9510	Specification for bitumasitc, Acid resisting grade.

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.

Doors, Windows and Allied Works

IS : 204	Tower Bolts
Part-I	Ferrous metals.
Part-II	Nonferrous metals.
IS : 208	Door Handles.
IS : 281	Mild steel sliding door bolts for use with padlocks.
IS : 362	Parliament Hinges.
IS : 420	Specification for putty, for use on metal frames.
IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.
IS : 1038	Steel doors, windows and ventilators.
IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS : 1341	Steel butt hinges.
IS : 1361	Steel windows for industrial buildings.
IS : 1823	Floor door stoppers.
IS : 1868	Anodic coatings on Aluminium and its alloys.
IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels

IS:2209	Mortice locks (vertical type).
IS:2553	Safety glass
IS:2835	Flat transparent sheet glass.
IS:3548	Code of practice for glazing in buildings.
IS:3564	Door closers (Hydraulically regulated).
IS : 3614	Fire check doors; plate, metal covered and rolling type.
IS:4351	Steel door frames.
IS:5187	Flush bolts.
IS:5437	Wired and figured glass
IS:6248	Metal rolling shutters and rolling grills.
IS:6315	Floor springs (hydraulically regulated) for heavy doors.
IS:7196	Hold fasts.
IS:7452	Hot rolled steel sections for doors, windows and ventilators.
IS:10019	Mild steel stays and fasteners.
IS:10451	Steel sliding shutters (top hung type).
IS:10521	Collapsible gates.

R oof Water Proofing and AlliedWorks

IS:1203	Methods of testing tar and bitumen.
IS:1322	Specification for bitumen felts for water proofing and damp proofing.
IS:1346	Code of practice for water proofing of roofs with bitumen felts.
IS:1580	Specification for bituminous compound for water proofing and caulking purposes.

IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.

Floor Finishes and Allied Works

IS:1237	Specification for cement concrete flooring tiles.
IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.
IS:2114	Code of practice for laying in-situ terrazzo floor finish.
IS:2571	Code of practice for laying in-situ cement concrete flooring.
IS:3462	Specification for unbacked flexible PVC flooring.
IS:4971	Recommendations for selection of industrial floor finishes.
IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS:8042	Specification for white portland cement.
IS:13801	Specification for chequered cement concrete flooring tiles.

Painting and Allied Works

IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.
IS:1477	Code of practice for painting of ferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:1650	Specification for colours for building and decorative finishes.
IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.
IS:2338	Code of practice for finishing of wood and wood based materials.
Part-I	Operations and workmanship

Part-II	Schedules
IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.
Part-I	Operations and workmanship.
Part-II	Schedule.
IS:2524	Code of practice for painting of nonferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.
IS:2933	Specification enamel paint, under coating and finishing.
IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.
IS:5410	Specification for cement paint
IS:5411 (Part-I)	Specification for plastic emulsion paint-for exterior use
IS:6278	Code of practices for white washing and colour washing.
IS:10403	Glossary of terms relating to building finishes.

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:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).
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.
Stop Log and Trash Rack	
IS:4622	Recommendations for fixed - wheel gates structural design.
IS:5620	Recommendations for structural design criteria for low head slide gates.
IS:11388	Recommendations for design of trash rack for intakes.
IS:11855	General requirements for rubber seals for hydraulic gates.
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:34	Recommendations for road construction in waterlogged areas.
IRC:36	Recommended practice for the construction of earth embankments for road works.
IRC:37	Guidelines for the Design of flexible pavements.
IRC:56	Recommended practice for treatment of embankment slopes for erosion control.
IRC:73	Geometric design standards for rural (non-urban) highways.
IRC:86	Geometric Design standards for urban roads in plains.

IRC:SP:13	Guidelines for the design of small bridges & culverts.
IRC - Public-ation	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.
IS:73	Specification for paving bitumen
Loadings	
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.
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.

Architectural design of buildings

SP:7	National Building Code of India
SP:41	Hand book on functional requirements of buildings (other than industrial buildings)

Miscellaneous

IS:802	Code of practice for use of structural steel in
(Relevant parts)	overhead transmission line towers.
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.
IS:10430	Creteria for design of lined canals and liner for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
CIRIA	Design and construction of buried thin-wall pipes.
Publication	

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

Temperature Measurements

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.
3. Temperature measuremnet by electrical Resistance thermometers - IS:2806.
4. Thermometer - element - Platinum resistance - IS:2848.

Pressure Measurements

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).

   b) Electonic transmitters BS:6447.
2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.
3. Process operated switch devices (Pr. Switch) BS-6134.

Flow Measurements

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

Electronic Measuring Instrument & Control Hardware/ Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.
2. Safety requirements for electrical and electronic measuring and controling instrument - ANSI C 39.5 - 1974.
3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).
5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.
6. Printed circuit boards - IPC TM - 650, IEC 326 C.
7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).
11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).
12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.
13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.
14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.
15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.

17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.

18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.

19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.

20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.

21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.

22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.

2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).

2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).

3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

Apparatus, enclosures and installation practices in hazardous area

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.

2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.

3. Instrinsically safe apparatus - NFPA 493 1978.

4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.

5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.
3. Water and steam in power cycle - ASME PTC 19.11.
4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.
2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472
3. Damp heat cycling test - IS:2106
4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.
2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.
3. Turbine water damage prevention - ASME TDP-1-1980.
4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.
2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.
3. Surge withstand capability test - ANSI C 37.90 1 -1989.
4. Performance testing of UPS - IEC 146.
5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.

6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.

7. Printed Circuit Board - IPC TM 650, IEC 326C.

8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.

2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.

3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).

4. Codes for pressure piping - ANSI B 31.1

5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.

2. Seamless carbon steel pipe ASTM - A - 106.

3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.

4. Material for socket welded fittings - ASTM - A - 105.

5. Seamless ferritic alloy steep pipe - ASTM - A - 335.

6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.

7. Composition bronze of ounce metal castings - ASTM - B - 62.

8. Seamless Copper tube, bright annealed - ASTM - B - 168.

9. Seamless copper tube - ASTM - B - 75.

10. Dimension of fittings - ANSI - B - 16.11.

11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.

2. Material of socketweld fittings - ASTM - A105.

3. Dimensions of fittings - ANSI - B - 16.11.

4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.
2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.
3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorugh 2/83.
4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).
5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.
6. Rules for Testing insulated cables and flexible cables : VVDE - 0472
7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)
8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.
9. Oxygen index and temperature index test - ASTM D - 2863.
10. Smoke density measurement test - ASTMD - 2843.
11. Acid gas generation test - IEC - 754 - 1.
12. Swedish Chimney test - SEN - 4241475 (F3).
13. Teflon (FEP) insulation & sheath test - ASTMD - 2116.
14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.
15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).

Cable Trays, Conduits

1. Guide for design and installation of cable systems in power generating staiton (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.
2. -do- Test Standards. NEMA VE-1-1979.
3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTMA - 386-78.

Public Address System

1. Specifications for lod speakers - IS:7741 (Part-I, II and III)
2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301
3. Specification for Public Address Amplifiers - IS:10426.
4. Code of practice for outdoor installation of PA system - IS:1982.
5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.
6. Basic environmental testing procedures for electronic and electrical items - IS:9000.
7. Characteristics and methods of measurements for sound system equipment - IS:9302
8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732
9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)
10. Fittings for rigid steel conduits for electrical wiring - IS:2667
11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.

Vibration Monitoring System

1. API 670 - 1994
2. BS : 4675 Part-2

ANNEXURE-I

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV.NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: …. OF….	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.

		LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** **M:** MANUFACTURER/SUB-SUPPLIER C**:** MAIN SUPPLIER, **N**: NTPC **P:** PERFORM **W**: WITNESS AND **V:** VERIFICATION. AS APPROPRIATE, **CHP:** NTPC SHALL IDENTIFY IN COLUM "N" AS ' W"	एनटीपीसी NTPC	DOC. NO.:		REV…… CAT…..
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER		FOR NTPC USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F1-R1 1/1 ENGG. DIV./QA&I

ANNEXURE-II

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS	FIELD QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
			REV. NO.:	CONTRACT NO. :
		SUB-SYSTEM:	DATE:	MAIN-SUPPLIER:
			PAGE: …. OF….	

SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.

		LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. **LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A'** SHALL BE WITNESSED BY NTPC FQA, **'B'** SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND **'C'** SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)	एनटीपीसी NTPC	DOC. NO.:		REV……
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER		FOR NTPC USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F2-R1 1/1 ENGG. DIV./QA&I

ANNEXURE-III

एनटीपीसी NTPC	**Project :** **Stage ::** **Package :** **Supplier :** **Contractor No. :**	**LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL** **SUB-SYSTEM :**	**DOC. NO.:** **REV. NO.:** **DATE :** **PAGE : OF**

S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

LEGENDS

SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – **For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list alongwith the condition of approval, if any.**

DR **– For these items "Detailed required" for NTPC review. To be identified with letter "DR" in the list.**

NOTED **– For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with "NOTED.'**

QP/INSPN CATEGORY:

CAT-I **: For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.**

CAT-II **: For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.**

CAT-III **: For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.**

UNITS/WORKS **: Place of manufacturing Place of Main Supplier of multi units/works.**

FORMAT NO.: QS-01-QAI-P-1/F3-R0 1/1 Engg. Div. / QA&I

ANNEXURE-IV

एनटीपीसी NTPC	Project : Stage : : Package : Contractor : Contractor No. :	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL	DOC. NO.: REV. NO.: DATE : PAGE : OF

S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks

FORMAT 1/1 Engg. Div. / QA&I

ANNEXURE-V

एनटीपीसी NTPC	Project : Stage : Contractor : Contractor No. : System :	FIELD WELDING SCHEDULE (To be raised by the contractor) Welding Code: ……	DOC. NO.: REV. NO.: DATE : PAGE : OF

Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	

NOTES:

SIGNATURE

FORMAT	1/1	**Engg. Div. / QA&I**

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents		
	First submission and submission with major changes		
	▪ Layout (A0&A1 sizes)	4	-
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-
	▪ P&ID (All sizes)	4	-
	a) Final drawings/documents (Directly to site)	6	2
	b) "As Built" Drawing/Documents (Directly to site)	6	2
	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2
2	Erection Manual (Directly to site)	4 sets	2
3	Operation & Maintenance manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2
4	Plant Hand Book i) First Submission	1	1
5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	–
	ii) Approved Copies (Direct to Site)	4 sets	2
7	Project Completion Report (Directly to site)	6 sets	2
8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	–
9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	–
10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment	1	–
	ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2
11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment	1 set	–
	ii) Approved copies (Direct to Site)	4 sets	2
12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
1.0	**Steam Generator & Auxiliaries (Mechanical)**													
1.1	Boiler	General famlarisation of supplied boiler	6 months	3	a) General Design, equipment, system and parameter famlarisation of supplied boiler i.e. features, design, operating parameters etc. b) Genaral Layout of boiler & ESP area, basic layout selection criteria, arrangement of pressure part, flue gas duct, coal pipe, bunker, valves, dampers, equipments, piping trestles etc.	Design office of the QSGM	3	1. Manufacturing of pressure parts 2. Welding processes 3. Testing Facilities 4. Product Development in process/ progress 5. Future plan for Technology induction 6. R&D work in progress	Manufacturer's works where the boilers of the subject project is being manufactured.	4	1. General Design, equipment, system and parameter famlarisation of operating boiler (visited) (which preferably should be simillar to supplied boiler) i.e. features, design, operating parameters. The palnt visit should include the following: a) Boiler each floor level walk through b) Visit to all the boiler auxiliaries location. c) Visit to BOP area. 2. Collection of Performance data of the plant	Operating plants in any country including India where same make with similar capacity boilers are under operation.	2	27
1.2	Boiler	Pressure parts	6 months	3	Basic theory/ concept, calculation with illustrative example, Design application, arrangement of following: 1. Thermal design and hydraulic circulation balance 2. Strength Calculation 3. Pressure Part arrangement, coil orientation and basis. 4. Tube metal temperature calculation, criteria for location of thermocouple. 5. Selection Creiteria for soot blower (i.e. location, nos. etc.)	Design office of the QSGM	3							9
1.3	Boiler	Performance	6 months	3	Basic concept, calculation of performance data with illustrative example (such as Heat Duty, boiler efficiency, predicted performance, NOX calculation, furnace sizing etc.) of offered boiler and its application to boiler design.	Design office of the QSGM	4							12
1.4	Boiler	Boiler System	6 months	3	a) Basic concept, Sizing calculation of following systems with illustrative examples alongwith details of criteria affecting the sizing calculation : 1. Air & Gas System (duct sizing, air & gas weight calculation, damper & gates sizing etc.) 2. Start up system (Circulation calculation, sizing and input data for SGWC pump etc.) 3. Fuel firing/ Combustion system (Sizing calculation of Pulveriser, feeders, burners, PA & Seal Air Fans etc.) 4. Fuel Oil firing system (Sizing calculation of HFO/ LFO pump, heater, strainers, pressure drop calculation etc.) 5. Draft System (sizing calculation of FD & ID Fans etc.) b) Impact of the above sizing calculation on the overall boiler design/ performance.	Design office of the QSGM	6							18

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
					c) Selection/ optamisation of above system from techno-economics point of view such as start up system: selection criteria for wet mode upto 30% or 40% BMCR flow etc. d) Selection/ Optamisation of various auxilieries/ equipments covered under above systems from techno-economics point of view. Such as type & no. of fans (axial- single/ double stage), APH (Tri sector/ bisector APH), Mills etc.	Design office of the QSGM								
1.5	Boiler	General familarisation of supplied SCR System	6 months	3	General Design, equipment, system and parameter famlarisation of supplied SCR system i.e. features, design, operating parameters etc.	Design office of the SCR System supplier	2	1. Manufacturing of Catalyst 2. Testing Facilities for Catalyst 3. Product Development in process/ progress 4. Future plan for Technology induction 5. R&D work in progress	Manufacturer's works where the SCR Catalysts of the subject project is being manufactured.	1	1. General Design, equipment, system and parameter famlarisation of operating SCR System (visited) (which preferably should be simillar to supplied boiler) i.e. features, design, operating parameters. The plant visit should include the following: a) SCR system each floor level walk through b) Visit to all the SCR system auxiliaries location including Ammonia Dosing system. 2. Collection of Performance data of the plant	Operating plants in any country including India where same make with similar capacity SCR system are under operation.	1	12
1.6	Boiler	Ammonia Dosing System for SCR System	6 months	3	1. Basic theory/ concept. 2. Selection & Sizing calculation of Ammonia dosing system with illustrative examples for Compressors, Storage Tanks, Pumps, vaporisers, Air-NH3 mixers, Glycol-water heaters etc. 3. Familirisation of Safety measures to be ensured for Storage & Using Ammonia. 4. Selection & Sizing Criteria for Safety equipments to be ensured as per Indian Regulations for Ammonia Handling	Design office of the SCR System supplier	2							6
1.7	Boiler	Catalyst Modules for SCR System	6 months	3	1. Basic theory/ concept. 2. Seclection criteria of catalyst 3. Sizing calculation of catalyst & calculation of performance data (i.e. Activity etc.) with illustrative examples	Design office of the SCR System supplier	1							3
1.8	Boiler	FGD System	6 months	3	1. Mass balance, Design, selection and sizing calculations of FGD 2. Training on factors affecting sizing/ efficiency of FGD system, equipments & auxiliaries 3. Materials for FGD & selection 4. Basic concepts, Design and sizing calculations on slurry systems including piping, valves, etc. 5. Layout & model of FGD area, cable & piping trestles etc. 6. Erection strategies, erection procedures. 7. Performance as per applicable code and demonstration tests.	Design office of the FGD System supplier	5	1. Manufacturing process of Absorber and other equipment 2. Welding process 3. Testing facilities 4.Product development in process 5. Future plan for technology induction 6. R&D work in progress.	Manufacturer's works where FGD system equipment of the subject project are being manufactured.	2	1. Familiarization with various system and equipment 2. Performance, data collection analysis and review 3. O&M feed back 4.Operation history of various equipment and system 5. Failure analysis	Operating plants in any country including India where same type with similar capacity FGD system are under operation.	3	30
1.9	Boiler	Buck stay & structure	6 months	3	Basic theory, calculations with illustrative example & Design application of Buck stay & structure design	Design office of the QSGM	2							6
1.10	Boiler	Erection & PG Test	6 months	3	Erection strategies, erection procedures Performance and demonstration tests.	NTPC PMI	2							6

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
1.11	Boiler	Review & discussion after Plant Visit	6 months	3	1. Analysis and review of collected performance data of the plant visited. 2. Co-relation of the operating plant design, parameter visited wrt to boiler supplied under contract. 3. O&M feedback of the plant 5. Failure analysis: Atleast elaborative case study of one major failure	NTPC PMI	2							6
1.12	Boiler Auxiliaries	Equipments /Auxiliaries	6 months		Selection criteria of auxiliaries (Type, Model, Nos. etc.) based on input data, design features, working & importance of	NTPC PMI			Manufacturer's works where the equipment of the subject project is being manufactured.					
				2	1. Coal pulveriser		2	Visit to manufacturer Works		1				6
				2	2. Fans (ID, FD, PA & Seal Air Fans)		2	Visit to manufacturer Works		1				6
				2	3. Air-preheater		2	Visit to manufacturer Works		1				6
				2	4. Soot Blowers		1							2
				2	5. Dampers & Gates		1							2
				2	6. Valves including safety valves		2							4
				2	7. Feeder		1							2
				2	8. Burner		1							2
				2	9. SG WC pump		1							2
				2	10. Fuel Oil (HFO & LFO) Pumps, Heaters, Strainers etc.		2							4
				2	11. Any other equipment/ auxiliaries not specified above		1							2
Steam Generator & Auxiliaries (Mechanical) TOTAL Mandays		***173***					***128***			***27***			***18***	173

