

Bharat Heavy Electricals Limited



NTPC KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4 x 210 MW)

TECHNICAL SPECIFICATION FOR MILL REJECT SYSTEM MODIFICATION

Technical Specification No.: PE-TS-455-160-11000-A-A001

POWER SECTOR - PROJECT ENGINEERING MANAGEMENT

NOIDA, INDIA



TITLE
NTPC KAHALGAON STAGE-I(4X210MW)
MILL REJECT SYSTEM MODIFICATION

SPECIFICATION NO. PE-TS-455-160-A001

REV 00

Sub Section -IA

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1. Preamble

Kahalgaon Super Thermal Power Station (KHSTPS) is located in the district Bhagalpur of Bihar State. The station is around 250 Kms from the state capital Patna. The station is having four (4) units of 210 MW each with a total installed capacity of 840 MW; Stage-I comprising 4 units and Stage-II having 3 units. The stage-I (4X210 MW) units were commissioned in the year 1992-96, Stage-II (3X500 MW) units in the year 2008- 2010. Stage-I Units (U#1, U#2, U#3 & U#4) have completed around 20-24 years of service.

The Mill Reject System of Stage-I were originally designed, supplied & commissioned by M/s Marshall Sons & Co. (India) Ltd.

The present mill reject system of Kahalgaon Super thermal power plant Stage-1 (4x210 MW) consists of conveying of mill rejects from pyrite hoppers of all six mills of all four units by a mill reject conveyor MRC-1 which is further dropped on to another mill reject conveyor MRC-2. The MRC-2 drops the mill rejects into the mill reject silo located at the end of the MRC-2.

It is proposed to install new ESP pass of Unit # 1 after dismantling of the MRC-2. The Mill reject conveyor-2 (MRC-2) near Unit #1 needs to be suitably dismantled and a new Bucket Elevator near Unit # 4 is to be erected. The owner wishes to erect the new mill reject Bucket Elevator and a new mill reject silo near Unit # 4. This requires, in addition to others, the extension and reversal of direction of movement of MRC-1.

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2. Intent of Specification

The scope of work comprises turnkey supply, erection and commissioning of complete mechanical, electrical, C&I and design & engineering of associated civil, structural and architectural works of mill reject system for Stage-I (4x210MW) for NTPC Kahalgaon as specified and defined in this specification.

The scope of work for the equipment and accessories to be furnished in accordance with this specification shall include design, engineering, manufacturing, inspection and testing at supplier's works, packing, forwarding to site, unloading, receiving and storage at site, painting, pre-assembly, assembly, dismantling as required, erection, pre-commissioning, trial operation, testing and commissioning and performance testing of the equipment / system for Mill Reject System work for Kahalgaon STPS—Stage-I (4x210MW). Any item or works though specifically not mentioned in this specification but needed to complete equipment & systems within the scope of work and battery limit to meet the objective of the specification shall also be furnished, unless specifically mentioned under exclusion of this specification.

The scope shall also include modification of the existing system and structures to suit the requirement of the mill reject system. Notwithstanding the scope mentioned for various sub-systems in the following paragraphs, it is the responsibility of the contractor to carry out complete job on turnkey basis and integrate the existing and proposed systems with each other.

It is not the intent to specify herein all aspects of services and equipments to be provided by the Contractor who, in any case, shall be responsible for fulfillment of the basic intent of this specification. Irrespective of whether specifically mentioned or not, the service and equipments to be provided in accordance with this specification shall conform in all aspects to the highest standard of engineering, design, quality and workmanship so that after completion of renovation / retrofitting by the Contractors, the Mill Reject System shall be capable of performing completely safe, reliable operation in a manner acceptable to the Owner. All material, equipment and services necessary for designing, fabrication, delivery, erection, commissioning and making Mill Reject System ready for such safe, reliable and sustained operation considering ease of maintenance, accessibility, service life, availability etc. shall be provided by the Contractor. All such requisite goods & services shall be provided by the contractor to make the system complete, whether specified or not.

