SUB SECTION – GENERAL

1.00.00 **INTENT OF SPECIFICATION**

1.01.00 This specification intends to cover the following activities, services and works on **Turnkey Basis** in respect of 400/132kV Switchyard Package at Nabinagar Super Thermal Power Project situated in the state of Bihar, India. The two 400KV bays at Nabinagar (BRBCL) switchyard end along with the integration of its BCU/BPU/ energy meters with the existing system is also intended to be included in this package.

a) ~~Complete design and engineering of all the systems, sub-systems, equipment, material and services~~.
b) ~~Providing engineering data, drawings and O&M manuals for Employer's review, approval and records.~~
c) ~~Manufacturing, supply, testing, packing, transportation and insurance from the manufacturer's work to the site including port and customs clearance, if required.~~
d) Receipt, storage, ~~insurance~~, preservation and conservation of equipment at the site.
e) ~~All civil works as required.~~
f) Fabrication, pre-assembly (if any), erection, testing and putting into satisfactory operation of all the equipment/material including successful commissioning.
g) ~~Furnishing of spares on FOR site basis~~.
h) ~~Reconciliation with customs authorities, in case of foreign supplies.~~
i) Satisfactory conclusion of the contract.

Detailed scope of work under this package is listed at clause 3.00.00.

1.02.00 In addition to the requirements indicated in this section (Technical specifications), all the requirements as stated in other sections shall also be considered as a part of this specification as if completely bound herewith.

1.03.00 The Bidder shall be responsible for providing all material, ~~equipment~~ and services specified or otherwise which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification.

1.04.00 It is not the intent to specify all aspects of design and construction of equipment mentioned herein. The systems, sub-systems and equipment shall conform in all respect to high standards of engineering, design and workmanship, and shall be capable of performing in continuous commercial operation.

US BAR ~~ALL~~ MATERIAL SHALL BE SUPPLIED AT NABINAGAR STPP (3X660 MW). CONTRACTOR WILL SHIFT THE MATERIAL REQD AT NABINAGAR TPP (4X250 MW)

Clause No.	TECHNICAL REQUIREMENTS
1.05.00	Whenever a material or article is specified or described by the name of a particular brand, manufacturer or trade mark, the specific item shall be understood as establishing type, function and quality desired. Products of other manufacturers may also be considered, provided sufficient information is furnished so as to enable the Employer to determine that the products are equivalent to those named.
1.06.00	Bidder is requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. Such clarifications should be sought at least 15 days before the scheduled date of the opening of the bids. The bid should not include any sections like clarifications, interpretations and/or assumptions. If the Bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately.
1.07.00	The Bidder may also make alternative offers provided such offers are superior in his opinion, in which case adequate technical information, operational feed back, etc., shall be submitted with the offer to enable the Employer to assess the superiority and reliability of the alternative offered. For each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumption, etc. shall be clearly brought out in the bid for the Employer to make an overall assessment. In any case, the base offer shall necessarily be in line with specifications. Under no circumstances the specified equipment etc., shall be brought out as an alternative.
1.08.00	Any deviation or variation from the scope requirement and/or intent of this specification shall be clearly mentioned under Deviation Schedule of the Bid Proposal Sheets irrespective of the fact that such deviations/variations may be standard practice or a possible interpretation of the specification by the Bidder. Except for the deviations/variations, brought out in the deviation schedule and which are accepted by the Employer before the award of the contract, it will be the responsibility of the Bidder to fully meet the intent and the requirements of the specification within the quoted price. No other departure from the specification except for the declared deviation indicated by the Bidder in his proposal shall be considered. The interpretation of the Employer in respect of the scope, details and services to be performed by the Bidder shall be binding, unless specifically clarified otherwise by the Employer in writing before the award of contract.
1.09.00	The drawings enclosed as per list at Part-III to this section and forming a part of the specification shall supplement the requirements specified herein. The scope and terminal points for the equipment to be furnished under this contract are also identified in these drawings and are to be read in conjunction with the text of the specifications. These are preliminary drawings for bidding purpose only and are subject to changes that may be necessary during detailed engineering after award keeping the basic parameters as specified.

1.10.00 Failure of any equipment to meet the specified requirements of tests carried out at works or at site shall be sufficient cause for rejection of the equipment. Rejection of any equipment will not be held as a valid reason for delay in the completion of the works as per schedule. Contractor shall be responsible for removing all deficiencies, and supplying the equipment that meet the requirement.

2.00.00 **PROJECT INFORMATION**

2.01.00 'Project Synopsis' and other details about Nabinagar STPP & Nabinagar TPP are enclosed at Annexure-IA & IB respectively.

2.02.00 The criteria for wind resistance design of structure and equipment for Nabinagar STPP & Nabinagar TPP is enclosed at Appendix-I.

2.03.00 Criteria for earthquake resistant design of structures and equipment for Nabinagar STPP & Nabinagar TPP is enclosed at Appendix-II.

2.04.00 The meteorological data of Nabinagar STPP & Nabinagar TPP are enclosed at Appendix-IIIA & IIIB respectively.

3.00.00 **SCOPE OF WORK**

3.01.01 The scope of work comprises of execution of 400/132 kV Switchyards at Nabinagar Super Thermal Power Project and 400 kV Switchyard extension at Nabinagar Thermal Power Project. The scope also includes 400kV Double Circuit Transmission Line between Nabinagar STPP & Nabinagar TPP and 33kV Transmission Lines. The 400kV switchyard shall be with one and half breaker scheme and 132kV switchyard with double bus scheme. The scope of work shall comprise, but not limited to the ~~design, engineering, manufacture, testing and inspection at manufacturer's works, packing, supply, transportation, transit~~ insurance, ~~delivery to site~~, unloading, storage and equipment erection including associated ~~civil and~~ structural works. Further it shall include the cabling, lighting, earthing, association of sub vendors if any in the erection, supervision, site testing, inspection and commissioning of 400/132kV switchyards ~~and 400kV &~~ 33kV ~~Transmission Lines.~~ SWYd.

Bay Details (As indicated in Single Line Diagram): The various bays envisaged under this package are as follows:

I) At Nabinagar STPP (3X660MW)

(a). Execution of following bays at 400 kV Switchyard:

i) Three (3) Nos. of Generator Transformer bays.

Clause No.	TECHNICAL REQUIREMENTS
	ii) Two (2) Nos. of Line bays for interconnection with Nabinagar TPP (4x250MW) Switchyard. iii) Four (4) Nos. of Line bays (Two (2) Lines ~~with 63 MVAR Line Reactors and its NGR~~). iv) Two (2) Nos. of 400/132/33kV, 200MVA ICT bays. v) One (1) No. of Bus Reactor (125 MVAR) bay. **(b). Execution of following bays at 132 kV Switchyard:** vi) Two (2) Nos. of 400/132/33kV, 200MVA ICT bays. vii) Three (3) Nos. of Station Transformer bays. viii) Two (2) Nos. of Miscellaneous Service Transformer bays. ix) Two (2) Nos. of Bus Coupler bays. x) Two (2) Nos. of Bus Section bays. **II) At Nabinagar TPP (4X250MW)** **Execution of following bays at 400 kV Switchyard:** Two (2) Nos. of Line bays for interconnection with Nabinagar STPP (3X660MW) Switchyard. **III) Transmission Line** **(a). 400kV Transmission Line** 400kV Double Circuit Transmission Line (Twin Moose ACSR Conductor) between Nabinagar STPP (3X660MW) & Nabinagar TPP (4X250MW) Switchyards with OPGW: 10 Kms (Approx.) **(b). 33kV Overhead Line** (i). 33 kV Transmission Line (AAAC (100 Sq. mm)) of 8.0 Km length (approx.) with Single Circuit tower between Misc. Service Switchgear and Make Up water Switchgear. (ii). 33 kV Transmission Line (AAAC (100 Sq. mm)) of 8.0 Km length (approx.) with Double Circuit tower with single circuit stringing between Misc. Service

III 33 KV SWITCHYARD

1. AT POWERPLANT END
2. AT MAKEUP WATER SWITCHGEAR END.

Switchgear and Make Up water Switchgear.

3.01.02 **400kV & 33kV Transmission Line**

The scope covers supply, erection, commissioning of 400kV & 33kV Transmission Lines and towers and associated equipments as shown in the single line diagram.

Supply of all items for civil and structural works to include detailed route survey including survey for PTCC clearance, route marking, survey and selection of tower locations (including all crossings), route clearance / tree cutting, geo-technical investigation of soil, tower foundations for all types of soil at each location etc.

Supply, erection and commissioning of 400 kV & 33kV transmission lines on towers and their extensions, parts, conductor and accessories, earthwire and accessories, insulator and insulator hardwares, vibration dampers, anticlimbing devices, phase markers, danger plates, counterpoise earthing, tower accessories etc

3.01.03 This scope covers all the work required for detailed soil investigation and preparation of a detailed report for 400 kV lines. It shall include mobilization of necessary equipment, providing necessary engineering supervision and technical personnel, carrying out field investigation and tests, laboratory tests, analysis and interpretation of data and results, collecting data regarding geographical conditions from local sources, giving flood details of the area (past history), preparations for the type of foundations and the safe bearing capacity for different sizes of foundations, different founding strata for the various locations along the transmission lines. In addition the soil investigation may be required to be carried at other locations

3.01.04 The weed growth/ tree cutting shall be responsibility of the Contractor. The contractor shall count, mark and put proper numbers with suitable quality of paint on all the trees that are to be cut, cost of the same shall be included in the bid price. Contractor may note that Employer shall not pay any compensation for any loss or damage to the properties or for tree cutting due to contractor's work. However the approval for the same shall be obtained by Owner.

3.01.05 The equipment and materials to be supplied by the Contractor shall form a complete 400/132kV switchyards and 400kV & 33kV transmission line. The equipment and services as detailed in all sections of the bidding documents and as shown on the tender drawings shall be within the scope of supply of the Contractor.

3.02.00 The following is the list of items under the scope of contractor. However any items though not specifically mentioned but which are required to make the switchyard complete in all respects for its safe, efficient, reliable and trouble-free operation shall be ~~supplied and~~ erected by the Contractor, unless they are specifically excluded in the text of exclusions given in Clause-3.05.00 of this section.

- 400 & 132kV equipments: Circuit Breakers, Isolators (with/without earth switches), Current Transformers, Surge arresters, Bus post insulators and Capacitor voltage transformers.
- 400kV Wave traps.
- Main Switchyard Control Room building
- 400kV/132kV Switchyard Civil Works
- 400/132kV Switchyard materials:
  - 4" & 3" EHIPS Aluminum tube
  - ACSR 'Moose' Conductor
  - 10.98 dia G.S. Earthwire
  - Insulators and hardware
  - Clamps, connectors and spacers
  - Bay Marshalling kiosks
- Complete earthing grid (inclusive of supply of 40mm dia MS rod and GI flat) earthing of all switchyard equipments and direct stroke lightning protection system and its connection to earthing grid.
- Earth resistivity measurements at site (based on four electrode method) and design the earthing grid as per IEEE: 80 (Latest edition) and connect the earthing grid with power plant earthing grid.
- Direct Stroke Lightning Protection of 400/132 kV switchyard either through LM or through Shield wire based on detail engineering.
- Power & Control cables, cabling (including interpole and interpanel), Cabling between Contractor and owner supplied equipment, cable support angles, cable trays and accessories necessary for cable erection such as glands, lugs, clamps for cables, ferrules, cable ties, hume pipe etc. cable route markers for buried cable trench are also included in the scope.
- Power & Control cable schedule & termination schedules shall be prepared by the Contractor .
- Internal and outdoor lighting system for control room building and 400/132kV switchyard. Lightning mast shall be used for mounting lighting fixtures for outdoor switchyard lighting.