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
2.0	**Steam Generator & Auxiliaries (Power Cycle Piping)**													
2.1	Power Cycle Piping	Stress analysis of piping	6months	4	1. Critical pipe sizing including pressure drop calculation	Design office of the QSGM	2	1. Familarisation of manufacturing/ fabrication/testing of critical piping (including welding techniques & heat treatment methods employed) and norms	Manufacturer's works	2	Familarisation of Power cycle piping & equipment layout	Operating plants in any country including India operating on similar parameters	1	20
2.2	Power Cycle Piping			4	2.Static analysis of critical piping system	Design office of the QSGM	2	2. Familarisation of variable & constant load hanger setting & snubber setting	Manufacturer's works	1				12
2.3	Power Cycle Piping			4	3.Dynamic analysis (safety valve blowing, wind, siesmic & steam hammer) of critical piping	Design office of the QSGM	2							8
2.4	Power Cycle Piping			4	4.Familarisation of Hanger engineering	Design office of the QSGM	1							4
2.5	Power Cycle Piping			4	5.Familarisation of piping vibration analysis & norms	Design office of the QSGM	1							4
POWER CYCLE PIPING TOTAL Mandays		***48***		***4***			***32***			***12***			***4***	48
3.0	**Steam Generator & Auxiliaries (Electrical)**													
3.1	Boiler	Electrical	6 months	3	Integral Actuator	Manufacturer Works	3	1. Design,interface and funtional aspect 2. Familiarisation with various types of actuator	Manufacturer Works	2				15
3.2	Boiler	Electrical	6 months	3	BCW motor	Manufacturer Works	3	1. Design review , manufacturing process, preservation. 2. operation and maintenance,preservatio n during storage	Manufacturer Works	2				15
3.3	Boiler	Electrical	6 months	3	HT Motor	Manufacturer Works	3	Design review , manufacturing process, storage.	Manufacturer Works	2				15
Electrical TOTAL Mandays		***45***		***3***			***27***			***18***			***0***	45

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
4.0	**Steam Generator & Auxiliaries (Control & Instrumentation)**													
4.1	C&I	SG-DDCMIS-Hardware and Operating System	18 months	4	(a) Hardware & Software organization of the system (b) Basis of selection of H/W memory sizing (c) Operating System features (d) Interface with other system, Openness and inter-operability (e) Upgradability and System testing features	SG-DDCMIS vendor works	2	(a) Hardware & Software organization of the system (b) Basis of selection of H/W memory sizing (c) Operating System features (d) Interface with other system, Openness and inter-operability (e) Upgradability and System testing features	SG-DDCMIS vendor works	2	Operational feedback	Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1.5	22
4.2	C&I	SG-DDCMIS-Human Machine Interface System Engineering & Application Software	18 months	5	(a) Specific system customization (b) Various system modules & interface with OS © Database organisation & development (d) Development of mimics, other applications like calculations, logs, historical storage functionalities & use	SG-DDCMIS vendor works	4	Hands on experience, Testing methodologies	SG-DDCMIS vendor works	2	Operational feedback	Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1	35
4.3	C&I	SG-DDCMIS-(i) Control system hardware (ii) Control system Application Software	18 months	4	(i) (a) Basic design features for system & its Modules, (b) System capabilites & system design techniques (c) Communication with HMI & other systems	SG-DDCMIS vendor works	4	(a) Manufacturing processes with special attention to handling of the modules (b)	SG-DDCMIS vendor works	1	Operational feedback	Operating plants in any country including India where same make/ model of SG-DDCMIS is in	1	24
				4	(ii) (a) Database structure (b) Organization & interface between appplication program & database(c) Application for implementation of Control functions (d) Study of standard algorithms & development of new algorithm	SG-DDCMIS vendor works	3	(ii) (a) System integration & system capabilites testing	SG-DDCMIS vendor works	1				16
4.4	C&I	Boiler Controls: (i) Study of Control loops (ii) Burner Management system	20 months	4	(i) (a) General concept of closed loop controls of the OEM (b) Critical analysis of some important control loops like Boiler Start up control, Feedwater control etc.	Design office of the QSGM	3				Operational feedback	Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1	16
				4	(ii) (a) Hardware logic (b) NFPA-85/ EN-50156/ EN-61508/ En-61511 requirements and other applicable safety standards (c) Flame scanner locations.	Design office of the QSGM	4							16
4.5	C&I	Special SG-related instrumentation (i) Flame Scaneers (ii) Boiler Flame viewing system(iii) Acoustic	24 months	2	(i) (a) Flame scanners: Principle of Operation (b) Suitability for the proposed boiler	Flame scanner vendor's work	1	Manufacturing & testing procedures	Flame scanner vendor's work	1	Operational feedback	Operating plants in any country including India where same make/ model of Flame scanner is in operation.	1	6
				2	(ii) (a) Boiler Flame viewing system: Principle of operation (b) Location (c) Details of software & methods of modification/ customization	Flame camera vendor's work	1				Operational feedback	Operating plants in any country including India where same make/ model of Flame scanner is in operation.	1	4

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
		Pyrometer		2	(iii) (a) Acoustic Pyrometer: Principle of operation (b) Location (c) Details of software & methods of modification/ customization	Acoustic Pyrometer vendor's work	1				Operational feedback	Operating plants in any country including India where same make/ model of Acoustic Pyrometer is in operation.	1	4
4.6	C&I	Electric Power Supply System	22 months	2	System architecture and Component details	Electric power supply system vendor's work	2	Manufacturing/ assebling & testing procedures	Electric power supply system vendor's work	0.5				5
C&I TOTAL Mandays		***148***					***94***			***29***			***25***	148
5.0	**Steam Generator & Auxiliaries (Quality Assurance)**													
5.1	Quality Assurance & Inspection- QA System & Programme	QA System Procedure, Plant Standard	12 months	2	a) Integrated QAManagement System for enhanced reliability of equipments. b) QA system in design, procurement, manufacturing, installation and operation of equipments/ systems. c) QA System for developing and establishing new processes and vendors. d) System of structured documentation of Engg. and test records.	Manufacturer's work	5	1. Appreciation of implementation of QA programmes in various manufacturing, asembly and testing activities. 2. Appreciation of developmental activities for new processes and vendors. 3. System of prequalification of special processes.	Manufacturer's works where the equipment of the subject project is being manufactured.	3	1. operating feedbacks 2. Co-relation of reliability and performance of the equipment with implementation of QA system. 3. Appreciation of the use of structured Engg./ QA documentation during operational phase of plant and during RLA studies of plant.	Operating plants in any country includinh india where same make and similar capacity boilers are under operation.	1	18
5.2	Quality Assurance	SG & Auxiliaries	12 months	5	a) General Design, equipment, system and parameter famlarisation of supplied boiler	PMI	3							15
5.3	Quality Assurance	SG & Auxiliaries (Mechanical)	12 months	4	Pressure parts (Water wall panels, superheaters, Reheaters, headers, economiser, power cycle piping etc.) & Auxiliaries (Fans, Pulversier, APH, Soot blowers, Gates & Dampers, Feeder, SGWC pump etc.) Main design aspect including material of construction and applicable codes/ standards, manufacturing processes, machinery involved, various welding process involved, testing and inspection etc.	Manufacturer's work	3	1. Manufacturing, testing and inspection at various stages of Boiler Pressure parts and Auxiliaries 2. Shop level exposure to these processes with understanding of applicable code/ standard/ parameters involved in manufacturing of main pressure parts and auxiliaries. 3. Various testing and inspection activity in shop for above components.	Manufacturer's works where the equipment of the subject project is being manufactured.	4				28

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training			Training at Manufacturer works			Training at Operating Plants			Total no. of days
					Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	Content of traning	Location of training	No of days	
5.4	Quality Assurance	SG & Auxiliaries: Control & instrumentation: Material, construction, Manufacturing, assembly, testing wrt QA aspects, quality procedure and QA system & I	12 months	1	1. Familarisation with control system and instrumentation. 2. QA system for manufacturing of reliable components.	Manufacturer's work	2	1. Manufacturing activities for critical instruments/ items. 2. Implementation of testing programme to ensure reliability.	Manufacturer's works where the equipment of the subject project is being manufactured.	2	Feedback on performance of C&I system	Operating plants in any country includinh india where same make and similar capacity boilers are under operation.	1	5
QA TOTAL Mandays		***66***					***39***			***24***			***3***	66

SUMMARY

1.0	**Steam Generator & Auxiliaries (Mechanical) TOTAL Mandays**	***173***
2.0	**Power Cycle Piping TOTAL Mandays**	***48***
3.0	**Electrical TOTAL Mandays**	***45***
4.0	**C&I TOTAL Mandays**	***148***
5.0	**QA TOTAL Mandays**	***66***
GRAND TOTAL MANDAYS OF TRAINING FOR STEAM GENERATOR & AUXILIARIES		**480**
GRAND TOTAL MANMONTHS OF TRAINING FOR STEAM GENERATOR & AUXILIARIES		**16.0**