Bidder is advised to visit the site and collect any further information if required, to assess the present plant / equipment condition, before quoting against this specification. The Owner will provide all cooperation to the representative of the Bidder in obtaining the required information during the visit to site. Condition of the plant, equipment and system shall be carefully assessed by the Bidder for assessing the scope of work.

The bid must include all the details called for in this specification.

Relevant Plant layout drawings have been furnished in the specification for the purpose of familiarization. The successful bidder shall be required to prepare additional drawings, write-ups, as may be required, for erection, commissioning and operation.

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Any deviation or variation from the scope requirement or the intent of the specification shall be clearly brought out under the schedule of Technical / Commercial deviations, irrespective of the fact that such deviation / variation may be standard practice or possible interpretation of the specifications by the Contractor. In case no clear and specific deviation is taken by the bidder in the relevant schedule of deviation while making his bid proposal, it will be construed that the bidder has fully understood the intent of the specification and shall completely comply with the stipulations of the specification with regard to the objective to be achieved and scope of services and supplies to be provided by him. Further, unless otherwise specifically clarified by the Owner during the bidding period, the interpretation by the Owner in respect of scope, details and services to be performed by the Bidder shall be final and binding.

All specialised equipment/services necessary for proper erection, construction, commissioning and performance testing of all items of the Mill Reject System and accessories under this contract shall be arranged by the CONTRACTOR. The cost of the same shall be included in Contract price.

All necessary co-ordination with regard to sub-contracted equipment shall be carried out by the CONTRACTOR. BHEL/NTPC will communicate only with the CONTRACTOR for all matters pertaining to this contract.

This is R&M (Renovation and Modernization) work, hence there may be fouling with the underground and above ground existing facilities. The drawing needs to be revised due to fouling with the existing facilities. Bidder shall note that any re-routing and modification work that will be suggested by the Bidder in such an eventuality shall be subject to the Employer's approval and, if required, Bidder shall modify his design to suit the actual site conditions. However, all over ground modification, rerouting of fouling/interference item, dismantling, re-erection work as desired by NTPC/BHEL during execution shall be done by bidder.

BHEL reserves the right to revise the schedules at his discretion in order to keep up the scheduled completion period and to suit the project commissioning requirement and such alterations shall not entitle the Contractor for any extra payment.

All the material shall be jointly inspected by BHEL/BHEL TPI and NTPC as per approved QAP.

Bidder has to submit reference drawing/data sheet/sizing calculation etc. of other projects, if required by BHEL/NTPC for approval of the drawing of NTPC Kahalgaon project as part of standard drawing approval using previous projects reference drawings.

Technical review meeting shall be conducted at BHEL/NTPC offices/site periodically for fast approval of the drawings. Bidder's designer shall attend the meeting to close the engineering related issue.

Bidder's designer shall visit the site frequently and whenever required to resolve the design/fouling/redesign due to fouling with the existing facilities. It is bidder's responsibility to resolve the fouling issues of site. BHEL and NTPC team will co-ordinate with the bidder to resolve the issue whenever required.

L-2 vendor list shall be finalized with NTPC with successful bidder for mill reject system.

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All above ground hindrances for modified mill reject system shall be cleared by the bidder.

For items/equipments required for Mill Reject System but details specification is not available in the tender, bidder to ask for the detailed technical specification during enquiry or engineering stage. These items shall be supplied as per detailed specification provided by NTPC.

The contractor shall make a visit to the site to see the existing facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The bidder has to carry out all the works with in the layout and other constraints existing at site. the complete work shall be carried out with minimum disturbance to the existing plant and equipment.

Complete design/engineering is in bidder's scope. BHEL will execute civil RCC work based on the bidder/approved drawings. Detailed structural & fabrication drawing shall be submitted by the bidder for approval. If any rework/modification required after completion of civil work due to wrong civil input by bidder, same shall be corrected by the bidder.

Geotechnical Investigation is in BHEL scope. BHEL shall design civil foundation based on geotechnical investigation report and vendor's equipment load inputs.

BHEL reserves the right to revise the schedules at his discretion in order to keep up the scheduled completion period and to suit the project commissioning requirement and such alterations shall not entitle the Contractor for any extra payment.