- Substation Automation System, protection and metering system including Generator Relay protection panel, disturbance recorder, fault locators, GPS Time Synchronisation Equipment and dummy panels for mounting owner's supplied energy meters as per specification, AC bay kiosk.

- Relay setting calculations shall be submitted by the Contractor and approved by Owner.

- Integration of two bays at Nabinagar (BRBCL) switchyard end with the existing SAS, bus bar protection, ABT metering system and islanding scheme including supply of necessary hardware and software.

- Supply of OPGW and Line terminal units for line current differential relays for both Nabinagar and BRBCL end.

- Testing of the total Integrated Substation Automation System to establish complete functionality including the third party interfaces as indicated in SAS architecture drawing.

- 400kV & 33kV transmission line, towers, conductors, earth wire, insulator, hardware, other material and accessories etc.

- Supply, erection, commissioning of

  (i) Air Conditioned Bay kiosks for housing of control and relay panels as per philosophy specified in Chapter- E10 for 400 & 132kV Switchyard at Nabinagar STPP (3X660MW).

  (ii) One no. of Air Conditioned bay kiosk for housing of control and relay panels for two bays of 400kV Switchyard at Nabinagar TPP (4X250MW).

- All LT cables and cabling works associated with 2 nos. of owner's supplied 630kVA, 11/0.433 kV Switchyard Service transformer and LT Switchgears.

- Automatic start/ stop type centrifugal pump for sump pit.

3.03.00 **Services and Items**

The scope also include but not limited to the following services/items described herein and elsewhere in specification:

a) System design and engineering

b) Supply of equipment and material

c) Civil works

d) Structural works

e) Erection works

f) Project management and site supervision

g) Testing and commissioning

h) Interface coordination

i) Performance testing

j) Clearance from statutory authority. Owner shall provide support for this activity.

3.03.01 **System Design and Engineering** (NA)

a) The Contractor shall be responsible for detailed design and engineering of overall system, sub-systems, elements, system facilities, equipments, auxiliary services, etc. It shall include proper definition and execution of all interfaces with systems, equipment, material and services of Employer for proper and correct design, performance and operation of the project.

b) Contractor shall provide complete engineering data, drawings, reports, manuals, etc. for Employer's review, approval and records.

c) The scope shall also include the design and engineering as per details elaborated elsewhere in this specification.

d) The contractor shall carry out earth resistivity measurements at site switchyard site (based on four electrode method)

e) For all structural works, the Contractor shall prepare all fabrication drawings. Similarly for civil works, the detailed construction drawings shall be prepared for those items whose design is to be done by the Contractor.

3.03.02 **Supply of Equipment and Material** (NA)

a) The Contractor shall be responsible for design, engineering, manufacture, testing, inspection at manufacturer's works, supply, transportation, insurance, delivery at site, unloading, storage, in plant transportation at site, complete erection & supervision, site testing & inspection, and successful commissioning of all the equipment and material as detailed elsewhere in specification and as shown on the tender drawings. Any item though not specifically mentioned, but is required to complete the project works in all respects for its safe, reliable, efficient and trouble free operation shall be supplied and erected by the Contractor unless it is explicitly excluded as given in clause 3.05.00 below.

b) All consumables, wastages and damages shall be to the account of Contractor.

3.03.03 **~~Civil~~ Structural Works**

The scope of civil works shall include ~~design, engineering &~~ construction of all ~~civil,~~ structural ~~and architectural~~ works ~~including supply of all materials~~ complete for all equipments, gantry structures and associated facilities for the switchyard package.

The nature of work generally involves earthwork in excavation and filling in all types of soils, dressing to the required profile, dewatering till the structures are constructed/erected up to required level or as directed by the engineer, shoring, backfilling around completed structures and plinth filling, disposal of surplus earth, concreting including reinforcement and formwork, fabrication and erection of all structural steel and miscellaneous steel (i.e. cable/pipe supports, ladders, railings, inserts, embedments, gratings, chequered plate covers, platforms, anchor bolts, etc.), rail track for movement of shunt reactor, fabrication, galvanising, Proto-assembly & erection of Gantry Structure, Lighting Mast & Equipment supporting structure, R.C.C. cable trench & precast covers, cable ducts / duct banks, soil sterlisation / anti-weed treatment, gravel filling, drainage, fencing, gates, final grading, ~~supplying and~~ laying earthing mat and any other work required for completion and proper functioning of the switchyard

All material including cement, reinforcement steel and structural steel required for completion of the work covered under this package are in the scope of the bidder.

The scope of work described below is general in nature. The Bidder shall provide all structures / facilities required for the effective functioning of switchyard of the power plant, whether or not they are specifically mentioned. The scope of Bidder for civil, structural and architectural works shall include but not limited to the following:

a) Detailed design criteria including basis of design shall be prepared by the Bidder based on various requirements specified elsewhere in the specifications. All the above documents shall be finalised after Owner's approval and the same shall form the basis of Detailed Engineering Work.

b) Civil and structural works associated with switchyard gantry structure (Towers & Beams) and Lighting Mast including proto assembly and substructure as required complete.

c) Civil and structural works associated with switchyard equipment supporting structures and cable sealing ends including proto assembly and substructure as required complete.

d) Civil structural and architectural works associated with RCC switchyard control room building with brick wall cladding including substructure, superstructure and all other related works complete as per system requirement.

e) Civil and structural works associated with foundations for two (2) number 200MVA Inter Connecting Transformer (ICT), two (2) number 63MVAR Line Reactor, three (3) number 125/3 MVAR Bus Reactor with fire walls, two (2) number 16MVA Misc. Service Transformer and two (2) number 630KVA Switchyard Service Transformer including oil pit, stone filling, laying and fixing of rails for movement of Transformers/reactors, rail track and jacking pad as required, arrangement for cabling etc. all complete.

f) Civil and structural works associated with foundations for AC Bay Kiosk inside Switchyard bays including supporting/fixing arrangement complete as per electrical requirement.

g) All necessary embedments, inserts, supporting structures, supporting members as per requirement. All cable tray supporting structures including angles/bends/insert plates etc. inside control room building are also in scope of bidder.

h) All pipe and cable supporting arrangement/structures, pipe and cable trenches etc.

i) All culverts (i.e. box culverts/ pipe culverts/ duct-banks) at the crossing of cable trenches/drains with roads, railway lines and drains, etc. as required.

j) Supply of all materials for the construction of structures / facilities in the switchyard package. Bidder has to make arrangements for supply of all materials. Employer will not supply any material to the Bidder.

k) Storm water drainage system for switchyard area and connecting to the Employer's nearby storm water drains along road side.

l) Sewage system for buildings and connecting to the Employer's nearby sewer lines.

m) Water supply for toilet and office in the buildings and connecting water supply line to Employer's nearest located water supply line

n) Single lane WBM road with black top road in switchyard and connecting to the Employer's road.

o) Site Preparation, soil sterilization /anti-weed treatment including gravel filling but excluding major levelling.

p) Fencing along with gates for switchyard area

q) Disposal of surplus excavated soil up to a lead of 5.0 km as directed by the Engineer.

r) Any other facility / structure that would be required as per system requirements.

s) All protection measures to prevent any damage to the adjoining structures / facilities.

t) Scope of the Bidder shall also include supply and laying of 40mm dia MS Rods as earthing mat as per requirement.

u) Geotechnical investigation for switchyard area is not in the scope of the Bidder and the soil data to be considered shall be as specified in the specification.

All works relating to ~~design, preparation of drawings including fabrication drawings, procurement of material, fabrication, proto assembly, mass fabrication~~, transportation to site, handling, storage and erection of all Towers & Beams, Lighting Mast and Equipment supporting structures (both lattice type and pipe type) for the switchyard as per design and drawings to be prepared by the Contractor and approved by the Owner. This shall also include all types of bolts, nuts, hangers, shackles, clamps, step bolts etc. and any other items those are required to complete the job.

The Contractor shall construct, erect and install all structures, equipments and material of switchyard covered under the project. He shall be responsible for provision of all labour, tools and plant, and supervisory staff for safe, reliable, proper and correct erection of project components.

The tools and plant shall include, but not limited to, special hoisting equipment, cranes, stringing equipment, slings, consumables and all other articles and supplies as required.

The Contractor shall ensure periodic cleaning of work sites and removal of all waste material, packing material, surplus earth and left-overs and their proper disposal.

3.03.04

Construction Facility

The following are also in the Bidder's scope of work pertaining to construction facilities for the project.

a) Development of Bidder's temporary staff colony and labour colony along with fencing etc. wherever required.

b) Bidder's temporary construction office, construction stores (open/ covered), workshops, material/ field testing laboratory and any other temporary building and construction equipment, labour and materials.

c) All necessary fire fighting devices/ equipment/ fire tender etc. required for safety purpose during the project execution stage.

d) All tools and tackles required for the work.

e) Bidder shall arrange skilled/ semiskilled/ unskilled labour from local sources as far as available in this country and supervisory staff for quality execution of all civil, structural and architectural works.

f) Construction water

The contractor shall arrange for construction water, service water and also potable water for labour and other personnel at the worksite/ colony from underground source. The quality of water should meet the requirements, for which it is proposed to be used~~. All Civil and Structural work associated with the above including borings, pipe lines, valves, pumps, tube wells, pump house, underground storage tank, over ground storage tank, water tankers etc. whatsoever required for taking the water from the underground source to the site of work shall be provided/ erected/ constructed/ maintained by the contractor at his own cost.~~

The Contractor shall not be entitled to any compensation on account of the expenditure incurred in arranging the construction water.

g) Construction Power

Construction power shall be provided by the Owner as per the provision of General conditions/ Special conditions of contract for works to be executed within the plant boundary. For works to be executed outside the plant boundary, power for the construction purposes shall be arranged by the contractor at his own cost.

Clause No.	TECHNICAL REQUIREMENTS
3.03.05	**Scope of supply shall also include:** NA a) Access such as stairs. b) All steel inserts, plates, bolts, nuts, sleeves etc. to be grouted in concrete work and used to hold / support the equipment / system being supplied and erected under this specifications.
3.03.06	**Scope of Services:** NA a) Any additional civil works, materials and services, which though not specially mentioned but are required to make the system complete. b) Drawing, data sheets, design calculations and erection operation for complete system. c) As built drawing for all structures and layout.
3.03.07	**Erection Works** a) The Contractor shall construct, erect and install all equipment and material of switchyards covered under the project. He shall be responsible for provision of all labour, tools and plant, and supervisory staff for safe, reliable, proper and correct erection of project components. b) The tools and plant shall include, but not limited to, special hoisting equipment, cranes, stringing equipment, slings, consumables and all other articles and supplies as required. c) The Contractor shall ensure periodic cleaning of work sites and removal of all waste material, packing material, surplus earth and left-over and their proper disposal.
3.03.08	**Project Management and Site Supervision** a) The Contractor shall be responsible for the overall management and supervision of works. He shall provide experienced, skilled, knowledgeable and competent personnel for all phases of the project, so as to provide the Employer with a high quality system. b) The Contractor shall be responsible for training of Employer's operation and maintenance personnel as to be able to operate & maintain the project and its components properly, safely and efficiently over long period of time.

c) The Contractor's supervisory personnel shall provide operation and maintenance assistance during the warranty period.

d) A project execution schedule called Master Network (MNW) in the form of PERT chart/network and based on `Work break down structure' shall be prepared by the Contractor for Employer's approval. The MNW shall identify milestones of key events for each work/component in the areas of engineering, procurement, manufacture, dispatch, erection and commissioning. It shall also indicate interfaces and inputs required to be given by Employer.