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
TURBINE GENERATOR AND IT'S INTEGRAL AUXILIARIES	Turbine cycle optimization and turbine performance in off design condition.	Familiarization of power plants of various makes of turbines for super critical units	Manufacturing processes of turbine	
	Rotor design and strength calculation	Collection of data for analysis of availability of turbines	Assembly of turbine	
	Rotor dynamic behavior studies wrt natural frequency, critical speed, vibration etc.	Comparative studies for integral systems of turbine	Testing of turbines	
	Blade profile/root design and blade strength design, blade vibration analysis	O&M history/problems related to turbine	Product development in process	
	Casing & diaphragm design	Failure analysis	Future plan for technology induction	
	Labyrinth seal selection & design for different turbine configurations		R&D work in progress	
	Selection of turbine type (i.e. Tandem vs cross compounding, separate HP/IP vs combined HP/IP, material of construction etc.)			
	Design principle for Up rating/down rating of existing design/ modules for the			

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
	specific project. of bearings, load calculation on bearings, bearing oil flow calculation Selection, design and control principle for Turbine governing system Performance calculation Steam path audit Layout principle of various equipment's of TG and its integral system Latest technological advancements			
MANDAYS **Boiler Feed Pumps**	**45** Techno-economic studies for Selection of BFP Configuration and its drive Criteria for selection of boiler Feed Pump parameters Rotor design, strength calculation and rotor dynamic behavior studies wrt critical speed, vibration etc	**10** Familiarization of power plants of various makes of feed pumps for super critical units Data collection of BFP parameters and configuration Collection of data for analysis of availability of BFP	**10** Manufacturing process of various components of BFP Assembly of BFP Testing, capabilities of BFP at works wrt performance, NPSH, dry run, visual cavitation, axial thrust measurement	

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
	Impeller design and its hydraulic behavior Role of critical para- meters such as NPSH(R), Suction specific speed, running clearances, speed etc. in design of feed pumps Material selection of BFP components Guiding factors for selection of BFP seals Computation of axial thrust under various flows Performance calculation Transient analysis in pump suction piping wrt NPSH margin Latest technological trends in BFP design	O&M history/problems related to BFP Comparative studies for various types of BFP& its features	Product development in process Future plan for techno-logy induction R&D work in progress	
MANDAYS	**20**	**5**	**10**	
Condenser	Selection of condenser type and its optimization wrt temp rise across condenser, pressure drop in condenser, surface area etc.	Comparative studies of salient features	Manufacturing process of various components of condenser Assembly	

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
	Techno economic studies for Selection of condenser tube material and other parts depending on water quality Condenser support selection & design Sizing of condenser w.r.t. super critical units Latest technological trends in condenser arrangement and design Condenser vacuum system design	Collection of data for analysis of availability of Condenser O&M history/problems related to condenser	Testing capability at works Product development in process Future plan for techno-logy induction R&D work in progress	
MANDAYS	**10**	**5**	**5**	
Feed Regenerative Equipment's	Thermal and mechanical design calculation of heaters Basis of selecting horizontal/vertical heaters Selection of TTD and DCAs for various heaters, and their effect on turbine heat rate Configuration of HP heaters (2x50% v/s100% capacity Sizing criteria for De- aerator/Heaters Selection of tube & tube sheet material of heaters	Comparative studies of salient features Analysis of data O&M history/problems related to heaters	Manufacturing process of various components of heaters Assembly Testing capability at works Product development in process Future plan for techno-logy induction R&D work in progress	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-VIII			
PRODUCT	**AREAS OF TRAINING REQUIEMENT**			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
MANDAYS	Latest technological trends in heaters design **15**	**10**	**10**	
3-dimensional CFD modeling	CFD model development and validation of design data for steam turbine, BFP, CEP, condenser, heaters etc.			
MANDAYS	**20**			
CONTROL & INSTRUMENTATION DDCMIS*-Man Machine Interface - Hardware & Operating System	Hardware & Software organization of the system Basis of selection of H/W memory sizing Operating system features, interface with other system, openness & inter-operability Upgradability System testing features Trouble shooting and fault analysis	Operational feedback		
MANDAYS	**15**	**5**		
DDCMIS*-Man Machine Interface System Engineering & Application Software	Specific system customization Various system modules & interface with OS Database organization & development	Operation feedback		

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
	Development of mimics Other application like calculations, logs historical storage functionalities & use Trouble shooting and fault analysis			
MANDAYS	**30**	**5**		
DDCMIS* - Control System Hardware	Basic design features for system & its modules System capabilities & system design techniques Communication with MMI & other system	Operation feedback	Manufacturing processes special attention to handling of the modules Maintenance facilities	
MANDAYS	**15**	**3**	**10**	
DDCMIS*- Control system Application Software	Database structure Organisation & interface between application program & database Application for implementation of Control functions Study of standard algorithms & development of new algorithms Trouble shooting and fault analysis	Operation feedback	System integration & System capabilities testing	
MANDAYS	**8**	**2**	**4**	
DDCMIS* - DDCMIS-Control Strategies for TG System:	P&ID and process/System Descriptions of Governing System, Protection System, Automatic Turbine Testing, Oil System, Evacuation System & Generator Auxiliaries, Turbine stress Computation	Yes	Yes	

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
Process Concepts of Main TG Integral Systems	System, Gland seals, Turbine Start up and Shut-down process, Hot ,cold and Warm modes of Turbine start up etc.			
DDCMIS* - DDCMIS-Control Strategies for TG System: Control Strategies	Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system. Function Blocks: Introduction and explanation of TG process specific Function block as being implemented in offered Control system. Open Loop Control strategies for ATRS, including turbine Run/Up Shutdown, Auto Synch, Oil System Automation concept, Auto Changer over philosophies, Condenser evacuation system, ATT and Generator Auxiliaries. Close Loop Control strategy-EHTC, Seal/Leak steam Controls, Interfacing of unit Controls Protection-Fail Safe philosophy implementation in turbine protection.	Yes	Yes	
DDCMIS-Control Strategies for TG System: Process Concepts of HP/LP BP Systems	P&ID and process/System Descriptions of HP/LP BP System, Protection System, Oil System, HPBP operations under various modes like start up, Shutdown, Load throw off etc.	Yes	Yes	

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
DDCMIS-Control Strategies for TG System: HP/LP BP Systems Control Strategies	Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system. Function Blocks:- Introduction and explanation of HP/LP process specific Function block as being implemented in offered Control system. Open Loop Control strategies for HPBP operation during various modes of plant operation like Start Up/Shut down and Load Throw Off etc. Close Loop Control strategy- Applicable Control Loops like HP/LP BP Press Control/Position Control, LP BP Spray Controls etc. Interfacing o unit Controls etc. Protection-Fail Safe philosophy implementation in HP/LP BP system	Yes	Yes	
DDCMIS-Control Strategies for TG System: Process Concepts of BFP Drive Turbine/ BFP Systems	P&ID and process/System Descriptions of Drive Turbine Governing System, Protection System, Oil System, Turbine Start up and Shut-down process, Hot, cold and Warm modes of Turbine start up etc.	Yes	Yes	
DDCMIS-Control Strategies for TG System:	Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system.	Yes	Yes	

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
BFP Drive Turbine/ BFP Systems Control Strategies	Function Blocks:- Introduction and explanation of BFP Drive Turbine process specific Function block as being implemented in offered Control system. Open Loop Control strategies for Drive Turbine Start UP/Shutdown, Oil System Automation concept, Auto Changer over philosophies. Close Loop Control strategy-EHTC, Seal/Leak steam Controls, Interfacing of unit Controls Protection-Fail Safe philosophy implementation in Drive turbine protection.			
MANDAYS	**24**	**5**	**4**	
DDCMIS-operator	Use of the system at work + at Site			
MANDAYS	**4**			
Turbo supervisory system : Measurement Concepts	Discussions on various measurement points, Types, Ranges and locations for the offered Turbine	Yes	Yes	
Turbo supervisory system : System Concepts	System implementation of sensors, Monitors, Drivers, Cabling, earthing shielding and grounding, Buffered signals, Technical aspects of sensor selection, Sensor specifications, filter setting, Configuration settings for displacement, Velocity ,acceleration, key phasor and other types of sensors. Diagnostics and	Yes	Yes	

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
	trouble shooting features of Sensors, Drivers and Monitors.			
Turbo supervisory system : Analysis Software	1)System Setup-Hardware and Software 2)Case Studies showing utilization of various data displays e.g Bode Plot, Polar Plot, Waterfall Plot, Orbit & Waterfall Plot etc. 3)Tools and methods of finding Machinery faults like oil whirl, Oil whip, Mis-alignment etc	Yes	Yes	
MANDAYS	**8**	**2**	**2**	
Wherever "DDCMIS" is indicated, it will mean TG C&I part of DDCMIS, which is in Contractor's Scope				
(ELECTRICAL) GENERATOR	(a) Design aspects of the following areas - Insulation system - Cooling medium & arrangement - Winding & core support systems b) Design aspects associated auxiliary systems	- Operational feed back - Familarisation with different sub-systems	(a) Manufacturing process for - Core - Winding bars - Assembly (b) Testing facilities	
MANDAYS	**30**	**15**	**15**	
Generator Excitation system including AVR.	Design features of various sub- System Exciter PMG Transformer Controllers & different limiters etc.	- Operational feed back - Familiarisation with various equipment functioning at reference plants	Manufacturing process & testing facilities for various equipment of excitation system	