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3.00.00 SCOPE OF SUPPLY AND SERVICES

- 3.01.00 Modification in the existing mill reject conveyor-1 (MRC-1) such that in the modified MRC-1 the head end will be at unit#4 side whereas the tail end will be at Unit#1 side. MRC-1 shall be extended towards unit#4 in such a way that the drive unit and discharge chute shall be located above ground. Installation of new Bucket Elevator with MRS Silo. Bucket Elevator shall be installed above ground. Short supports and stringers of existing MRC-1 shall be retained. Carrying idlers position shall be suitably changed w.r.t. change in drive end of MRC-1.
- 3.02.00 Extension of existing mill reject conveyor-1 (MRC-1) towards unit#4 side, complete with short supports, stringers, deck-plate, pulley, idlers, gravity take up, take up structure, internal and external belt cleaners, pull cords switches, belt sway and zero speed switches, the idlers, short supports, stringers, foundation bolts shall be provided for extended portion of the mill reject conveyor-1. Conveyor 1 shall be extended up to the extent required to bring the head pulley and discharge chute above ground so that it is terminated at Bucket Elevator chute.
- 3.03.00 Belt conveyor for the complete MRC-1
- 3.04.00 Pulley and belt cleaners for modified MRC-1.
- 3.05.00 New drive motor, drive unit, gear box, fluid coupling etc. for MRC-1 as per new extended conveyor above ground design.
- 3.06.00 Bucket elevator along with drives, accessories and supporting structures to raise the mill rejects discharge by the belt conveyor for discharging into storage silo. Bucket elevator shall be above ground.
- 3.07.00 One (1) number Mill reject storage silo in steel construction having an effective storage capacity of 100 M3 (160Metric tones). Necessary supporting steel structure, platforms, staircase, manual operated unloading gate, 3 mm thick SS plate liners covering straight length portion and conical portion of mill reject storage silo, level switches, etc. shall be provided. The storage silo shall be designed to provide a clear access of 4.0 m for a road truck/tanker to come under the silo and receive the reject using suitable chute work.
- 3.08.00 Necessary lifting devices of adequate capacity to handle the mill reject handling equipment.
- 3.09.00 Structural work associated with mill reject handling system including supply of foundation bolts etc.
- 3.10.00 All electrical and C&I work associated with the system.

BHEL/NTPC shall provide 1 no. un-cabled supply feeder of 250A rating (for feeding drives near Unit-4) and 1 no. un-cabled supply feeder of 16A rating (for feeding drives near Unit-1). Bidder has to consider following in their scope of supply:



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- a) Engineering, supply and installation of incoming **Power cables** from supply feeders (1 no. 250A and 1 no. 16A) to different Power/Control Panels including termination hardware for complete coal mill rejection system.
- b) Engineering, supply and installation of **Control & Instrumentation cables** including termination hardware for complete coal mill rejection system.
- c) Engineering, supply, installation, testing and commissioning of **Power-cum-control panel** which shall meet the requirement to provide power supply and control of all equipment/ drives under scope of supply of bidder. It shall consist of but not limited to power & control components, control transformer, contactors, meters, relays, indication lamps, annunciation system, wires, TBs etc. which should meet the requirement as specified in the electrical portion of specification.
- d) Engineering, supply, installation, testing and commissioning of associated electrical, C&I items, instruments, switches, cords, inter-connecting power, control, instrumentation cables to all drives, equipment, instruments etc. with cables support system, JBs, local boxes etc. for coal mill rejection system.
- e) Engineering, supply, installation, testing and commissioning of **lighting system and illumination** including LED luminaires, lighting panel, receptacles, fixtures, conduits, cables, wires, switchboards, distribution boards or any other item required to complete the system for open conveyer, bucket elevator and MRS silo area.
- f) Engineering, supply and installation of **cable tray with cable tray support system** and **earthing material** for coal mill rejection system.