3.03.09 **Testing and Commissioning**

a) The scope includes testing and commissioning of all equipment, sub-systems and systems of the project and putting them into successful commercial operation. The scope shall include but not limited to the requirements given elsewhere in the specification.

b) The Contractor shall be responsible to provide all necessary testing and commissioning personnel, tools and plant, test equipment, etc.

3.03.10 **Interface Coordination**

a) The Contractor shall identify all interface issues with Employer and other agencies, and shall be responsible for such interfacing, coordination and exchange of all necessary information.

b) The Contractor shall submit to the Employer all drawings for review. He shall list the detailed requirements of interface between Contractor's work and the material and services to be supplied by Employer.

3.04.00 **Terminal Points**

The Contractor shall be responsible for making all connections at terminal points, ~~and shall supply necessary jointing material, connectors, nuts, bolts, etc.~~ The following are the project terminal points for the purposes of the scope of this contract as indicated in the single line diagram:

3.04.01 **<u>For 400kV Switchyard(Nabinagar STPP):</u>**

a) "A" row of power plant column for termination of overhead stringing and connections to Generation Transformers.

b) Terminations at the switchyard line take off gantry for 400 kV lines. The clamps and connectors for droppers to equipment connections/ line terminations including suspension string insulators(if required) are in the

bidder's scope however the line side insulators shall be provided by the line contractor.

c) 400 kV bushings of Employer's 400kV, 125/3 MVAR (single phase) Bus Reactors & 63 MVAR Line Reactors.

c) 400 kV bushings of Employer's 400/132/33 kV ICTs.

3.04.02 **For 400kV Switchyard(Nabinagar TPP):**

a) 400kV Busbars

3.04.03 **For 132 kV Switchyards:**

a) "A" row of power plant column for termination of overhead stringing and connections to Station Transformers.

b) 132 kV bushings of Employer's 400/ 132/33kV ICTs.

c) 132 kV bushings of Employer's Miscellaneous Service Transformers.

d) 132 kV Cable Sealing ends.

3.04.04 **33kV Transmission Lines**:

a) 33kV cables at Miscellaneous Service Switchgear end & Make Up Water Switchgear ends.

3.05.00 **Exclusions**

The following are excluded from the scope of Contractor under this contract:

a) Supply, erection and commissioning of PLCC equipment, HF cable and telemetry equipment.

b) Supply, erection and commissioning of Generator transformers, Bus Reactors, Inter Connecting Transformers (ICT), Station Transformers, Miscellaneous Service Transformers & Switchyard Service Transformers.

c) Fire protection for Reactors, Transformers and control room building.

d) HVAC and ventilation system for switchyard control room building.

e) 132kV cable (supply and laying) and cable sealing ends.

f) L T Switchgear

g) 220 V and 48 V Battery and Battery Chargers

3.06.00 **Inputs by Employer**

a) Legally cleared and generally labeled land with approach road.

b) The Construction power supply (415 V, 3phase, AC Supply) will be made available at one point.

3.07.00 **Arrangement by the Contractor**

Contractor shall make his own necessary arrangements for the following and for those not listed anywhere else:

a) Construction power supply at all work areas

b) Construction and potable water

c) Construction office and store (open & covered)

d) Construction workshop and material/field testing laboratory

e) Boarding & lodging arrangement for their personnel

f) Fire protection and security arrangements during construction stage

4.00.00 **SPARES** (NA)

4.01.00 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended for replacement. The spares shall be treated and packed for long term storage in the climatic conditions prevailing at the site. Small items shall be packed in sealed transparent plastic covers with desiccant bags as necessary.

4.02.00 Each spare part shall be clearly marked and labeled on the outside of the packing together with the description when more than one spare part is packed in single case. A general description of the contents shall be shown on outside of the case and detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

4.03.00 Commissioning spares: The Bidder shall include in his scope of supply all commissioning spares. List of such spares along with the quantities shall be indicated in the bid.

4.03.01 The Contractor shall supply spares which he expects to consume during installation testing and commissioning of system. The quantity of these spares shall be decided based on his previous experience, such that site works shall not be hampered due to non-availability of these spares. Contractor shall submit a complete list of such spares along with the bid, the cost of which shall be deemed to have been included in the lump sum proposal price of the package. The unused commissioning spares may be left at the site for use by the Owner, if so agreed at a cost to be negotiated.

4.03.02 No mandatory or recommended spares will be used during the commissioning of the equipment/plant before take over by the Employer.

4.04.00 **Mandatory spares and Maintenance Equipment** (NA). ONLY UNLOADING STORAGE HANDING OVER

4.04.01 The mandatory spares as listed elsewhere in this chapter are those spares and maintenance equipments which are considered essential by the Employer. The Employer reserves the right to buy any or all of these mandatory spares and mandatory maintenance equipments. The Bidder shall furnish the itemized and total prices for these spares in the offer.

4.04.02 In compliance with the requirements of tender documents, the prices for mandatory spares and maintenance equipments must be given separately, and shall be used for bid evaluation purposes. All mandatory spares and equipments shall be delivered at site.

4.05.00 **Recommended spares** (NA)

4.05.01 In addition to the mandatory spares, the Contractor shall also provide a list of recommended spares giving unit prices and total prices for 3 years of normal operation of equipment in the relevant schedule of the Section-VII. This list shall take into consideration the specified mandatory spares and should be a separate list. The Employer reserves the right to buy any or all the recommended spares. The recommended spares parts shall be delivered at the site. The list of recommended spares to be furnished by the Bidder should also contain the following:

a) Population of each item installed along with reference drawing number.
b) Service life expectancy of each item.
c) Offer validity period

4.05.02 Price of recommended spares will not be used for evaluation of bids. The prices of these spares will remain valid for a period of six months after the date of placement of Notification of Award. Whenever recommended spares are the same as mandatory spares, then the prices of the mandatory spares and such common recommended spares shall be the same. Further, the prices of any recommended spares, which are not common with mandatory spares listed in the volume, shall be subject to review by the Employer and shall be finalised after mutual discussions.

Clause No.	TECHNICAL REQUIREMENTS
4.06.0	**Tools & tackles** NA The Contractor shall also supply at site one set of all special tool & tackles, etc. which are required by the Employer's maintenance staff to maintain the works successfully, cost of the same shall be included in bid price. The list of such tools and tackles shall be enclosed with the offer.
5.00.00	**TYPE, ROUTINE AND ACCEPTANCE TESTS:** NA
5.01.00	**TYPE TEST REQUIREMENTS FOR EQUIPMENTS OTHER THAN 400 & 132 kV CIRCUIT BREAKERS**
5.01.01	All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years (other than that of transmission line towers for which the type tests reports conducted prior to ten years shall also be accepted) from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.
5.01.02	However if contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.
5.01.03	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
5.01.04	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.
5.02.00	**TYPE TEST REQUIREMENTS FOR 400 & 132 kV CIRCUIT BREAKERS** NA
5.02.01	The contractor shall carry out the type tests as listed in this specification on the Circuit Breaker to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section-VII (Forms & Procedures) and the same shall be considered for the evaluation of the bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.

5.02.02 The type test shall be carried out in presence of employer's representative for which minimum 15 days notice shall be given by contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure clearly specify the test set up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

5.02.03 In case contractor has already conducted such specified type test(s), he may submit during detailed engineering the type test reports to the owner for waival of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test (s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.

5.02.04 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

5.02.05 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

6.00.00 **REQUIREMENTS IN RESPECT OF SUPPLY ITEMS**

6.01.00 All the major equipments to be supplied for the project shall meet the following requirements:

(A) 400 KV EQUIPMENTS

I. 400 KV CIRCUIT BREAKERS

400kV Circuit Breakers being offered should be from manufacturer who has manufactured and supplied minimum five(5) nos. of three phase circuit breakers suitable for Air Insulated Substation/ Switchyard of 400 kV or above class which must have been in successful operation for a minimum period of two(2) years as on the date of bid opening.

II. 400 KV INSTRUMENT TRANSFORMERS

400 kV Instrument Transformers being offered should be from manufacturer who

has manufactured and supplied minimum fifteen (15) nos. of single phase Current Transformers and fifteen (15) nos. of single phase Capacitor Voltage Transformers suitable for Air Insulated Substation/ Switchyard of 400 kV or above class which must have been in successful operation for a minimum period of two (2) years as on the date of bid opening.

III. 400 kV DISCONNECTORS

400kV Disconnectors being offered should be from manufacturer(s) who have manufactured and supplied atleast five (5) nos. of three phase Disconnectors suitable for Air Insulated Substation/Switchyard of 400kV or above class which must have been in successful operation for a minimum period of two (2) years as on the date of bid opening.

IV. 400 KV SURGE ARRESTORS

400kV Surge Arrestors being offered should be from manufacturer who has manufactured and supplied atleast fifteen (15) nos. of single phase Surge Arrestors suitable for Air Insulated Substation/ Switchyard of 400kV or above class which must have been in successful operation for a minimum period of two (2) years as on the date of bid opening.

(B) 132 KV EQUIPMENTS

I. 132 KV CIRCUIT BREAKERS

132 kV Circuit Breakers being offered should be from manufacturer who has manufactured and supplied minimum five(5) nos. of three phase circuit breakers suitable for Air Insulated Substation/ Switchyard of 132 kV or above class which must have been in successful operation for a minimum period of two(2) years as on the date of bid opening.

II. 132 KV INSTRUMENT TRANSFORMERS

132 kV Instrument Transformers being offered should be from manufacturer who has manufactured and supplied minimum fifteen (15) nos. of single phase Current Transformers and fifteen (15) nos. of single phase Capacitor Voltage Transformers

suitable for Air Insulated Substation/ Switchyard of 132 kV or above class which must have been in successful operation for a minimum period of two (2) years as on the date of bid opening.

III. 132 KV DISCONNECTORS

132 kV Disconnectors being offered should be from manufacturer(s) who have manufactured and supplied atleast five (5) nos. of three phase Disconnectors suitable for Air Insulated Substation/Switchyard of 132 kV or above class which must have been in successful operation for a minimum period of two (2) years as on the date of bid opening.

IV. 132 KV SURGE ARRESTORS

132 kV Surge Arrestors being offered should be from manufacturer who has manufactured and supplied atleast fifteen (15) nos. of single phase Surge Arrestors suitable for Air Insulated Substation/ Switchyard of 132 kV or above class which must have been in successful operation for a minimum period of two (2) years as on the date of bid opening.

(C) SUBSTATION AUTOMATION SYSTEM & PROTECTIVE RELAYS

The Substation Automation System offered with distributed architecture should have been in successful operation in atleast one (1) Substation/Switchyard of not less than 220 kV class for a minimum period of one(1) year as on date of bid opening.