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
	PSS & associated system studies	functioning at referplants		
MANDAYS	**30**	**15**	**15**	
Integral Actuators	a) Basic design philosophy of integral actuator b) Design aspects of wiring diagram c) Type and range of application of integral actuators d) Operation and selection of integral actuator to various type of loads Methods of fault diagnose system.		Manufacturing process & testing facilities for various equipment of actuators	
MANDAYS	**2**	**1**	**1**	
MDBFP motor	Design criteria for the stator core and winding rotor core and winding, insulation systems and cooling arrangement. Study of forces and vibration. Diagnostic and testing of large Electrical machines	Operational Feedback	Manufacturing process and testing facilities.	
MANDAYS	**14**	**4**	**10**	

ANNEXURE-IX

Area	Topics	MANDAYS
DDCMIS-Man Machine Interface - Hardware & Operating System	• Hardware & Software organization of the system • Basis of selection of H/W memory sizing • Operating system features, interface with other system, openness & inter-operability • Upgradeability • System testing features	**20**
	• Trouble shooting and fault analysis.	
DDCMIS-Man Machine Interface System Engineering & Application Software	• Specific system customisation • Various system modules & interface with OS • Database organisation & development • Development of mimics • Other application like calculations, logs historical storage functionalities & use • Trouble shooting and fault analysis.	**40**
DDCMIS - Control System Hardware and Control system Application Software	• Basic design features for system & its modules • Manufacturing processes with special attention to handling of the modules Maintenance facilities	**50**
	• System capabilities & system design techniques • System integration & System capabilities testing	
	• Communication with MMI & other system	
	• Database structure Organisation & inter- face between application program & database	

	• Application for implementation of Control functions • Study of standard algorithms & development of new algorithms	
	• Trouble shooting and fault analysis.	
DDCMIS-Operator Training	• Use of the system at Works + at Site	**20 + 100**
DDCMIS-Specialized Network security training	• To be finalized during detailed engineering.	**15**
UPS system	• Theory & design features Manufacturing/assembly process • Testing methodology	**5**
	• Trouble shooting and fault analysis.	
24 V DC system	• Theory & design features Manufacturing/assembly process • Testing methodology • Trouble shooting and fault analysis.	**5**
SWAS	• Theory & design features • Trouble shooting and fault analysis	**5**
PA System	• Theory & design features • Trouble shooting and fault analysis	**4**
CCTV System	• Theory & design features • Trouble shooting and fault analysis	**4**

QA SYSTEM & PROGRAMME	• Integrated QA Management system for enhanced reliability of equipments. • QA system in design, procurement, manufacturing, installation and operation of the equipments/ systems. • QA system for developing and establishing new processes and vendors. • System of structured documentation of Engg and test records. • Appreciation of implementation of QA Programme in various manufacturing, assembly and testing activities. • Appreciation of develop-mental activities for new processes and vendors. • System of pre-qualification of special processes.	**10**
Controls & Instruments	• Familiarization with control system and instrumentation • QA System for manufacture of reliable components. Manufacturing activities for critical instruments/items. • Implementation of testing programme to ensure reliability.	**10**
Note	**One week shall constitute of five (5) man days.**	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS ANNEXURE-X			
PRODUCT	**AREAS OF TRAINING REQUIEMENT**			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
GIS			Training on GIS equipments including system description basic design and engineering. Quality assurance concepts and Erection and operational aspects for the offered equipments. Concepts and operational aspects for the offered equipments	Training on Operation, Maintenance,, site testing & troubleshooting of GIS.
MANDAYS			**40**	**30**
Substation Automation System				Training for site personnel for operation, maintenance & troubleshooting of total system for 5 working days at NTPC site.
MV and LT Switchgear : Numerical relays & Switchgear SCADA system	Numerical relay engineering and associated training for relay software and O&M SCADA system design, engineering and associated training for SCADA and O&M			
MANDAYS	**60 (Total) inclusive of visit to manufacturer's site)**			

ANNEXURE - XI

Area	Topics	MANDAYS
UF Membranes	**Product design** - Basic design features - Theory & principle of operation - Latest technological trends in Ultrafiltration membranes and design **Plant Visit** - Operational feedback - O&M history/problems related to UF membranes **Visit to Manufacturer's Work** - Manufacturing process of UF membranes and equipments - Testing facilities **Operation & Maintenance of Plant** - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	**7**

RO membranes	**Product design** - Basic design features - Theory & principle of operation - Latest technological trends in RO membranes and design **Plant Visit** - Operational feedback - O&M history/problems related to RO membranes **Visit to Manufacturer's Work** - Manufacturing process of RO membranes and equipments - Testing facilities **Operation & Maintenance of Plant** - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	**7**
Zero Liquid Discharge (ZLD)	**System Design** - Plant water optimization and Scheme to achieve the ZLD - Basic design features - Latest technological trends for ZLD in Thermal Power Plant **Plant Visit** - Operational feedback	**5**
Note	**One week shall constitute of five (5) man days.**	

Annexure-XII

TRAINING REQUIREMENTS FOR SIMULATOR

In addition to the other stipulations in the bidding documents regarding training of Employer's personnel, the following shall also be covered:

(i) The scope of service under training of Employer's Engineers shall necessarily include, training in the areas of:

(a) Design, engineering and Quality Assurance.

(b) Operation & maintenance.

Arrangement for the trainees to get trained at the Works of the Contractor's, Works of their sub-vendors and at the plants of similar type and comparable size, operating elsewhere shall be made by the Contractor.

(ii) The training shall enable the O&M personnel to individually take responsibility of operating & maintaining the respective systems to ensure sustained guaranteed performance of the equipment and availability of the systems offered. The design & engineering personnel of the Employer shall be familiarized with the design philosophy adopted & practices followed by the Contractor or Sub-Contractor's Engineers for design engineering and shall be given special training in the shops, where the equipment will be manufactured and/or in their collaborator's works and where possible, in any other plant where equipment manufactured by the Contractor or his collaborator is under installation operation, or testing to enable these personnel to become familiar with the equipment being furnished by the Contractor. The training requirements of Employer's Engineering and O&M personnel are as below:

Area	Topics	MANDAYS
Simulator & Human Machine Interface – Hardware and Operating System	• Hardware & software organization of the system	90
	• Basis of selection of HW memory sizing	
	• Operating system features, interface with other system, openness & inter operability & upgradability System Testing features	
	• Trouble shooting & Fault Analysis	

Simulator System Engineering (Simulator Kernel and Interface) & Application Software (Process and C&I Modelling)	• Overview of Simulator • Starting up and Shutting down of the simulator • Details of Simulator hardware & software • Interaction between Simulator Models and controls & Instructor Station operations • Manipulation of Simulator parameters and data.	150
	• Details of Plant Modelling & C&I Modelling simulation software	
	• Details of Simulator and DCS interface	
	• Backup and Restore procedures	
	• Details of I/O system	
	• Fault finding of simulator hardware & Software diagnostic procedures	
	• Simulator maintenance procedures	
Human Machine Interface System Engineering & Application Software	• Specific system customisation	90
	• Various system modules & interface with OS	
	• Database organisation & development • Development of mimics • Other application like calculations, logs historical storage functionalities & use • Trouble shooting and fault analysis.	
Instructor Training	Use of the system including • Interaction between Simulator Models and controls • Instructor Station operations	150
	• Communication with MMI & other system	
	• Database structure Organisation & inter-face between application program & database	

	• Application for implementation of Control functions • Study of standard algorithms & development of new algorithms	
	• Trouble shooting and fault analysis.	
UPS system	• Theory & design features manufacturing/assembly process • Testing methodology	**10**
	• Trouble shooting and fault analysis.	
Note	**Note One week shall constitute of five (5) man days.**	

ANNEXURE – 3B

NTPC SPECIFICATION: GENERAL ELECTRICAL SPECIFICATION – SUB SECTION B-0

SUB – SECTION – B-0

GENERAL ELECTRICAL SPECIFICATION

1.00.00 GENERAL REQUIREMENTS

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment. However, for equipment in air conditioned areas, design ambient temperature shall be 35 deg.C, if 2x100% air conditioning system is provided.

1.02.00 All equipments shall be suitable for rated frequency of 50Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification. The step-up voltage level for the project shall be 765 KV or 400 KV. The turbo generator unit will be connected to its own step-up transformers for feeding power into the EHV grid. The overall system shall be designed considering voltage variation of +/- 5% and fault level of 50kA for 765KV/400KV system. Under weak grid condition the minimum fault level of 1000 MVA shall be considered at 400 KV and 2500 MVA shall be considered for 765 KV system. Voltage variation at 400 kV may be considered as +/-10% and 765 kV may be considered as 5% till system stabilization.