Power distribution is tentatively conceptualized as following by BHEL which shall be finalized during detailed engineering:

250A rating supply feeder (near Unit-4) shall be fed to a Power-cum-control panel (MRS vendor scope) from which supply shall be distributed to:

- New head pulley motor for modified Mill Reject Conveyor-1 (with local push button station with start and stop push buttons).
- Bucket Elevator head pulley motor (with local push button station with start and stop push buttons).
- Supply to local control panel of 2 nos. Sump Pumps (1 Working+1 Standby) which are to be placed in the trench near new head end of MRC-1.
- Supply to Electric Hoist panel.
- Supply to lighting panel (MRS vendor scope) for Illumination in the new area of installation.
- Single supply to welding receptacles (63A, 415V, TPNE Industrial Receptacle with switches).

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16A rating supply feeder (near Unit-1) shall be fed to:

- Local control panel of 2 nos. Sump Pumps (1 Working + 1 Standby) which are to be placed in the trench near new tail end of MRC-1.

Unloading, storage & material handling of all materials related to coal mill rejection system shall be in bidder's scope.

3.11.00 The erection of Bucket Elevator, mill reject storage silo and extended portion of MRC-1 shall be carried out in such a way that the operation of existing mill reject system is not affected. However, during interconnection of the new mill reject system with the existing system the operation of the existing system can be stopped for a very short duration.

3.12.00 Dismantling of the existing MRC-2, existing mill reject silo and its associated structure and transportation to a location as identified by the Engineer-in-charge. The dismantling scope includes of all associated electrical, C&I equipment, instruments, switches, cords, inter-connecting power, control, instrumentation cables, cables support system, lighting items, JB's, local boxes etc.

3.13.00 Dismantling of stair case and lift (42M – Rack and Pinion type). The lift has to be handed over to end customer in without any damage. Location of Staircase & Lift to be dismantled are as per the furnished tender drawings. Additional details may be collected from visit to site like drawings, weights of lift & staircase.

3.14.00 Location and area for Bucket Elevator and Silo is shown in the tender drawing.

3.15.00 First fill of all consumables e.g.; oils and lubricants and one year toppings requirements.

3.16.00 Preservative shop coating, final painting of all structures and equipment under the scope.

3.17.00 Complete unused set of all special tools and tackles, which are necessary or convenient for erection, commissioning and overhauling of any equipment, covered under the scope.

3.18.00 Commissioning of the mill reject conveyor 1, bucket elevator and the mill reject silo.

3.19.00 Complete feeding arrangement from existing pyrite hoppers to the mill reject conveyor-1, including modification of chute, skirt board wherever required. In the impact zone of mill reject conveyor-1 six (6) numbers carrying idlers with a spacing of 400 mm shall be provided.

3.20.00 Four (4) Nos. fixed type sump pumps, (1W+1S) near head pulley location and (1W+1S) tail pulley location of modified MRC-1, complete with motors, local control panel, level switches, individual discharge piping with fittings and valves

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to nearest plant drain including pipes etc. upto disposal point.
3.21.00 One (1) set of Mandatory Spares as per the list attached in specification.

Storage and Material Handling at Site

Construction of closed stores and open stores of adequate size and numbers are in bidder's scope for mill reject system materials. All critical equipments like pump, idlers, gear box, fluid coupling, valves, all electrical equipments/items, all C&I equipments/items & all other items which are prone to damage while kept in open atmosphere shall be kept in closed store, with required protection and preservation.

Unloading, Storage, Stacking, Material Handling, Security, documentation, material issue, scrap disposal etc. of all materials including Mandatory spares shall be in bidder's scope for mill reject system.

The modalities for the above activities shall be finalized at site by BHEL site engineer. The decision of BHEL site engineer shall be final in all cases.

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Terminal Points & Exclusions

TERMINAL POINTS

The principle terminal points for mill reject system are detailed below. Within following termination points the contractor shall supply and erect all mechanical, electrical, C&I equipment, and entire structural works including supports, platforms etc. as specified and as required for a complete mill reject system.

- Pyrite hoppers outlet
- Discharge of new Mill Reject Silo

EXCLUSIONS

Complete civil work pertaining to RCC work and equipment foundation. BHEL shall prepare the foundation drawings based on load data and layout input provided by bidder.