The Generator Protection Relays, the Bay Protection Units including the Busbar protection and the energy metering System offered should be from manufacturer(s) who have manufactured and supplied the offered type of devices for respective equipment (excluding the requirement of IEC 61850) which must have been in successful operation in a 100 MW or above unit/ 220 kV class or above Substation/Switchyard for a minimum period of one (1) year as on the date of bid opening.

(D) TRANSMISSION LINE TOWERS

The bidder/sub vendor should have designed, fabricated and successfully type tested, erected and commissioned transmission line towers of 400 kV rating and above.

	(E) SITE SUPERVISION OF EQUIPMENTS Bidder shall furnish undertaking (as per the enclosed format) from respective equipment manufacturer(s) for the equipments indicated above that erection, testing and commissioning shall be carried out under their supervision.
6. 02.00	The Bidder shall clearly and unambiguously identify and name the proposed sub-Vendors for various equipment and enclose detailed documents for each proposed sub-vendor with the bid to establish that such sub-vendors meet the above stipulated requirements. Any vague statements like '... make or equivalent' shall not be accepted.
6.03.00	Any Bidder who fails to comply with the above clause 6.01.00 to 6.02.00 is liable to be disqualified and his bid is liable to be rejected.

Annexure-IA

PROJECT SYNOPSIS

1.00 **PROJECT INFORMATION**

1.01 **BACKGROUND**

Details of proposed Stage / Units

Project name	:	Nabinagar STPP
No. of Units x capacity	:	3 X 660 MW
Project setting up by	:	NPGC (A Joint Venture Company between NTPC Ltd. & Bihar State Electricity Board)

1.02 **Location and Approach**

Project Location	: (i.) Place : Nabinagar
	: (ii) District :Aurangabad
	: (iii.) State :Bihar
Latitude and Longitude of project location	: North :24 deg.42' 30" (N) East :84 deg. 05' 36" (E)
Nearest Railway station	: Dehri-On-Sone
Distance of project location from the Railway station	: 30 KM (Approx.)
Nearest Major Town	: Aurangabad
Distance of the town from the Project site	: 50 KM
Nearest Commercial Airport	: Gaya
Distance of airport from the project site	: 100KM
Nearest Highway	: National Highway - 2
Distance from nearest highway point to the site	: 25KM

1.03 **Criteria for Wind Resistant Design of Structures and Equipment**

All structures and equipment shall be designed for wind forces as given in the Appendix - I of this subsection.

1.04 **Criteria for Earthquake Resistant Design of Structures and Equipment**

All equipment and structures shall be designed to withstand seismic criteria as given in the Appendix - II of this section.

1.05 **Meteorological information**

The Meteorological data are enclosed as Appendix-IIIA of this section.

Annexure-IB

PROJECT SYNOPSIS

1.00 **PROJECT INFORMATION**

1.01 **BACKGROUND**

Details of proposed Stage / Units

Project name	:	Nabinagar Thermal Power Project (BRBCL)
No. of Units x capacity	:	4 x 250 MW
Project setting up by	:	Bhartiya Rail Bijlee Company Ltd. (A Joint Venture Company between NTPC Ltd. & Ministry of Railways)

1.02 **Location and Approach**

Project Location	: (i.) Place : Nabinagar
	: (ii) District :Aurangabad
	: (iii.) State :Bihar
Latitude and Longitude of project location	: North :24 deg.42' 30" (N) East :84 deg. 05' 36" (E)
Nearest Railway station	: Dehri-On-Sone
Distance of project location from the Railway station	: 30 KM (Approx.)
Nearest Major Town	: Aurangabad
Distance of the town from the Project site	: 50 KM
Nearest Commercial Airport	: Gaya
Distance of airport from the project site	: 100KM
Nearest Highway	: National Highway - 2
Distance from nearest highway point to the site	: 25KM

1.03 **Criteria for Wind Resistant Design of Structures and Equipment**

All structures and equipment shall be designed for wind forces as given in the Appendix - I of this subsection.

1.04 **Criteria for Earthquake Resistant Design of Structures and Equipment**

All equipment and structures shall be designed to withstand seismic criteria as given in the Appendix - II of this section.

1.05 **Meteorological information**

The Meteorological data are enclosed as Appendix-IIIB of this section.

Chapter-G2

ADDITIONAL CONSTRUCTION WORK SPLIT RESPONSIBILITIES

1.00.00 **GENERAL**

1.01.00 The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work or this contract to be performed at site.

1.02.00 The Contractor upon signing of the contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at site suitably designated for the purpose of overall responsibility and co-ordination of the works to be performed at site. Such person shall function from the site office of the Contractor during the pendency of contract.

2.00.00 **REGULATION OF LOCAL AUTHORITIES AND STATUTES**

2.01.00 The Contractor shall comply with all the rules and regulations of local authorities during the performance of his field activities. He shall also comply with the Minimum Wages Act, 1948 and the Payment of Wages Act (both of the Government of India) and the rules made thereunder in respect of any employee or workman employed or engaged by him or his sub-Contractor.

2.02.00 All registration and statutory inspection fees, if any, in respect of his work pursuant to this contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the any statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.

3.00.00 **EMPLOYER'S LIEN ON EQUIPMENT**

3.01.00 The Employer shall have lien on all equipment including those of the Contractor brought to the site for the purpose of erection, testing and commissioning of the plant. The Employer shall continue to hold the lien on all such equipment throughout the period of contract. No material brought to the site shall be removed from the site by the Contractor and/or his Sub-contractors without the prior written approval of the Project Manager.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The provisions of the clause entitled Inspection, Testing and Inspection Certificates under General Technical Requirements in Chapter-G1 shall also be applicable to the erection portion of the works. The Project Manager shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at site. If by the above inspection, the Project Manager rejects any

equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Project Manager. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

5.00.00 **ACCESS TO SITE AND WORKS ON SITE**

5.01.00 Suitable access to and possession of the Site shall be afforded to the Contractor by the Employer in reasonable time.

5.02.00 The works so far as it is carried out on the Employer's premises, shall be carried out at such time as the Employer may approve and the Employer shall give the Contractor reasonable facilities for carrying out the works.

5.03.00 In the execution of the works, no person other than the Contractor or his duly appointed representative, Sub-contractor and workmen, shall be allowed to do work on the site, except by the special permission, in writing of the Project Manager or his representative.

6.00.00 **CONTRACTOR'S SITE OFFICE ESTABLISHMENT**

6.01.00 The Contractor shall establish a site office at the site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Project Manager or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.

7.00.00 **DISCIPLINE OF WORKMEN**

7.01.00 The Contractor shall adhere to the disciplinary procedure set by the Project Manager in respect of his employees and workmen at site. The Project Manager shall be at liberty to object to the presence of any representative of employee of the Contractor at the site, if in the opinion of the Project Manager such employee has mis-conducted himself or is incompetent or negligent or otherwise undesirable and then the Contractor shall remove such a person objected to and provide in his place a competent replacement.

8.00.00 **CONTRACTOR'S FIELD OPERATION**

8.01.00 The Contractor shall keep the Project Manager informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Project Manager shall not relieve the Contractor of any of responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Project Manager or the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safe ty, adequacy and efficiency of plant and equipment and his erection methods.

8.02.00 The Contractor shall have the complete responsibility for the conditions of the work-site including the safety of all person employed by him or his Sub-con-

tractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Project Manager is not intended to include review of Contractor's safety measures in, or of near the work-site, and their adequacy or otherwise.

9.00.00 **PHOTOGRAPHS AND PROGRESS REPORT**

9.01.00 The Contractor shall furnish three (3) prints each to the Project Manager of progress photographs of the work done at site. Photographs shall be taken as and when indicated by the Project Manager or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.

9.02.00 The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.

10.00.00 **MAN-POWER REPORT**

10.01.00 The Contractor shall submit to the Project Manager, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.

10.02.00 The Contractor shall also submit to the Project Manager on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill-wise and the areas of employment of such labour.

11.00.00 **PROTECTION OF WORK**

11.01.00 The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Project Manager. No claim will be entertained by the Employer or the Project Manager for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because or other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the Clause 7.0 above entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.

12.00.00 **EMPLOYMENT OF LABOUR**

12.01.00 The Contractor will be expected to employ on the work only his regular skilled employees with experience of his particular work. No female labour shall be

	employed after darkness. No person below the age of eighteen years shall be employed.
12.02.00	All travelling expenses including provisions of all necessary transport to and from site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.
12.03.00	The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.
12.04.00	Contractor's employees shall wear identification badges while on work at Site.
12.05.00	In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contact Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Employer may make such payments and shall recover the same from the Contractor's bills.
13.00.00	**FACILITIES TO BE PROVIDED BY THE CONTRACTOR**
13.01.00	Tools, tackles and scaffoldings The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, erection, testing and commissioning of the equipments covered under the contract. He shall submit a list of all such materials to the Project Manager before the commencement of pre-assembly at site. These tools and tackles shall not be removed from the site without the written permission of the Project Manager.
13.02.00	**First-aid** The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the site. Enough number of Contractor's personnel shall be trained in administering first-aid.
13.03.00	**Cleanliness**
13.03.01	The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Project Manager. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.
13.03.02	Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Project Manager. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.
14.00.00	**LINES AND GRADES**

	All the works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and lay-out the Works. Basic horizontal and vertical control points will be established and marked by the Project Manager at site at suitable points. These points shall be used as datum for the works under the contract. The Contractor shall inform the Project Manager well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Project Manager to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Project Manager at Contractor's expense.
15.00.00	**FIRE PROTECTION**
15.01.00	The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.
15.02.00	Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water-proof and flame resistant type. All the other materials such as working drawings, plans, etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.
15.03.00	All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the site during the entire period of the contract.
15.04.00	The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area, etc. Access to such fire protection equipment, shall be easy and kept open at all time.
16.00.00	**SECURITY**
	The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the project site only with the written permission of the Project Manager in the prescribed manner.
17.00.00	**CONTRACTOR'S AREA LIMITS**

The Project Manager will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contractor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Project Manager.

18.00.00 **CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER**

In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Project Manager and the same shall be acceptable at all times to the Contractor. The Project Manager may impose such restrictions on the facilities provided to the Contractor such as electricity, water, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Project Manager. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and erected by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.

19.00.00 **PRE-COMMISSIONING TRIALS AND INITIAL OPERATIONS**

The pre-commissioning trials and initial operations of the equipment furnished and erected by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these trials. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such trials.

20.00.00 **MATERIALS HANDLING AND STORAGE**

20.01.00 All the equipment furnished under the Contract and arriving at site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.

20.02.00 Contractor shall be responsible for examining all the shipment and notify the Project Manager immediately of any damage, shortage, discrepancy etc. for the purpose of Project Manager's information only. The Contractor shall submit to the Project Manager every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the equipment at site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

20.03.00 The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Project Manager.

20.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Project Manager. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at site.
20.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
20.06.00	All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Project Manager.
20.07.00	The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.
20.08.00	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.
20.09.00	All the materials stored in the open or dusty location must be covered with suitable weather-proof and flameproof covering material wherever applicable.
20.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Project Manager will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.
20.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space . The Project Manager, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.
21.00.00	**CONSTRUCTION MANAGEMENT**
21.01.00	The field activities of the various contractors executing different contracts for the project, will be coordinated by the Project Manager and the Project Manager's decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Project Manager shall not be a cause for extra compensation or extension of time for the Contractor.