1.03.00 Contractor shall provide fully compatible electrical system, equipments, accessories and services for the entire station/plant in his scope as well as those specifically required by the Employer.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and International Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 The auxiliary AC voltage supply arrangement shall have 11 kV, 3.3KV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition:

a)	11KV/3.3KV	+/- 6%
b)	415 V/240 V	+/- 10%
c)	220V/110V/48 V DC	-15% to +10%

1.06.00 The voltage level for motors shall be as follows:

a) Upto 0.2 KW	:	Single phase 240V AC / 3 phase 415V AC
b) Above 0.2 KW and upto 200 KW	:	3 phase, 415V AC
c) Above 200 KW and upto 1500 KW	:	3 phase, 3.3 kV AC
d) Above 1500 KW	:	11 kV

The bidder may adopt 415V/3.3 KV for the drives rated in the range of 160-210 KW.

For CHP conveyor motor's rating above 160 kW, 3.3 KV, three phase AC supply is to be used.

The voltage rating of the drives indicated above is for basic guideline. Minor variations in above can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.

Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

1.07.00	The preferred AC control supply voltage shall be 110V for all 415 V non breaker controlled feeders. Control supply voltages other than above may be offered by bidder based on the bidder's standard proven practice.
1.08.00	The designed fault levels for various voltage level shall be restricted to the following values: 11 KV systems - 50KA rms for 1 second 3.3 KV systems - 40 kA rms for 1 second 415 V systems --50 kA rms for 1 second
1.09.00	The nominal voltage of main DC system shall be 220V. DC batteries shall be designed for continuous float operation with trickle charge, hence all the associated components like batteries, battery chargers, DC motors, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous battery float voltage including suitable temperature correction factors. In addition, the bidder may propose 110V, 48V or 24V systems as per requirements of control and instrumentation of his equipment and design.
1.10.00	The Contractor shall furnish calculations of maximum loading and fault levels under the most onerous conditions for the various equipment/systems as defined else where in the specification to prove adequacy of their parameters. In case any equipment or system is found to be inadequate, it shall be changed/ modified without any additional liability to the Employer.
1.11.00	Transformer voltage ratios, taps, impedances and tolerances thereon, shall be so optimised so that the auxiliary system voltages under various grid and loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of motors such as MDBFP etc. The vector groups of the transformers shall be so selected that all the buses of particular voltage level have same vector within the plant.
1.12.00	In fire hazardous areas like gas/ liquid fuel storage/ handling areas, lighting fixtures, switchgears shall be flame proof.
1.13.00	The responsibility of coordination with electrical agencies /TAC/Pollution control board and obtaining all necessary clearances shall be of the contractor.
1.14.00	Provenness of the Equipment, system, being offered by the bidder should satisfy the criteria Indicated in the "Provenness criteria" indicated elsewhere in the specification.
2.00.00	**ELECTRICAL SCHEME FOR ELECTRICAL POWER DISTRIBUTION** For Electrical Power Distribution the electrical schemes for the project as conceived by the Employer are as under: i) Option-I : Station Transformer Scheme: (Refer Single Line Diagram enclosed with the specification documents enlisted in the Part-E, Section-VI of technical specification) ii) Option-II : Generator Circuit Breaker(GCB) Scheme: (Refer Single Line Diagram enclosed with the specification documents enlisted in the Part-E, Section-VI of technical specification) Bidder may offer either of the above electrical scheme.

The scheme with minor variations to above may also be offered as long as they meet the redundancies indicated in the above drawings and sizing criterion specified.

2.01.00 The power supply shall be designed with unitized and Station load concept. All auxiliaries/systems required for operation of the unit like ID Fan, ID Booster Fan, FD Fan, PA Fan, Coal Mills, BFP, CEP, ACC System, ESP, FGD unitized loads, Ash Extraction etc. shall be fed from respective unit's power supply system. Facilities/auxiliaries/systems required for more than one unit like Coal Handling, Ash Handling, Water System, FGD common loads, Fuel Oil, Aux Boiler etc. shall be fed from Station/ different unit's power supply system as shown in the Electrical Single Line Diagram.

As indicated in the schemes, each unit's power supply system shall have two Nos. of Unit Transformers, two Nos. of Unit Auxiliary Transformers along with required number of auxiliary/LT transformers. In order to ensure safe shut down of the plant under emergency condition and to provide backup in case of total power failure, one Diesel Generating set per unit and 1 no. of Standby DG set shall be provided.

In case of Station Transformer Scheme: Each unit shall have 2 Nos. Unit Transformers and one No. dedicated Station transformer as indicated in the Single Line Diagram. In addition to meeting the requirements of Station Power Supply System, this Station transformer shall provide backup to Unit Power Supply system during unit start-up, shutdowns, HP-LP bypass condition and outage of unit transformer as indicated in the sizing criteria.

In case of GCB Scheme: Each unit shall have 2 Nos. Unit Transformers and 01 No. Generator Circuit Breaker. In addition to this, One No. Standby transformer shall be provided. The Standby transformer shall provide backup for Three units as indicated in the Single Line Diagram.

2.02.00 The overall system shall be such that failure of any one unit auxiliary like transformer, DC battery, Battery charger and DG set shall not reduce the plant's generating capability or affect the safe shut down requirements of the unit.

2.03.00 Loads of AWRS/Seepage water System/Raw Water Pumphouse located outside the plant boundary are in Bidder's scope and shall be suitably fed from 11kV Switchgear through isolation transformers. The basic scheme is shown in the Single Line diagram. The voltage level at AWRS and Raw water Pump house shall be based on system requirement i.e. 415 V or 3.3 KV as per criteria specified else where in the specification. Further distribution for seepage pump house/ dyke lighting shall be at suitable voltage level meeting system requirement.

3.00.00 SIZING & DESIGN

3.01.00 **Generator**

3.01.01 Generator and its excitation system shall have a capability at least matching the declared maximum continuous rated output of the associated steam turbine for the design maximum secondary cooling water temperature (ECW temperature) at all power factors between 0.85 lagging and 0.95 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5% and combined voltage & frequency variation of 5%. It shall be ensured that when the Generator is working at this capability and design maximum secondary cooling water temperature (ECW temperature), no part of the Generator shall attain a temperature in excess of the temperature limits specified for Thermal Class 130 (B) insulation as per IEC-60034.

3.01.02 Also the generator and its excitation system shall be capable of continuous stable operation without any excessive temperature rise at the peak output of the associated steam turbine

under VWO & HP heater out condition, etc. as available for design maximum secondary cooling water temperature (ECW temperature) at all power factors between 0.85 lagging and 0.95 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5% and combined voltage & frequency variation of 5%. Temperature of different parts may exceed those permissible for Thermal Class 130 (B) insulation under such operating conditions, but shall be lower than those permissible for Thermal Class 155 (F) insulation as per IEC-60034.

3.02.00 **Generator Transformer**

The Generator Transformer shall comprise of bank of three (3) single phase GT's and shall have off circuit tap changer with the minimum range of +/- 5% with each step of 2.5%. The rating of the Generator Transformer shall be suitable for continuous stable operation of unit at the rated nominal output at all power factors between 0.85 lagging and 0.95 leading. The minimum rating of the each single phase GT shall be 315 MVA (1 Phase for 800 MW).

Further the Generator transformer shall be rated for evacuation of peak net output (peak output of the generator under VWO/ HP heater out condition etc. less running load of one UT i.e. one of the unit board fed from station/standby transformer) as indicated above at Clause 3.01.02, at all power factors between 0.85 lagging and 0.95 leading, continuously, subject to minimum rating of each single phase GT of rating 315 MVA.

3.03.00 **Generator Circuit Breaker (if applicable) and Generator Busduct**

The continuous rating of the Generator circuit breaker and Generator busducts shall be such that the maximum continuous peak output of the steam turbine unit under VWO/ HP heater out condition etc. at any ambient temperature between 0 deg C and 50 deg. C can be delivered at the rated power factors and allowable generator voltage variations without exceeding the permissible temperature rise limits as specified for these equipments. The Generator Circuit Breaker shall have interrupting capability conforming to IEEE std C37.013 under most onerous fault condition i.e. system source or Generator source for the offered unit configurations.

3.04.00 **Transformers**

All the transformers shall be sized based on the maximum load expected to be fed by the them under most onerous conditions or as per the rating indicated in the Aux Power Supply Drawing No-9585-999-POE-J-001/002/003/004. All transformers, except Generator Transformer (GT), Tie Transformer(TT), Station Transformer (ST), Standby Transformer (SBT), Unit Transformers (UT), Start-up Transformer (SUT) and Reactors are classified as Auxiliary transformers.

All Auxiliary transformers (unless their ratings have been indicated in Single line Diagram or for which sizing criteria has been indicated in the specification), shall be sized so as to have 10% margin at design ambient conditions after considering final load requirements, including owner's load (if applicable), at peak load conditions and the No Load Voltage Correction Factor.

No Load Voltage Correction Factor (= Transformer No Load voltage/ rated bus Voltage) shall be used for sizing of all transformers i.e.

The transformer size = the calculated size X no load voltage correction factor (11.5/11, 3.45/3.3, 0.433/0.415).

3.04.01

Station Transformer Scheme:

Unit Transformers

These transformers would be sized to meet the loads corresponding to auxiliaries required to meet the peak load requirements of the unit. Further, the unit transformers shall be able to withstand over voltages up to 140% for 5 seconds.