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DETAILED SPECIFICATION OF MECHANICAL



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The specific codes/standards followed for the design of the system are as below:

IS:8531-1986	Specification for pulleys for Belt conveyors
IS:8598-1987	Specification for idlers and idlers set for belt conveyors
IS: 9295-1983	Steel tubes for idlers for belt conveyors
IS:7167 (Latest)	Code for selection and use of bucket elevators
IS:6833 (Latest)	Buckets for Bucket Elevators
CEMA	Conveyor belt manufacturing association
IS:11592-2000	Code of practice for selection and design of belt conveyors
IS:1891-1994	Conveyor and elevator textile beltings spec. Part.1 General
ISO 5049/1 or IS:800	Code of construction of structural works
IS:2062-2006	Steel for general structural purposes
IS:1239 2004 Part 1	Spec for mild steel tubes tubular and other wrought steel
IS 7155 (part 5):1990	Code of Recommended Practice for Conveyor safety
IS 7155 (part 5):1990	Code of Recommended Practice for Conveyor safety
IS:3938	Specification for Electric Wire Rope Hoist
IS:3832	Chain pulley blocks
IS:2429	Round steel short link chain
IS:6216	Short link chain grade 80
IS:15560	Points hooks with shank up to 160 Tonne
IS:210	Cast Iron Castings

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Dismantling works (Existing Mill Reject Conveyor-2, Silo, Staircase and Lift)

Dismantling of the existing Mill Reject Conveyor-2, existing mill reject silo and its associated structure and transportation to a location as identified by the Engineer-in- charge. The dismantling scope includes of all associated electrical, C&I equipment, instruments, switches, cords, inter-connecting power, control, instrumentation cables, cables support system, lighting items, JBs, local boxes etc.

Dismantling of stair case and lift (42M – Rack and Pinion type) which lies in the way of extension of Mill Reject Conveyor-1. The lift has to be handed over to end customer without any damage. Location of Staircase & Lift to be dismantled are as per the furnished tender drawings. Additional details may be collected from visit to site like drawings, weights of lift & staircase.

The lower part of staircase structure (4 columns) shall be retained and used for supporting the extension of Mill Reject Conveyor-1.

Existing HGTU of Mill Reject Conveyor-1 shall also be dismantled as new head pulley and tail pulleys with motors shall be installed for reversal of conveyor.

Dismantling of existing structure shall be carried out carefully to prevent damage to other nearby structures/areas as applicable for MRS work under bidder's scope. The scope of work under these items shall include making all necessary arrangement for accessing the various areas at height, all tools & tackles required for carrying out the work, taking all safety measures for existing building and other facilities. Before carrying out any dismantling activities, the various existing electrical fittings/fixtures and other existing facility if any are to be suitably removed carefully taking all safety precautions as per the directions of Engineer and the same to be returned to the owner store. The damaged surface will be making good with PCC M20.

All serviceable material received from dismantling to be stacked neatly within a lead of 1 km and all un-serviceable material to be disposed off as directed by Engineer.



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Modified Mill Reject Conveyor-1

Modification in the existing mill reject conveyor-1 (MRC-1) such that in the modified MRC-1 the head end will be at unit#4 side whereas the tail end will be at Unit#1 side. MRC-1 shall be extended towards unit#4 in such a way that the drive unit and discharge chute shall be located above ground. Short supports and stringers of existing MRC-1 shall be retained. Carrying idlers position shall be suitably changed w.r.t. change in drive end of MRC-1.

Extension of existing mill reject conveyor-1 (MRC-1) towards unit#4 side, complete with short supports, stringers, deck-plate, pulley, idlers, gravity take up, take up structure, internal and external belt cleaners, pull cords switches, belt sway and zero speed switches, the idlers, short supports, stringers, foundation bolts shall be provided for extended portion of the mill reject conveyor-1. Conveyor 1 shall be extended up to the extent required to bring the head pulley and discharge chute above ground so that it is terminated at Bucket Elevator chute. New HG TU shall be designed, supplied and erected at tail pulley side of modified MRC-1.