21.02.00	The Project Manager shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Project Manager. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Project Manager and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Project Manager may call for other meeting either with individual contractors or with selected number of contractors and in such a case the Contractor if called, will also attend such meetings.
21.03.00	Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Project Manager, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.
21.04.00	The Project Manager shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.
22.00.00	**FIELD OFFICE RECORDS** The Contractor shall maintain at his site office up-to-date copies of all drawings, specifications and other contract documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain the continuous record of all changes to the above contract documents, drawings, specifications, supplementary data, etc. effected at the field. On completion of his total assignment under the contract, the Contractor shall incorporate all such changes on the drawings and other project engineering data to indicate 'as installed' conditions of the equipment furnished and erected under the contract. Such drawings and project engineering data shall be submitted to the Project Manager in required number of copies.
23.00.00	**CONTRACTOR'S MATERIALS BROUGHT ON TO SITE**
23.01.00	The Contractor shall bring to site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the works under intimation to the Project Manager. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Project Manager. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.
23.02.00	The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.

23.03.00 After the completion of the works, the Contractor shall remove from the site under the direction of the Project Manager the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Project Manager. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Project Manager to do so then the Project Manager shall have the liberty to dispose off such materials as detailed under clause 23.02.00 above and credit the proceeds thereto to the account of the Contractor.

24.00.00 **PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY**

24.01.00 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub-Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.

24.02.00 The Contractor will ensure provision of necessary safety equipment such as barriers, sign-boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Project Manager and the Employers of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance or his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.

25.00.00 **PAINTING**

All exposed metal parts of the equipment including pipings, structures railings etc. wherever applicable, after installation unless otherwise surface protected, shall be first painted with at least one coat of suitable primer which matches the shop primer paint used, after throughly cleaning all such parts of all dirt, rust, scales, greases, oils and other foreign materials by wire brushing, scraping or sand blasting and the same being inspected and approved by the Project Manager for painting . Afterwards, the above parts shall be finished painted with two coats of allowed resin machinery enamel paints. The quality of the finish paint shall be as per the standards of ISI or equivalent and to be of the colour as approved by the Project Manager.

26.00.00 **INSURANCE**

In addition to the conditions covered under the Clause entitled "Insurance" in Section GCC, Conditions of Contract, the following provisions will also apply to the portion of work to be done beyond the Contractor's own or his subcontractor's manufacturing works.

26.01.00 **Workmen's Compensation Insurance**

This insurance shall protect the Contractor against all claims applicable under the workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not

covered under the Workmen's Compensation Act 1948. The liabilities shall not be less than:

Workmen's Compensation	As per Statutory Provisions
Employee's liability	As per Statutory Provisions

26.02.00 **Comprehensive Automobile Insurance**

This insurance shall be in such a form to project the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Employership of such vehicles the liability covered shall be as herein indicated

Fatal Injury	:	Rs. 100,000/- each person
	:	Rs. 200,000/- each occurrence
Property Damage	:	Rs. 100,000/- each occurrence

26.03.00 **Comprehensive General Liability Insurance**

26.03.01 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section GCC, Conditions of Contract.

26.03.02 The hazards to be covered will pertain to all the works and areas where the Contractor, his sub-contractors , his agents and his employees have to perform work pursuant to the Contract.

26.03.03 The above are only illustrative list of Insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

27.00.00 **UNFAVOURABLE WORKING CONDITIONS**

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Project Manager. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

28.00.00 **PROTECTION OF MONUMENTS AND REFERENCE POINTS**

	The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his works either during excavation or elsewhere, are properly protected and handed over to the Project Manager. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Project Manager or by the Project Manager shall not be disturbed in any way during the performance of his works. If, any work is to be performed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Project Manager. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.
29.00.00	**WORK & SAFETY REGULATIONS**
	As per annexure – I
30.00.00	**FOREIGN PERSONNEL**
30.01.00	The Contractor shall submit to the Employer data on all personnel he proposes to bring into India for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience, etc. in relation to the work to be performed by him.
30.02.00	Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.
30.03.00	No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Project Manager. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.
30.04.00	The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.
30.05.00	The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India, the Employer and the Project Manager may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employement neither part-time or full-time nor shall they take part in any local politics.

30.06.00	The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.
31.00.00	**CODE REQUIREMENTS**
	The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Boiler Regulations, ASME codes and accepted good project manageering practice, the Project Manager's drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.
32.00.00	**FOUNDATION DRESSING & GROUTING**
32.01.00	The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to erection of equipment/equipment bases.
32.02.00	All the equipment bases and structural steel base plates, shall be grouted and finished as per these specifications unless otherwise recommended by the equipment manufacturer.
32.03.00	The concrete foundation surfaces shall be properly prepared by chipping, grinding as required to bring the type of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength. All laitance and surface film shall be removed and cleaned.
32.04.00	**Grouting Mix**
	The Grouting mixture shall be composed of portland cement, sand and water. The portland cement to be used shall conform to ISI No. 269 or equivalent sand shall conform to ISI No. 383/2386 or equivalent. The grout proportions for flat bases where the grouting space does not exceed 35 mm shall be 50 kg bag of cement to 75 kg of sand. Only the required quantity of water shall be added so as to make the mix quaky and flowable and the mix shall not show excess water on top when it is being puddled in place. For thicker grout beds upto 65 mm, the amount of sand shall be increased to 105 Kg per bag of cement. Bases which are hollow and are to be filled full of grouting shall be filled to a level of 25 mm above the outside rim with a mortar mix in the volumetric proportions of one part of cement and 1.5 part sand and 1.5 part 6 mm granite gravel. An acceptable plasticiser may be added to the grout mixes in a proportion recommended by the plasticisers manufacturer. All such grouts shall be throughly, mixed for not less than five minutes in an approved mechanical mixer and shall be used immediately after mixing.
32.05.00	**Placing of Grout**
32.05.01	After the base has been prepared, its alignment and level has been checked/approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back and forth to push the grout into every part of the space under the base.

32.05.02 The grout shall be poured either through grout holes it provided or shall be poured at one side or at two adjacent sides giving it a pressure head to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.

32.06.00 **Finishing of the Edges of the Grout**

The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothed with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.

32.07.00 **Checking of Equipment After Grouting**

After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check- up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Project Manager.

33.00.00 **SHAFT ALIGNMENTS**

All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

34.00.00 **DOWELLING**

All the motors and other equipment shall be suitable dowelled after alignment of shafts with tapered machined dowels as per the direction of the Project Manager.

35.00.00 **CHECK OUT OF CONTROL SYSTEMS**

After completion of wiring,cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

36.00.00 **COMMISSIONING SPARES**

36.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares like indicating lights/lamps, diodes, fuses recorder charts,ink pads/pens etc. required for initial operation till the equipment is declared by the Employer as having satisfactorily completed the Trial Operation. The Contractor shall have full responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract and the cost of the same shall be included in the bid price. These spare will <u>be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of trial operation of the respective equipment and utilised as and when required.</u>
37.00.00	**CABLING**
37.01.00	All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmertical bends for fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Project Manager.
37.02.00	Each cable, whether power or control, shall be porvided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.
37.03.00	Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulted cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.
37.04.00	In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.
37.05.00	Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to Project Manager's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specif-ically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly out.
37.06.00	The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The

	insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

ANNEXURE-I

CORPORATE SAFETY DEPARTMENT

SAFETY CLAUSES IN GENERAL CONDITIONS OF CONTRACT

I. General	
i)	The contractor shall comply with all the requirements of "*The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act*," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.
ii)	The Contractor shall follow NTPC Safety Rules as issued from time to time with respect to safety in construction & erection.
iii)	The contractor shall have the approved Safety, *Health and Environment (SHE)* Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge.
iv)	The contractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents to Engineer I/c for approval as per the format of Safety plan as annexed at Appendix – I.
v)	The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.
vi)	All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard.
vii)	The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.
viii)	The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.
ix)	The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NTPC safety documents as stated above.

x)	The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured. The *medical examination of the workers* employed in hazardous areas shall be conducted as per Rule 223 0f The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health records shall be maintained accordingly and to be submitted to Engineer I/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c).
xi)	*First Aid boxes* equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.
	a. **Emergency Action Plan**
	The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.
	b. **Scaffolding**
	The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.
	c. **Opening**
	The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. When ever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.
	d. **Explosives**
	The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.

II. Coffer Dam and Caissons

The contractor shall ensure that the cofferdam and caissons are of good construction and adequate strength. The cofferdam and caissons should be provided with adequate means for workers to reach safely at the top of such dams in the event of an in rush of water. The workers should be allowed to work in a cofferdam or caisson only after inspection and found safe by engineer (I/c). Such inspection report is to be maintained in a Register.

Where the workers are employed to work in a compressed air environment at the work site of coffer dam or caissons, a construction Medical Officer assisted by a Nurse or trained first aid attendant should be available at all the times during such work.

III. Fencing of Machinery

The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.

The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.

IV. Carrying of Excessive Weight by a Worker

The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.

V. Dangerous and Harmful Gases / Equipment

The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.

The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.

VI. Overhead Protection

The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

VII. Working at Heights

All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.

Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.

Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.

Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.

VIII. Handling of Hazardous Chemicals

The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.

Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule.

Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.

The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radioactive sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.

The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.

IX. Eye Protection

The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.

X. Excavation

The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides.

Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.

XI. Electrical Hazards

The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules.

The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.

The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools.

The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.

XII. Vehicular Traffic

The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.

XIII. Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc.

The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.

XIV. Excessive Noise, Vibration

The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000.

XV. Electrical Installation

The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment.

Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall

Satisfy the Engineer I/C that the appliance is in good working condition;

Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances;

Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected.

The Engineer I/C will not grant permission to connect until he is satisfied that:

The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.

The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation.

The installations are provided with suitable ELCBs and RCCBs wherever required.

	XVI. Safety Organisation
I	The contractor employing more than 250 workmen whether temporary, casual, probationary, regular or permanent shall employ at least one full time safety officer exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub contractor shall also be considered as the contractor's employees/workmen for the above purpose.
II	In case of contractor deploying less than 250 workmen he should designate one of his Engr / supervisor or the contractor himself (if he is directly supervising the work) as safety officer in addition to his existing responsibilities. The Engr./ supervisor should get at least 2days safety training from any reputed organization or from NTPC before resuming the work. If already trained in past the declaration along with Trg. certificate to be furnished to NTPC safety officer. The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.
	XVII. Reporting of Accident and Investigation
I	In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.
	XVIII. Right to stop Work
I	The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.
II	The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.

XIX. Fire Protection

I The contractor shall provide sufficient fire extinguishers at place /s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment.

XX. Penalties

If the Contractor fails in providing safe working environment as per the Safety Rules of NTPC or continues the work even after being instructed to stop the work by the Engineer I/C as provided in Clause XVIII (1) above, the Contractor shall be penalized at the rate of Rs. 25,000/- per day or part thereof till the instructions are complied with and so certified by the Engineer I/C. However, in case of accident, the provisions contained in Sub-Clause XX (II) below shall also apply in addition to the penalties mentioned in this sub-clause.