Each unit transformer shall be sized for the following:

a) The loads of a set of unit auxiliaries corresponding to 60% BMCR operation plus

b) Loads due to outage of largest transformer connected to the bus plus

c) 5% margin on the aforesaid mentioned sum

d) Multiplied by no load voltage correction factor as defined at Cl. 3.04.00.

Station Transformer

Each Station transformer shall be sized to meet the requirements of the worst case of following contingencies:

Case I : Outage of One Unit transformer

a) Loads served by fully loaded Unit transformer as defined above plus

b) MDBFP load for one unit, (including future MDBFP) plus

c) Meeting the station loads distributed on the respective station boards plus

d) Loads due to outage of largest transformer /outgoing feeder (except station to unit/station tie feeders) connected to the bus plus

e) 5% margin on the aforesaid mentioned sum

f) Multiplied by no load voltage correction factor as defined at 3.04.00.

Case II : Outage of any one of the Station Transformer and all the connected loads on the set of Station boards are fed from other available Station transformer.

a) Meeting loads of one unit operating under HP-LP bypass mode plus

b) MDBFP load for one unit (including future MDBFP) plus

c) Meeting full connected station auxiliary loads (on two sets of station boards as mentioned above) plus.

d) 5% margin on the aforesaid mentioned sum

e) Multiplied by no load voltage correction factor as defined at 3.04.00.

The station load shall be distributed in such a manner that the two LV windings shall be equally rated. The HV winding rating of Station transformer shall be equal to the sum of LV winding ratings.

3.04.02

Generator Circuit Breaker Scheme:

Unit Transformers

These transformers would be sized to meet the loads corresponding to auxiliaries required to meet the peak load requirements of the unit. Further, the unit transformers shall be able to withstand over voltages up to 140% for 5 seconds.

Each unit transformer shall be sized for the following:

a) The loads of a set of unit auxiliaries (including future MDBFP) corresponding to 60% BMCR operation plus

b) The connected station load on respective unit bus plus

c) Loads due to outage of largest rated outgoing transformer/outgoing feeder on other bus plus

e) 5% margin on the aforesaid mentioned sum

f) Multiplied by no load voltage correction factor as defined at Cl. 3.04.00.

Standby Transformer

The Standby transformer shall be sized to cater outage of two fully loaded Unit transformers under the condition specified above plus any other loads connected on each winding / station bus. However simultaneous outage of two unit transformers fed from one winding of the Standby transformer shall not be considered. A margin of 5 % and no load voltage correction factor as defined at Cl. 3.04.00 shall be considered.

3.04.03

Auxiliary Transformers

Adequate number of auxiliary transformers shall be provided to meet the demand on 11KV, 3.3KV and 415V systems under most onerous conditions, with the criteria that each 3.3KV / 415 V switchgear / MCC / DB shall be fed by 2x100% or 3 X 50 %, 3x100% transformers / feeders, and these shall be rated to carry the maximum load including owner's load (if applicable) expected to be imposed.

In case of ESP boards, a common standby transformer having rating equivalent to Main ESP load of one pass plus ESP AC & emergency etc. requirement, shall be provided for maximum of three ESP passes as indicated in the Aux Power Supply Drawing No 9585-999-POE-J-004.

In case of ACC boards, a common standby transformer shall be provided for maximum of three ACC Transformers as indicated in the Aux Power Supply Drawing No 9585-999-POE-J-004. The standby Transformer shall be rated to take full load of one ACC transformer plus any other loads fed from ACC standby board.

3.04.04

Startup Transformer

Incase 400KV evacuation voltage is adopted, bidder shall provide One No. startup transformer with rating as indicated in the Aux Power Supply Drawing No-9585-999-POE-J-002/003/004. This transformer shall be used for availing startup power from existing 132kV switchyard at Patratu.

3.05.00

MV Switchgears

Sizing of HT Switchgears (11kV/3.3kV) shall be in accordance with Clause No. 1.00.00 of Sub-section B-05(A) and its sub-clauses covering sizing criteria, performance / reliability criteria, layout criteria, spare capacity requirements, standardization, etc.

The switchgear boards shall have a single front, single tier, fully compartmentalized, metal enclosed construction complying with clause No. 3.102 of IEC 62271-200, comprising of a row of free standing floor mounted panels. The Service Class Continuity of Switchgears shall be LSC 2B-PM (as per IEC 622771-200). The Circuit Breakers / Contactors / Bus VTs shall be mounted on withdraw able trucks which shall roll out horizontally from service position to isolated position. The Switchgear shall have an Internal Arc Classification of IAC FLR 40kA 1 sec. The Circuit Breakers / Contactors shall be of Vacuum type.

All MV incomers from transformers and ties between switchgears shall be through bus ducts or adequately rated cables.11kV and 3.3 kV incomers from transformers to switchgear and ties between switchgears shall be through bus ducts for main plant. In the offsite areas, MV incomers from transformers to switchgear & ties between switchgears shall be through bus ducts or adequately rated cables.

LV Switchgears

Sizing of LT Switchgears shall be in accordance with Clause No. 1.00.00 of Sub-section B-06 and its sub-clauses covering design considerations, performance / reliability criteria, spare capacity requirements, standardization, etc.

All switchboards shall be of double front, draw out, metal enclosed, indoor, floor-mounted, free-standing type of bolted design. Entire bus bar system shall be insulated with PVC sleeves. Cable terminations located in cable alley shall be designed to meet the Form IVb Type 7 (as per IEC 60439) for safety purpose.

All ACDBs, DCDBs, Solenoid Valve DBs and MCCs located on Stacker Reclaimer, Paddle feeders and Travelling trippers shall be of Fixed Module type. All 415V Circuit breaker modules and other MCC modules shall be fully draw out type.

The Circuit Breakers / Contactors shall be of air break type & should conform to the requirements of IS / IEC 60947. MCCB shall be provided for 100A, 125A, 160A, 250A & 400A supply feeders. The motor feeders for 110kW & above shall be Air Circuit Breaker controlled.
For 415V system, busduct assemblies shall be preferred for incoming connection from transformers to the switchboard and interconnecting sections between switchboards wherever transformer rating is 1000KVA or above.

Switchgear SCADA

The Switchgear SCADA system shall be an integrated system for protection, control (except motor feeders), measurement and monitoring of all MV & LV circuit breakers / vacuum contactors in the Auxiliary Power Supply network. The system shall have communicable numerical relays complying with IEC-61850 on all feeders which shall be networked on Ethernet to form the Switchgear SCADA. The system shall have a distributed architecture with multiple Data Concentrators and HMI Stations interconnected through the Station LAN. The Switchgear SCADA shall be so designed as to provide fast, safe and reliable control of the Auxiliary Power Supply system along with online monitoring and data acquisition.

The circuit breaker will normally be controlled from remote control panels (DDCMIS) through closing and shunt trip coils. The control of the breakers shall also be possible from the switchgear SCADA system. All the protective relays associated with the Circuit breaker

modules shall be of Numerical communicable type for Protection, Control, Metering and Status monitoring. All the numerical relays shall have communications on three ports, local front port communication to laptop and dual ports on IEC 61850 to communicate with the data concentrator through LAN. The auxiliary contacts of the MCCB shall be fed to the digital inputs available in the numerical relays of Incomer / bus coupler / motor circuit breaker feeders, for integration into the numerical relay network.

Control Philosophy

The Design Philosophy shall be as follows:

(a) All the 33 KV/11 KV/ 3.3 KV & LT Incomers, Bus Ties , Bus couplers, Transformer feeders shall be controlled from Switchgear SCADA and also from DDCMIS.

(b) The motor feeders shall be controlled from the DDCMIS only and analog/digital signals pertaining to motor feeders shall be communicated on OPC from the switchgear SCADA to DDCMIS.

(c) To integrate with DDCMIS the final HMI out put shall be given to the LVS in respective control rooms. In case of offsite, the HMI shall be integrated with the respective offsite DDCMIS systems.

(d) The Architecture of Switchgear SCADA shall be double Ethernet ring networks with fast recovery features, redundant servers and dual port Numerical Relays to ensure a high reliability SCADA network.

(e) Bus transfers for 11KV station to unit shall be provided with fast bus, In phase and slow changeovers to ensure Bump less and Safe and Speedy BUS transfers and to avoid unit trips during bus transfers. Bus transfers for unit 3.3KV systems shall be provided with In phase and slow changeovers to ensure Bump less and Safe BUS transfers and to avoid unit trips during bus transfers.

3.06.00 **Cables and Bus Ducts**

The minimum rating of cable/ bus ducts shall meet the following criteria:

All the cables and bus ducts feeding switchboards from transformers shall be sized based on transformer rating and considering the maximum negative voltage variations envisaged in the specifications. All the cables and bus ducts feeding transformers shall be sized based on current ratings of transformer at the minimum voltage tap of the transformer. All other cables/bus-ducts shall be sized based on the load demand under most onerous conditions.

Cables shall be selected to so as to limit maximum voltage drop at equipment terminals during normal operation and starting conditions well within permissible values. Cables shall be derated for the site ambient and ground temperatures, grouping and soil resistivity and cable laying configuration.

All HT cables (except 132 KV voltage class) shall be of unearthed grade. The bidder shall furnish detailed cable selection/sizing criteria for Employer's approval.