a	Design capacity of the belt	40 TPH (Rated-36 TPH)
b	Belt width	500 mm
c	Max. Belt speed	1.0 m/s
d	Lump size	40 mm
e	Bulk density	1.6 T/m ³ (Volumetric) and 2.4 T/m ³ (for load)
f	Material to be handled	Pyrites/Hard coal/Shale/Stone chips
g	Belt Specification	HR grade, Nylon-Nylon, 5/2 rubber cover without negative tolerances, minimum number of piles for belting shall be three (3)
h	Maximum slope of the conveyor	16 degree
i	Maximum sag between idlers	2 %
j	Cover grade of belting	(1) Flame test confirming to iso:340) (2) Drum friction and electrical surface test-confirming to Canadian standard association CAN/CSA M-422-M84 Grade-C
k	Factor of safety for belt conveyor	10 (Minimum)
l	Normal working tension at design capacity	Less than 80 % of max. allowable working tension
m	Take up travel	To suit all operating condition or for N-N belting-2.5 % of conveyor centre-to-centre distance, whichever is higher. Further the initial location of take-up shall be decided in such a way that it is possible to carry out min. two (2) nos. vulcanizing joints without adding any external belt.

Belt conveyor system shall be designed as per the 5th edition of 'Belt Conveyors for Bulk Materials' published by Conveyor Equipment Manufacturer's Association ' or equivalent International Standard. Ai value for idler shall be considered 2.81b (min.) for the purpose of conveyor design calculation only.

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Mill Reject Storage Silo

One (1) number Mill reject storage silo in steel construction having an effective storage capacity of 100 M3 (160Metric tones). Necessary supporting steel structure, platforms, staircase, manual operated unloading gate, 3 mm thick SS plate liners covering straight length portion and conical portion of mill reject storage silo, level switches, suitable venting arrangement with bird screen etc. shall be provided. The storage silo shall be designed to provide a clear access of 4.0 m for a road truck/tanker to come under the silo and receive the reject using suitable chute work.



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Bucket Elevator

Bucket elevator along with drives, accessories and supporting structures to raise the mill rejects discharge by the belt conveyor for discharging into storage silo. Bucket elevator shall be above ground.

Location and area for Bucket Elevator and Silo is shown in the tender drawing.

General Requirement

Suitable type of the Bucket Elevator shall be chosen for mill rejects handling. The bucket shall be sized to handle rated capacity of mill rejects discharge by the belt conveyor at the minimum material bulk density and maximum bucket filling of 75%.

Casing

Casing to be self-supported, dust-tight construction and capable of supporting head shaft, drive, and service platform. Boot section to be fabricated of minimum 6mm steel plate, with front and rear access panels. A beam is to be provided in casing for servicing internal gravity take-up. The beam may be located either in the boot section or intermediate section as applicable.

Belting (if applicable)

Suitable heat resistant and fire resistant belting shall be provided.

Take-up

Take-up shall be screw or internal gravity type with guide rails and weights included.

Drive

Bucket elevator drive should be sized as follows:

Minimum power for drive, either:

100% bucket filling @ minimum material bulk density, or

75% bucket filling @ maximum material bulk density, whichever is greater.

Inspection and Access Doors

Inspection doors and access doors shall be loose-hinged type with quick-opening jamb bar fasteners and gaskets enclosed and retained in the door. Access doors shall be 1.5X1.5m minimum.

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Idlers

The rollers shall be made from ERW steel tube and shall be mounted on EN-8 or equivalent material spindles. The rolls shall be supported from fabricated steel brackets. Fixing arrangement of rollers with brackets shall be drop-in type. For adjusting the alignment of the idlers, slotted holes shall be provided in idler supporting base plates. Direction of belt travel shall be clearly marked on the brackets of carrying idlers by embossing / punching. Idler rollers shall be water proof, dust proof and weather proof against a high velocity water jet. All idlers shall be provided with minimum double labyrinth dust seal. All the conveyors shall be provided with one self-cleaning type rubber disc return idler located near the head pulley for cleaning the return belt.