If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or employees of other contractors, or NTPC's employees or any other person who are at the Site or adjacent thereto, the Contractor shall be responsible for payment of penalty to NTPC as per the following schedule:-

a)	Fatal injury or accident causing death	Penalty @10% of contract value or Rs. 5,00,000/- per person, which ever is less.	These are applicable for death to any person whosoever.
b)	Major injuries or accident causing 25% or more permanent disablement to workmen or employees	Penalty @ 2 1/2 % of contract value or Rs. 1,00,000/- per person which ever is less	These are applicable for injury to any person whosoever.

Permanent disablement shall have the same meaning as indicated in The Workmen's Compensation Act' 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen / employees under the relevant provisions of the Workmen's Compensation Act' 1923 and rules framed there under or any other applicable laws as applicable from time to time.

If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c / Safety Officer of NTPC shall have the right to penalize the contractor for Rs. 200/- per person per day and such worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.

If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has
(1) not complied with keeping adequate PPEs in stock or
(2) defaulted in providing PPEs to his workmen
(3) not followed statutory requirements / NTPC safety rules
(4) been issued warning notice/s by NTPC head of the project on non observance of safety norms
(5) not provided safety training to all his workmen,
the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident.

The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by NTPC. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evolution of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.

XXI. Award

If the Contractor's performance on safety front is found satisfactory i.e. without any fatal/reportable accident in the year of consideration; he may be considered for suitable award "ACCIDENT FREE SAFETY MERITORIOUS AWARD" as per scheme of the employer.

SAFETY PLAN

01.	Safety Policy of the Contractor to be enclosed	
02.	When was the Safety Policy last reviewed	
03.	Details of implementation procedure / methods to implement Safety Policy / Safety Rules	
04.	Name, Qualification, experience of Safety Officer	
05.	Review of Accidents Analysis Method, Methods to ensure Safety and Health	
06.	Unit executive responsible to ensure Safety at various levels in work area	
07.	List of employees trained in safety employed before execution of the job. Give the details of training	
08.	Safety Training Targets, Schedules, methods Adopting to providing safety training to all employees	
09.	Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed)	
10.	Regular Safety Inspection Methods and Periodicity and list of members to be enclosed	
11.	Risk Assessment, Safety Audit by Professional Agencies, Periodicity	
12.	Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up	
13.	Provision for treatment of injured persons at work site	
14.	Review of overall safety by top Management and Periodicity	
15.	System for Implementation of Statutory legislations	
16.	Issue of PPEs to employees, Periodicity / stock on hand etc.	

PART-II

TECHNICAL SPECIFICATION

CHAPTER – E13: INSTALLATION

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CHAPTER- E13: INSTALLATION

1.00.00 **EARTHING**

The earthing shall be done in accordance with requirements given in Annexure-I of this section and drawing enclosed with the specifications. Earthing of panels shall be done in line with the requirements given in respective equipment section of this specification. The cost of welding laying etc of earth flats and rods is deemed to be included in the cost of respective item.

2.00.00 **CIVIL WORKS**

The civil works shall be done in accordance with requirements stipulated under Part-II, Section-II of this specification.

3.00.00 **STRUCTURAL STEEL WORKS**

The structural steel works shall be done in accordance with requirements stipulated under Part-II, Section-II of this specification.

4.00.00 **BAY EQUIPMENT**

4.01.00 The disposition of equipment to be supplied are shown in enclosed single line diagrams and layout drawings.

4.02.00 The Contractor shall prepare layout drawings and submit the same for approval of the Employer. The approval of drg. shall not absolve Contractor from his responsibility regarding designing & engineering of switchyard and Contractor shall be fully responsible for all works covered in the scope of this specification.

5.00.00 **LIGHTNING PROTECTION**

5.01.00 Direct stroke lightning protection (DSLP) shall be provided in the switchyard by lightning masts (at least 50 m high) and shield wires.

5.02.00 Lightning protection System down conductors shall not be connected to other conductors above ground level. Also no intermediate earthing connection shall be made to Surge arrester, Voltage Transformer, earthing leads for which shall be directly connected to rod electrode.

5.03.00 Every down conductor shall be provided with a test joint at about 150mm above ground level. The test joint shall be directly connected to the earthing system.

5.04.00 The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.

6.00.00 **EQUIPMENT ERECTION NOTES**

a) All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity.

b) Where, assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense. The contractor shall strictly follow manufacturer's recommendations for handling and erection of equipment.

c) The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment, sling ropes etc. should be tested before erection and periodically thereafter for strength.

d) Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation.

e) Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.

f) For cleaning the inside and outside of hollow insulators only Muslin or leather cloth shall be used.

g) The rigid busbars for equipment interconnections shall have rigid connections at one end and expansion / flexible at the other end. The tubular aluminium connections shall have not more than one joint per span. Since no wastages are permissible, the bidder shall work out the cut lengths of aluminum tube based on finalized layout and dispatch the same to site without requiring owners's approval. Corona bells shall be provided at the end of the rigid busbars.

7.00.00 **STORAGE OF EQUIPMENT**

Contractor is responsible for the proper storage and maintenance of all materials/equipment entrusted to him. The Contractor shall provide & construct adequate storage shed for proper storage of equipment. Sensitive equipment shall

be stored indoors. All equipment during storage shall be protected against damage due to acts of nature or accidents. Contractor shall take all required steps to carryout subsequent inspection of materials/equipment stored as well as erected until the same is taken over by the Employer. The storage instruction of the equipment manufacturers/Engineer-in-Charge shall be strictly adhered to.

8.00.00 **CABLING**

8.01.00 Cabling shall be on cable racks, in trenches, vertical shafts, excavated trenches for direct burial, pulled through pipes and conduits run clamped on steel structures etc.

8.02.00 Cables inside the switchyard shall be laid on bolted GI angle supports at 600mm spacing with separate tiers for control and power cables. The GI angles shall be bolted / welded to galvanized insert plates inside RCC trenches. Prefabricated GI angles welded / bolted to galvanized insert plates before embedment in RCC shall be preferred.

8.03.00 Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the ground. In the case of equipment located away from cable trench either pipe inserts shall be embedded in the ground connecting the cable trench and the equipment or in case the distance is small, notch/opening shall be provided. In all these cases necessary bending radii as recommended by the cable supplier shall be maintained.

8.04.00 Cabling in the control room shall be done on ladder type cable trays.

8.05.00 All interpole cables (both power & control circuit) for equipments shall be laid in cable trenches/G.I. Conduit Pipe of NB 50/100mm which shall be burried in the ground at a depth of 300mm.

9.00.00 **CONDUITS, PIPES AND ACCESSORIES**

9.01.00 The conductor shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushings, reducers, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes etc. The size of the conduit/pipe shall be selected on the basis of maximum 40% fill criterion. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner, to prevent damage to threaded portion and entrance of moisture and foreign material.

9.02.00 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate coatings. The inner surface shall have silicone epoxy ester

coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/pipes shall be of a reputed make.

9.03.00 The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS: 458. All tests on hume pipes shall be conducted as per IS: 458.

9.04.00 Flexible conduits shall be of heat-resistant lead coated steel, water-leak, fire and rust proof and be of PLICA make or equivalent.

10.00.00 **JUNCTION BOXES**

Contractor shall supply and install junction boxes complete with terminals as required. The brackets, bolts, nuts and screws required for the erection shall be included in the installation price. The junction boxes shall conform to the requirements of sec. AUX.

11.00.00 **CABLE TAGS AND MARKER**

11.01.00 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

11.02.00 The tag shall be of aluminium with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS: 280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

11.03.00 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate.

11.04.00 Location of underground cable joints shall be indicated with cable marker with an additional inscription “Cable joint”.

11.05.00 The marker shall project 150mm above ground and shall be spaced at an interval 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

11.06.00 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry. Cable tags shall be provided inside the switchgear, motor control centres, control and relay panels etc., wherever required for cable identification, such as where a number of cables enter together through a gland plate.

11.07.00 The price of cable tags and markers shall be included in the installation rates for cables /conduits quoted by the Contractor.

11.08.00	Specific requirements for cabling, wiring ferrules as covered in respective equipment section shall also be complied with.
12.00.00	**CABLE GLANDS**
12.01.00	Double compression type tinned/Nickel plated (coating thickness not less than 20 microns in case of Tin and 10 to 15 Microns in case of Nickel) brass cable glands shall be provided by the Contractor for all power and control cables to provide dust and weather proof terminations. The cable glands shall be tested as per BS : 6121. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable gland shall be neoprene and of tested quality.
12.02.00	Required number of packing glands to close unused openings in gland plates shall also be provided.
13.00.00	**CABLE LUGS**
13.01.00	Cable lugs shall be tinned copper solderless crimping type conforming to IS: 8309 and 8394 suitable for aluminium or copper conductor (as applicable). Solderless crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided.
13.02.00	The cable lugs shall be of Dowell make or equivalent.
13.03.00	Crimping tool used shall be of approved design and make.
14.00.00	**STORAGE AND HANDLING OF CABLE DRUMS**
	Cable drums shall be unloaded, handled and stored in an approved manner and rolling of drums shall be avoided as far as practicable. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication the drums may be rolled in the same direction it was rolled during taking up the cables.
15.00.00	**CABLE SUPPORTS AND CABLE TRAY MOUNTING ARRANGEMENTS**
15.01.00	Cable trays in the control room are normally provided with embedded steel inserts on concrete floors/walls. The Contractor shall secure supports by welding to these inserts or available building steel structures.
15.02.00	However, in cases where no such embedded steel inserts are available, the Contractor shall have to secure the supports on wall or floors by suitable anchoring

	at no extra cost to the Employer. Details of fixing steel plates by anchor fasteners shall be decided during detailed engineering stage. The provision of fixing arrangement including supply of necessary angles etc. shall be included in the installation rates quoted by bidder.
15.03.00	The cable supports shall conform to the requirements of Sec. E12 of this Specification.
15.04.00	Insert plates will be provided at an interval of 600mm wherever cables are to be supported without the use of cable trays, while at all other places these will be at an interval of 2000mm.
16.00.00	**CABLE TERMINATIONS AND CONNECTIONS**
16.01.00	The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer's instructions, drawing and/or as directed by the Employer.
16.02.00	The work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking, (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.
16.03.00	Cost of all consumable material shall be included in the erection rates quoted.
16.04.00	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.
16.05.00	The contractor shall tag/ferrule the control cable cores at all terminations, as instructed by the Employer. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well.
16.06.00	Spare cores shall be similarly tagged with cable numbers and coiled up.
16.07.00	Control cables shall have stranded copper conductor. Bare portion of the solid conductors shall be tinned after removing the insulation and shall be terminated directly without using cable lugs.
16.08.00	All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.
16.09.00	The entry of cables to the panels through floor openings shall be suitably sealed by using fire proof cable penetration system as per BS – 476 part – 20, type A sealing system which would be either silicone foam or equivalent foam system or

using individual blocks for each cable along with individual blocks for each cable along with suitable frame work rated for one hour.

16.10.00 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the contractor as directed by the owner.

16.11.00 **Directly Buried Cables**

16.11.01 The Contractor shall construct the cable trenches required for directly burried cables. The scope of work and unit rates for construction of cable trenches for cables shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and reaming, supply and installation of route markers and joint markers. The bidder shall ascertain the soil parameters prevailing at site, before quoting the unit rates.

16.11.02 Laying the cable and providing protective covering shall be as per approved drawing.

16.12.00 **INSTALLATION OF CABLES**

16.12.01 Power and control cables shall be laid in separate tiers. The order of laying of various cables shall be as follows, for cables other than directly buried.

a) Power cables on top tiers.

b) Control, instrumentation and other service cables in bottom tiers.