The 132 KV voltage class cable shall be of earthed grade type.

3.07.00 **Earthing & Lightning Protection System**

The earthing system for plant and switchyard shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 50 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year.

Grounding and lightning protection for the entire power plant, switchyard and other areas or buildings covered in the specification shall be provided in accordance with IS 3043, IS 2309, IEEE 80 and IEEE 665.

3.08.00 **D.C. Systems**

Complete DC system, comprising of batteries, battery charges, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous float voltage including suitable temperature correction factors.

The battery sizing shall be done based on different types of continuous and intermittent loads including motor starting (wherever applicable) under complete blackout condition, for the duration specified so as to meet the system requirement. The total DC load shall include load for Employer's facilities also (if applicable), as identified in the scope given at Section-VI, Part-A Sub Section-IIB. All intermittent loads shall be considered with minimum 1 minute duration. The battery shall be sized considering a minimum electrolyte temperature of 15 ^{o}C along with temperature correction factors as per relevant standard. An ageing factor of 1.25 shall be considered. The no. of cells, end cell voltage shall be considered based on the minimum and maximum voltage window and cable drop etc as per system requirement.

Each system shall comprise of two nos. of batteries and two nos. of float-cum-boost chargers each rated for 100% capacity. DC scheme shall ensure that each critical consumer is fed from two different bus sections. DCDBs shall provide adequate number of feeders on each section.

Boost/ fast charging time shall be as per worst operating condition and would satisfy technical requirements recommended by battery manufacturer. Each battery charger must be capable of supplying all the continuous D.C. loads (fed through both section of DCDB) plus the trickle charging current of both the batteries. In addition, each charger must have sufficient surplus capacity for running of the largest D.C auxiliary so that the battery is not drained during testing of the same. Battery charger should also be capable of boost/ fast charge the battery from completely discharged condition to fully charged condition without imposing any limitations under worse operating conditions.

The various DC Systems envisaged are:

Area	DC Voltage	Load	Minimum Battery Bank Rating
Unit	220 V	Total DC load of the unit at an acceptable voltage for at least 30 minutes	As per system requirement
CHP	220 V	total CHP DC load at an acceptable voltage for at least 30 minutes and DC lighting for at least one hour	150AH for lead acid Plante type /90 AH for Ni-Cd High Discharge (KPH) type batteries
AWRS/Seepage water system, Ash silos, Raw Water Pump House,	220 V/ 110 V	supply total DC load of the associated area at an acceptable voltage for at least 30 minutes	150AH for lead acid Plante type /90 AH for Ni-Cd High Discharge (KPH) type batteries

Colony etc.			
400 KV switchyard	220 V batteries	(a) Emergency lighting in Switchyard control room for a period of 1 hour plus (b) All continuous DC loads of relay & control panels/PLCC panels for a duration of 3 hours plus (c) Interlocking coils of isolators/earth switches shall be considered including requirement of three future line bays for a duration of 3 hours plus (d) loads in worst of the following conditions (i) simultaneous operation of the maximum number of breakers & associated equipments in case of bus fault in the switchyard. (ii) Operation of Breaker failure relay (LBB relay)	625AH lead acid Plante type/410 AH Ni-Cd (KPH type)
PLCC System for Switchyard	48 V	supply total DC load of the PLCC system at an acceptable voltage for at least 3 hours	425AH lead acid Plante type/390 AH Ni-Cd (KPL type)

DC Health Monitoring Systems for Main Plant and Switchyard (220 V and 48 V) shall be provided to monitor the condition of each battery cell of 220V/48V battery banks on-line on 24x7 basis. With DC Health Monitoring System it shall be possible to measure & analyze the individual cell and battery parameters so that any damage to battery shall be prevented by pro-active maintenance.

3.09.00 **Diesel Generator Set**

For safe shut down of the plant under emergency condition and in case of total power failure, one Diesel Generating set per unit shall be provided. Each DG set shall be capable of meeting 100 % of essential load requirements of one generating unit including starting of the largest motor (DOL) with other loads connected without exceeding the permissible starting voltage drop. Some of the vital station auxiliaries/systems like battery chargers of switchyard, auxiliary supplies of instrument/plant air compressors, emergency air conditioning and ventilation system loads shall also be fed from DG set supply. The emergency air conditioning and ventilation system requirements pertaining only to the Main Plant areas (like Control Room, Control equipment Room, SWAS Room, UPS Room) shall only be provided the DG backup.

The minimum size of DG shall be 2000 KVA for 800 MW unit configurations. During Grid black-out condition, it shall be ensured that only the essential auxiliaries of all units are fed from Diesel generator & non- essential loads are automatically tripped.

In addition to above DG set, one standby DG set with rating identical to Main DG set shall also be provided, as a backup for three units, to cater the load requirements of one unit at a

time. Bus Trunking systems shall be used to connect DG set to Emergency Switchgears and Standby DG sets.

4.00.00 **ISLANDING SCHEME**

The plant shall be designed to operate in islanding mode of operation by tripping all the lines and generators except for one pre-selected unit, which shall run with the available plant load under such condition.

5.00.00 PLC based control system wherever envisaged shall be provided with 100% redundancy i.e. hot standby.

6.00.00 **INSULATION LEVEL**

The insulation level for the transformer windings and bushings shall be as follows:

	WINDING		**BUSHING**	
Highest System Voltage	Rated Power Freq. withstand Voltage (kVrms)	Rated lightning impulse withstand voltage (kVp)	Rated Power freq. withstand voltage (kV rms)	Rated lightning impulse withstand voltage (kVp)
0.433 KV	3	-	3	-
3.6 kV	10	40	11	40
7.2 kV	20	60	22	60
12 kV	28	75	30	75
17.5 kV	38	95	42	95
24kV	50	125	55	125
36kV	70	170	77	170
72.5 kV	140	325	155	325
145kV	275/38*	650	305	650
245 kV	395/38*	950/1050**	505	1050/1050**
420 kV	630/38*	1425/1570**	750	1550/1570***
800 kV	830/38*	1950**	880	2100***

Switching Impulse withstand voltage, (kVp)

765 kV 1550kVp

400 kV 1175kVp

* In case of non-uniformly insulated. **** Chopped wave BIL.**

*** Suitable for chopped wave impulse test on transformers.

7.00.00 NEUTRAL GROUNDING

7.01.00 Neutral earthing equipment shall be designed duly taking into account the maximum permissible operating voltage of the generator, voltage rise on load throw off (subsequent to detection of earth fault) field suppression time, ferro-resonance, etc. The generator shall be grounded through distribution transformer with secondary loading resistor, limiting the earth fault current to not less than capacitive current so as to restrict the over voltages caused due to capacitive currents. The neutral earthing equipment shall be rated to carry this current for at least 5 minutes considering the Generator Terminal Voltage under maximum field forcing conditions.

7.02.00 11KV/3.3KV system earthing shall be low resistance earthed type to limit earth fault current to 600A. The resistor shall be rated to carry this current at least for 10 seconds.

7.03.00 Neutrals of Generator Transformers (on 765KV/400kV side), Tie Transformers (on both 765KV and132kV side), 11 KV side of Colony Transformers #1 & 2 and all LT Transformers (415V) shall be solidly earthed through bolted links. The basic scheme for neutral earthing arrangement of 765/132kV Tie Transformer is enclosed as 'Appendix-IE' to this chapter.

7.04.00 220V DC system shall be kept ungrounded. However, 48V PLCC DC system shall be grounded type.

7.05.00 Diesel generator shall also be kept ungrounded (earthing through PT).

8.00.00 EHV CABLE (132 kV)

EHV cables feeding transformers shall be sized based on current ratings of transformer at the minimum voltage tap of the transformer and laying condition specified elsewhere in the specification. The cable screen shall be designed for solidly grounded system for the system fault level of 31.5kA for 1 sec. The BIL of the cable shall be 650 kVp.

9.00.00 FAULT LEVEL

Equipment through fault withstand capabilities under worst operating conditions duly taking into account negative tolerances on transformer, generator & maximum fault levels of source etc. shall be as follows :

i) a) Generator Transformer, Station transformer - 3 seconds (** Please See Note)
Standby Transformer

b) Unit transformer
In case of Station Transformer Scheme - 8 seconds (** Please See Note)
In case of GCB Scheme - 3 seconds (** Please See Note)

ii) All other transformers - 2 seconds

iii) Generator busduct main run (higher of generator or EHV system & motor fault contribution) - 1 second

iv) Delta and tap off run busduct (sum of generator, EHV and motor contribution through UT) - 1 second

v) 11 kV busduct - 1 second

vi) Switchgears - 1 second

vii)	Cables to the feeders protected by breakers		Main protection fault clearing time with 0.12 second minimum
viii)	Cables of all other feeders		As per fuse operating time
ix)	11KV & 3.3KV cable screen	-	2 seconds for the adopted ground fault current,
		-	1 second for the adopted ground fault current, for cables connected to miscellaneous switchgear/ transformer.
x)	EHV systems	-	1 second

(** Note) Thermal withstand design time duration. The indicated values of time durations are used in transformer design for ensuring thermal stability of the transformers and are to be proven through calculations.