The idlers shall be as per the following details

- Carrying idler - 35 degree, 3 roll, 114.3 mm diameter@ 1.2m pitching
- Return idlers - Single roll, 114.3 mm diameter, @ 3 m pitching
- Impact idler - 35 degree, 3 roll, rubber disc, 88.9 mm diameter over tube and 150 mm diameter over rubber disc@ 400 mm pitching, minimum 6 numbers at loading point
- Self aligning carrying idler - 35 degree, 3 roll, 114.3 mm diameter@10m from head and tail pulley with intermediate spacing 15m
- Self aligning return idler - Single roll, 114.3 mm diameter@10 m from head and tail pulley with intermediate spacing 20 m
- Self cleaning return idler – 88.9 mm diameter & 163 mm over rubber disc at head end
- Transition idler - 20 degree, 3 roll, 114.3 mm diameter near head pulley.
- Brg size for all above - Brg 6204, sealed and lubricated for life
- Thickness of all idlers - 4.0 mm (without any negative tolerance)

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Pulleys

The diameters of the pulleys shall be as follows:

- Head Pulley: 400mm diameter
- Tail and take up pulley: 315m diameter
- Snub/bend pulley: 315mm diameter

The face width of the pulleys shall be as stated in IS: 8531. The snub pulleys on each conveyor shall be located to provide a belt wrap on the drive pulleys of not less than 210 deg. The pulleys shall be made from mild steel conforming to IS:2062 (Tested Quality). Suitable stiffening shall be provided at all weld location in the shell on all pulleys. All the pulleys shall be mounted on the forged steel shafts of EN-8 or equivalent material of adequate proportion by taper lock arrangement, running in heavy duty roller bearings with proper greasing arrangement. The plummer blocks for pulleys shall be of horizontally split type construction with minimum (4) nos. bolts holding the two split halves and with min (4) nos. foundation bolts. The plummer blocks shall be dust tight with double labyrinth seals. Conical head shape nipples conforming to IS:4009, suitable drain plug and eye bolt shall be provided. Side covers of plummer blocks shall be heavy duty metallic sheets.

The lagging for drive pulleys and other pulleys shall be hot lagged with vulcanised natural rubber. The Lagging thickness for drive pulleys shall be 12 mm thick grooved in diamond pattern with grooves 6 mm wide x 6 mm deep. The Lagging thickness for other pulleys shall be 12 mm thick plain. The rubber for lagging shall be Natural rubber blended with styrene Butadiene rubber, hardness 55 to 65 durometer (Shore A), elongation over 300 %, strength 160-245 kg/cm², Abrasion loss 250 mm³ (max.) as per DIN 53516, Specific Gravity Max. 1.5 and Adhesion Strength 10 kg/cm (minimum).

**TITLE**

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Belt cleaner**External Belt Cleaner**

Spring loaded scraper type cleaner with modular segmented and replaceable polyurethane scrapers blades complete with main cleaner, pre-cleaner (mounted separately) along with accessories and necessary fines (reject of scrapper) chutes shall be provided for all belt conveyors, tripper head pulley and belt feeders at discharge pulleys. the modular units shall be easily replaceable. the scraper assembly shall be easily maintainable from outside without any interference with the chute arrangement and assembly.

Internal Belt Cleaner

V-plough type belt cleaner made of mild steel flats and hard rubber strips with automatic wear adjustment and necessary accessories shall be furnished for cleaning internal surface of the conveyor belt.



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Skirt Board

The skirt board shall cover the entire feeding chute and further extend 3.0 m front and 500 mm beyond the chute. The side plate shall be 10 mm thick TISCRA and the top cover shall be 6 mm thick MS.

Chute

Direct impact of material on conveyor belt shall be avoided by providing an inclined surface at 60 degrees valley angle at the feeding point to guide the material in the direction of belt travel. Bottom sides along with its adjacent sides shall be flanged and made from TISCRA or equivalent material of 20 mm thickness. The non-striking shall be of 10 mm thick mild steel and bolted to the flange. Hoods over the conveyor head pulleys shall be made of suitably stiffened minimum 4 mm M.S. Plates and shall be provided with hinged and gasketed inspection doors with suitable access to them.