16.12.02 Single core cables in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meters .All multicore cables shall be laid in touching formation. All power cables shall be laid with a minimum centre to centre distance equal to twice the diameter of the cable. After completion of cable laying work in the particular tray all the control cables shall be bound to trays / supports by aluminum strips at every 5 meter interval and at every bend. All power cables shall be laid with a minimum centre to centre distance equal to twice the diameter of the cable.

16.12.03 Power and control cables shall be securely fixed to the trays/supports. Horizontal runs in cable trays and trenches shall be secured by using self locking type nylon cable straps with deinterlocking facilities at every 5 m interval. Vertical and inclined cable runs shall be secured at every 1 m by nylon cable straps.

16.12.04 Cables shall not be bent below the minimum permissible limit. The permissible limits are as follows :

a)	Type of cable & voltage grade	Minimum bending radius
b)	Power cable	12 D
c)	Control cables	10 D

Where D is overall diameter of cable.

16.12.05 Where cables cross roads, drains and rail tracks, the cables shall be laid in reinforced spun concrete or steel pipes, burried at not less than one metre depth.

16.12.06 In each cable run some extra length shall be kept at a suitable point to enable one (for LT Cables) or two (for H.T cables) straight through joints to be made, should the cable develop fault at a later date.

16.12.07 Selection of cable drums for each run shall be so planned as to avoid using straight through joints. In case joints are necessary the same shall be supplied by the Contractor. Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Employer.

16.12.08 Control cable terminations inside equipment enclosures shall have sufficient lengths so that switching of termination in terminal blocks can be done without requiring any splicing.

16.12.09 Metal screen and armour of the cable shall be bonded to the earthing system of the station, wherever required.

16.12.10 Rollers shall be used at intervals of about 2.0 metres, while pulling cables.

16.12.11 All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kink, sharp bends etc.

16.12.12 Cable ends shall be kept sealed to prevent damage.

16.12.013 Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS: 1255 and other Indian Standard Codes of practices.

16.12.14 Wherever cables pass through floor or through wall openings or other partitions, wall sleeves with bushes having a smooth curved internal surface so as not to damage the cables, shall be supplied, installed and properly sealed by the Contractor at no extra charges.

16.12.15 The erection work shall be carried out in a neat workmanlike manner and the areas of work shall be cleaned of all scrap materials, etc. after the completion of work in each area every day. Contractor shall remove the RCC/steel bench covers before

taking up the work and shall replace all the trench covers after the erection work in that particular area is completed or when further work is not likely to be taken up for some time.

16.12.16 Contractor shall furnish three copies of the report on work carried out in a particular week, such as cable numbers and a date on which laid, actual length and route, testing carried out, alongwith the marked up copy of the cable schedule and interconnection drawing wherever any modifications are made.

16.12.17 Contractor shall paint the tray identification number on each run of trays at an interval of 10m.

16.12.18 In case the outer sheath of a cable is damaged during handling/installation, the Contractor shall repair it at his own cost, and to the satisfaction of the Engineer-in-Charge. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable, at no extra cost i.e. the Contractor shall not be paid for installation and removal of the damaged cable.

16.12.19 All cable terminations shall be appropriately tightened to ensure secure and reliable connections. The Contractor shall cover the exposed part of all cable lugs whether supplied by him or not with insulating tape, sleeve or paint.

16.13.00 **Conduits, Pipes and Duct Installation**

16.13.01 Contractor shall supply all conduits, pipes and ducts as specified and to be shown in detailed engineering drg. Flexible conduit should be used between fixed conduit and equipment terminal boxes. Where vibration is anticipated, the flexible conduit shall be as per the relevant IS.

16.13.02 Contractor shall have his own facility for bending, cutting and threading the conduits at site. Cold bending should be used. All cuts & threaded ends shall be made smooth without leaving any sharp edges. Anti corrosive paint shall be applied at all field threaded portions. The Contractor shall supply and apply this protective material.

16.13.03 All conduit/pipes shall be extended on both sides of wall/floor/openings. Exposed conduits/pipes shall be adequately clamped at an interval of about 2m. The fabrication and installation of supports and the clamping shall be included in the scope of work by Contractor.

16.13.04 When two lengths of conduits are joined together through a coupling, running threads equal to twice the length of coupling shall be provided on any length to facilitate easy dismantling of two conduits.

Clause No.	TECHNICAL REQUIREMENTS
16.13.05	Conduit installation shall be permanently connected to earth by means of special approved type of earthing clamps. G.I. Pull wire of adequate size shall be laid in all conduits before installation.
16.13.06	Each conduit run shall be painted with its designation as indicated on the drawings, such that it can be identified at each end.
16.13.07	Embedded conduits shall have a minimum concrete cover of 50mm. Positioning and ensuring proper alignment during concrete by other agencies shall be the responsibility of the Contractor.
16.13.08	Conduit runs sleeves shall be provided with the bushings at each end.
16.13.09	Metallic conduit runs at termination shall have two locknuts and a bushing for connection. Flexible conduits shall also be suitably clamped at each end. Bushings shall have rounded edges so as not to damage the cables.
16.13.10	Where embedded conduits turn upwards from a slab or fill, the termination dimensions shown on the drawings, if any, shall be taken to represent the position of the straight extension of the conduit external to and immediately following the bend. At least one half the arc length of the bend shall be embedded.
16.13.11	For underground runs, Contractor shall excavate and back fill as necessary.

ANNEXURE-I

1.00.00 **EARTHING NOTES**

1.00.01 **GENERAL**

Earthing of operating boxes, cubicles shall be done by 50 X 6 mm GS flat while cable trenches and structure by 75 X 12 mm GS flat.

1.00.02 Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipments and extraneous metal works associated with electric system shall be connected to a single earthing systems unless stipulated otherwise.

1.00.03 Earthing system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.

1.00.04 Bolts and nuts required for earthing all main equipment structures and for connecting with earthing system as explained in Cl. 1.00.02 above shall be in the scope of the Contractor.

2.00.00 **DETAILS OF EARTHING SYSTEM**

Item	Size	Material
Main Earthing conductor	40mm dia rod	Mild steel
Conductor above ground & earthing leads (for equipment)	75 x 12/ G.S. Flat 50 x 6 mm	Galvanized steel
Rod Electrode	40mm dia, 3000mm	Mild steel
G.I. Earthwire	7/8 SWG	GI

3.00.00 **EARTHING CONDUCTOR LAYOUT**

3.00.01 Earthing conductors in outdoor areas shall be burried atleast 600mm below finished grade level unless stated otherwise.

3.00.02 Minimum 6000mm or higher spacing between rod electrodes shall be provided based on the earthmat design calculations.

3.00.03	Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid atleast 300mm below them and shall be re-routed in case it fouls with equipment/structure foundations.
3.00.04	Tap connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid. Otherwise, “earth insert” with temporary wooden cover or “earth riser” shall be provided near the equipment foundation/pedestal for future connections to the equipment earthing terminals.
3.00.05	Earthing conductor along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable welding/cleating at intervals of 750mm. Earthing conductors along cable trenches shall be on the wall nearer to the equipment. Wherever it passes through walls, floors etc. galvanized iron sleeves shall be provided for the passage of the conductor. Both ends of the sleeves shall be sealed to prevent the passage of water through the sleeves.
3.00.06	Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.
3.00.07	In outdoor areas, tap connections shall be brought 300mm above ground level for making connections in future, in case equipment is not available at the time of grid installations.
3.00.08	Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.
3.00.09	Earthing conductors embedded in the concrete fibre shall have approximately 50mm concrete cover.
4.00.00	**EQUIPMENT AND STRUCTURE EARTHING**
4.00.01	The connection between earthing pads and the earthing grid shall be made by short and direct earthing leads free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with engineer.
4.00.02	Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.

4.00.03	Metallic conduits shall not be used as earth continuity conductor.
4.00.04	A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.
4.00.05	Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.
4.00.06	Cable and cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running alongwith the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points, whether specifically shown or not.
4.00.07	Railway tracks within switchyard area shall be bonded across fish plates and connected to earthing grid at several locations.
4.00.08	Earthing conductor shall be burried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop by one lead.
4.00.09	Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.
4.00.10	Equipment earthing (Riser & welding of two conductors) shall be done as per enclosed sketch. Drg. No. 9561-572-POE-A -015.
5.00.00	**JOINTING**
5.00.01	Earthing connections with equipment earthing pads shall be of bolted type. Contact surfaces shall be free from scales, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint/compound.
5.00.02	Connection between equipment earthing lead and between main earthing conductors shall be welded/brazed type. For rust protections, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.
5.00.03	Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingression.

5.00.04	Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
5.00.05	All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.
5.00.06	Bending of large diameter rod/thick conductor shall be done preferably by gas heating.
5.00.07	All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.
6.00.00	**POWER CABLE EARTHING**
	Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
7.00.00	**SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS**
7.00.01	Earthing terminal of each surge arrester, capacitor voltage transformer and lightning down conductors shall be directly connected to rod electrode which in turn, shall be connected to station earthing grid.
7.00.02	Earthing mat comprising of closely spaced (300mm x 300mm) conductors shall be provided below the operating handles of the isolators.
8.00.00	**SPECIFIC REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEM**
8.00.01	Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
8.00.02	Down conductors shall be cleated on the structures at 2000mm interval.
8.00.03	Connection between each down conductor and rod electrodes shall be made via test joint located approximately 150mm above ground level.
8.00.04	Lightning conductors shall not pass through or run inside G.I. conduits.
8.00.05	Lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.

A. PROCEDURE FOR NON DESTRUCTIVE TESTING

a) LIQUID PENETRANT EXAMINATION OF WELDED JOINTS

Evaluation of indications:

Relevant indications are those which result from mechanical discontinuities. Rounded indications or indications which are circular or elliptical with the length less than three times the width.

Linear indications are those indications in which the length is more than three times the width.

Any questionable or doubtful indications, shall be retested to verify whether or not actual defects are present.

Localised surface imperfections, such as may occur from machining marks, surface conditions, may procedure similar indications which are not relevant to the detection of unacceptable discontinuities.

b) **Acceptance Standards**

All surfaces to be examined shall be free of

linear indications;

four or more rounded defects with any dimensions more than 1.6mm in a line separated by 1.16 inch (1.6mm) or less (edge to edge).

c) **Defect removal and repair:**

Unacceptable imperfections shall be removed and re-examination made to assure the complete removal. Whenever a defect is removed and subsequent repair by welding is not required, the excavated area shall be blended into the surrounding surface so as to avoid sharp notches, crevices or corners. Where welding is required after removal of a defect, the area shall be cleaned and welding performed in accordance with a qualified welding procedure. Completed repairs shall be re-examined by the method originally used for detection of the defect.

d) **Treatment of imperfections believed non-relevant:**

Any indication of an imperfection which is believed to be non-relevant shall be regarded as a defect unless, on re-evaluation, it is shown by re-examination by the same method or by the use of other non-destructive methods and/or by surface conditioning that no unacceptable defect is present.

e) **Examination of areas from which defects have been removed:**

After a defect is thought to have been removed and prior to making weld repairs, the area shall be examined by suitable methods to ensure the defect has been eliminated.

f) Re-examination of repaired area:

After repairs are made, the repaired areas shall be blended.

B. RADIOAGRAPHIC EXAMINATION OF WELDED JOINTS

Radiographic examination shall cover minimum 10% of weld seam and acceptance standard for visual examination and Radiography shall be as follows:

Any of the following imperfections shall not be acceptable:

i) Cracks

ii) Zone of incomplete fusion or penetration, which exceed 10% of the weld length of the joint. In longitudinal or transverse butt weld, where full penetration is intended by the weld procedure, some lack of penetration is acceptable. The total length of weld with lack of penetration shall not exceed 10% of the overall weld length. At no place, shall weld penetration be less than 90% of the thickness of the material. Continuous occurrence of lack of penetration is permitted, but shall not exceed 50mm in any 500mm length of weld.

iii) Inadequate weld dimensions, Root Cavity (shrinkage) and incompletely filled groove greater than 10% effective throat thickness.

iv) Excess penetration shall be permitted provided it does not exceed 25% of the wall thickness or 4mm whichever is smaller.

v) Weld reinforcement:

Build up in excess of 25% of the effective throat thickness shall be dressed. Any reinforcement shall be substantially symmetrical about the centreline of the weld and shall be of smooth contour blending smoothly at the toes with the parent material.

vi) Undercutting and overlapping greater than 10% effective throat thickness.

vii) Elongated cavities and/or worm holes exceeding 3mm dia or equivalent area in length provided the limitations on porosity are met with.

viii) Copper, tungsten or oxide inclusions greater than t/4 or 3mm dia or its equivalentarea, whichever is smaller.

ix) Crater pipes exceeding 25% effective throat thickness or 3mm whichever is smaller.

x) Porosity:

Scattered porosity not exceeding 0.5% by volume is acceptable. In general, the size of the pores shall not exceed 0.8mm dia, but occasional 1.6mm dia pores may be acceptable, provided the following limits are not exceeded:

Where pore size is 0.4mm or less, upto 150t pores may be permitted in 1000mm sq. area or radiograph.

Where pore size is 0.8 mm dia or less, upto 19t pores may be permitted in 1000mm sq. area or radiograph.

Where pore sizes are generally 0.8mm dia or less, but occasional 1.6mm dia pores are present, upto 9t of 0.8mm dia may be permitted in 1000mm sq. area of radiograph, provided the number of pores upto 1.6mm in dia does not exceed it.

However, visible surface porosity > 1mm dia is not acceptable.

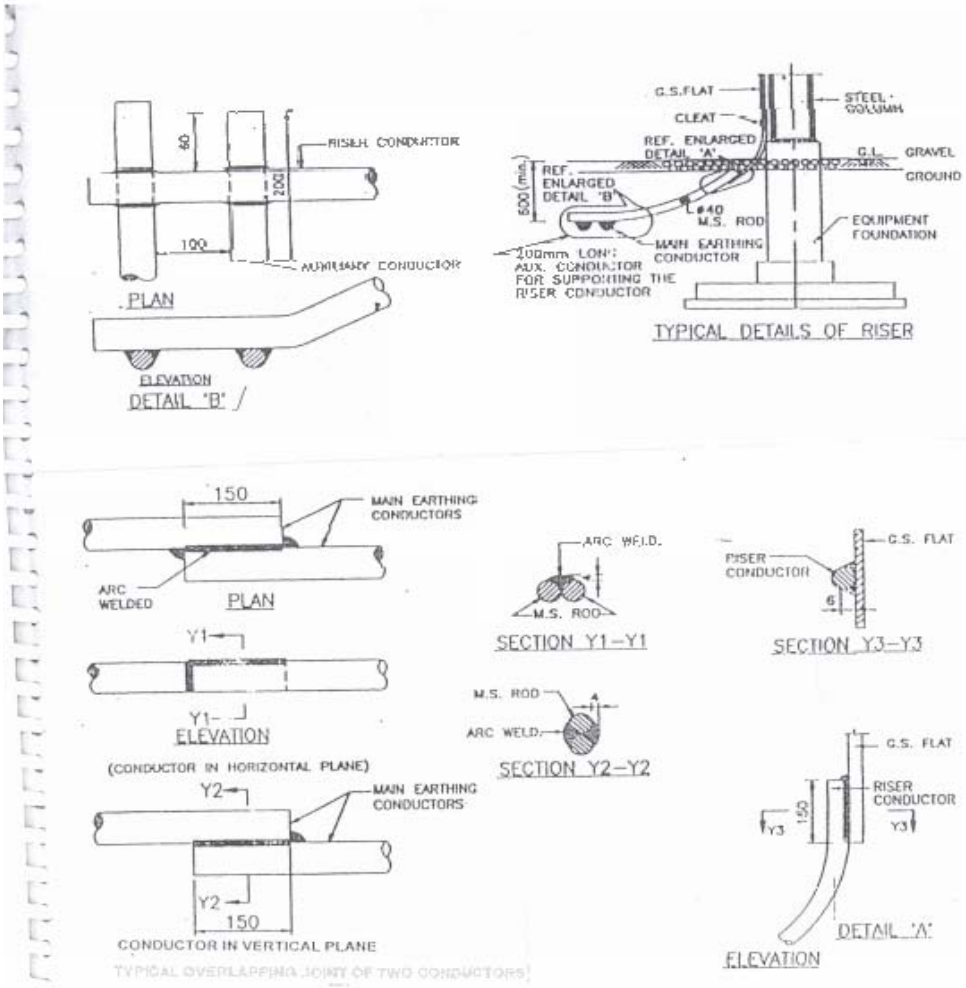
Note:

In all cases, t = thickness of the thinnest section of the weld under examination.

Unacceptable weld defects shall be repaired in accordance with the original welding procedure. All repairs shall be 100% inspected in accordance with original testing procedure.

Erection Drawings to be submitted by the Contractor

1. Single line diagram
2. Switchyard layout (Plan & Section)
3. Equipment & Foundation Cable trench layout
4. Structural Arrangement Drawing
5. Earthmat Layout
6. Composite G.A. Drawing
7. Clearance Diagram
8. Cable Trench Section
9. Equipment Earthing details
10. Welding Details
11. All Design Calculations
12. G.A. of Clamps and Connectors Drawings
13. G.A. and Part Drawing of Insulator String and Hardware
14. G.A. and Schematics of all Marshalling Kiosks and cabinets
15. Data Sheets and Drawings of all Other Miscellaneous Items


RISER CONDUCTOR
AUXILIARY CONDUCTOR
PLAN
ELEVATION
DETAIL 'B'
G.S.FLAT
STEEL COLUMN
CLEAT
REF. ENLARGED DETAIL 'A'
G.L.
GRAVEL
GROUND
REF. ENLARGED DETAIL 'B'
500 (min.)
ø40 M.S. ROD
EQUIPMENT FOUNDATION
MAIN EARTHING CONDUCTOR
200mm LONG AUX. CONDUCTOR FOR SUPPORTING THE RISER CONDUCTOR
TYPICAL DETAILS OF RISER
MAIN EARTHING CONDUCTORS
ARC WELDED
PLAN
ELEVATION
(CONDUCTOR IN HORIZONTAL PLANE)
CONDUCTOR IN VERTICAL PLANE
TYPICAL OVERLAPPING JOINT OF TWO CONDUCTORS
ARC WELD.
M.S. ROD
SECTION Y1–Y1
SECTION Y2–Y2
G.S. FLAT
RISER CONDUCTOR
SECTION Y3–Y3
DETAIL 'A'
ELEVATION
NOTE : WELDING OF EARTHING CONDUCTOR SHALL BE CONDUCTED IN VERTICAL PLANE WHEREVER POSSIBLE
EQUIPMENT EARTHING DETAILS
STANDARD DRAWING

PART-II

TECHNICAL SPECIFICATION

CHAPTER – E14: SITE TESTING AND COMMISSIONING

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4.00.00	Isolators	E14-2
5.00.00	Current Transformers	E14-2
6.00.00	Voltage Transformers	E14-2
7.00.00	Surge Arrestors	E14-2
8.00.00	Phasing out	E14-2
9.00.00	Station Earthing	E14-2
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CHAPTER- E14: SITE TESTING AND COMMISSIONING

1.00.00 INTRODUCTION

An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field QP/ instructions of the equipment supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Employer for approval.

2.00.00 GENERAL CHECKS

a) Check for physical damage.
b) Visual examination of zinc coating/ plating
c) Check from name plate that all items are as per older/ specification.
d) Check tightness of all bolts, clamps and connecting terminals using toque wrenches.
e) For oil filled equipment check for oil leakage, if any. Also check oil level and top up.
f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces.
g) Check cleanliness of insulator and bushings.
h) All checks and tests specified by the manufactures in their drawings and manuals as well as all tests specified in the relevant code of erection.
i) Check for surface finish of grading rings (corona control ring.)
j) Pressure test on all pneumatic lines at 1.5 times the rated pressure shall be conducted.

3.00.00 CIRCUIT BREAKERS

a) Insulation resistance of each pole.
b) Check adjustments, if any, suggested by manufacturer.
c) Breaker closing and tripping time.
d) Slow and power closing operation and opening
e) Trip free and anti pumping operation.
f) Minimum pick up volts of coils
g) Contact resistance
h) Functional checking of compressed air plant and all accessories
i) Functional checking of control circuits, interlocks, tripping through protective relays and auto-reclose operation.
j) Insulation resistance of control circuits, motor etc.
k) Resistance of closing and tripping coils.

Clause No.	TECHNICAL REQUIREMENTS
4.00.00	**ISOLATORS**
a)	Insulation resistance of each pole
b)	Manual and electrical operation on interlocks
c)	Insulation resistance of control circuits and motors.
d)	Ground connections
e)	Contact resistance
f)	Proper alignment to minimise the vibration to the extreme possible during operation.
g)	Measurement of operating torque for isolator and Earth switch
h)	Resistance of operating and interlocking coils.
5.00.00	**CURRENT TRANSFORMERS**
a)	Insulation Resistance Test
b)	Polarity test.
c)	Ratio identification test-checking of all ratios on all cores by primary injection of current.
d)	Dielectric test of oil (wherever applicable)
e)	Magnetizing characteristics test.
6.00.00	**VOLTAGE TRANSFORMERS**
a)	Insulation resistance test
b)	Polarity test
c)	Ratio test
d)	Dielectric test of oil (if applicable)
7.00.00	**SURGE ARRESTER**
a)	Grading leakage current
b)	Resistance of ground connection.
8.00.00	**PHASING OUT**
	The phasing out of all supplies in the station system shall be carried out.
9.00.00	STATION EARTHING
a)	Check soil resistivity
b)	Check continuity of grid wires
c)	Check earth resistance of the entire grid as well as various sections of the same.
d)	Check for weld joint and application of zinc rich paint on galvanised surface.
e)	Dip test on earth conductor prior to use.

Clause No.	TECHNICAL REQUIREMENTS
10.00.00	**CONDUCTOR STRINGING AND POWER CONNECTORS**
a)	Physical check for finish
b)	Electrical clearance check
c)	Testing of torque by torque by torque wrenches on all bus power connectors and other accessories.
d)	Milli volt drop test on all power connectors.
e)	Sag and tension check on conductors.
11.00.00	**INSULATORS**
	Visual examination for finish damage, creepage distance, etc.
12.00.00	**WAVE TRAP**
a)	Insulation resistance Test
b)	Visual check