Belt Take-up Arrangement

Automatic take-up of gravity type shall be generally provided with necessary take-up arrangements complete with bend pulleys, take-up pulley, with its supporting I sliding assembly, wire ropes with turn buckle arrangement (to adjust the level) for suspending the separate take - up weight sliding assembly close to the ground, counter weights and other accessories. Suitable guards marked up scale attached to the frame to monitor belt stretch and access/maintenance platforms with handrails all around etc. shall be provided.

Drive Motors

Rating of all drive motors of conveyors shall not be less than 110% of the power required at drive motor output shaft at specified design capacity. The motor rating shall be at 50 deg Cent. Ambient.

Conveyor Bridges

The conveyor gallery shall be complete with conveyor bottom deck plates, seal plates, walkways of chequered plates with anti-skid arrangement(s), hand rails (on both sides of conveyor belt. clear head room of 2.7 m shall be provided for overground and overhead conveyor. for overground conveyors the side walkways shall be of 1100 mm on one side and 800 mm on another side. for underground tunnel the side walkways shall be of 1100 mm on one side and 800 mm on another side. the height of the tunnel shall be 3.5 m. in case slope exceeds 10 degrees, chequered plate steps shall be provided. all conveyors shall be provided with 12 G steel seal plates throughout the length of the conveyor gallery in such a way that complete gallery bottom surface area forms a single water proof floor and no water i coal falls down from conveyor gallery in case of cleaning & washing. the conveyors shall be provided with continuous decking plate of minimum 3 mm thickness plain steel sheet.

Civil Specification for Overhead Conveyor Trestles

Overhead conveyor and its supporting trestles shall be of structural steel. Roof of conveyor gallery shall be of single skin troughed profile colour coated sheet.



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Gearbox

The gearboxes shall be designed for 24 hours continuous duty.

Gearboxes with cooling coils or external cooling are not acceptable. The gears used shall be helical conforming to IS:3681 (latest revision) or worm reduction units or spiral bevel speed reduction units conforming to suitable Indian Standards. The dimensions of the shaft end shall conform to IS:3688 or its latest revision. Hold back device integral with the gear box shall be provided for preventing of running back of the conveyor belt in case the conveyor is stopped in loaded condition. A service factor of 1.2 times the actual power requirement at drive pulley shaft at design capacity shall be taken.

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Fluid Coupling

The design of the coupling shall be such that it can take shock and misalignment without sacrificing its efficiency. Geared type flexible coupling shall be used on low speed side for all conveyors and other drive chains where gear box is provided. Other couplings in the drive chains shall be either rigid or flexible type, depending upon the requirement of equipment design. The coupling rating shall not be less than the motor name plate rating.

Fluid couplings shall be provided in all the drive machinery for belt conveyor systems and coal crushers if the actual power requirement at motor output shaft is more than 40 kW. The fluid coupling for LT motors shall be of traction type and for HT motors, shall be of scoop tube type. Suitable electrically operated actuators shall be provided for scoop tube operation from local as well as remote. Manual operation may also be provided. Separate pump with motor or integral shaft driven oil pump shall be provided for circulating the fluid coupling oil through oil cooler. Forced cooling water supply to oil cooler shall be provided for which cooling water pumps to be provided for group of scoop couplings. Suitable interlock using flow switches shall be provided in both oil as well as water lines to trip the drive motor in the event of flow in either lines falling below acceptable levels. Suitable pressure indicators and flow indicators shall be provided in the cooling water lines along with all- relevant valves, and accessories. Necessary isolation valves shall be provided in the oil/ water line for maintenance of any equipment in the line. Necessary interlock shall also be provided so that the HT motor cannot be started from remote /local unless position of scoop tube permits no load start of the motor. Tripping of downstream equipment while the system is under normal operation shall result in scoop tube re-positioning to permit no load run of the concerned HT motor. Temperature switch shall be provided in the oil circuit and shall trip the system in case of high oil temperature. The scoop tube operation must be such so to ensure draining of oil from the operating circuit by providing a double speed motor. The speed (for draining) shall be selected to match the coasting time of downstream equipment/conveyor.



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Sump Pumps

Four (4) Nos. fixed type sump pumps (2W+2S), complete with motors, local control panel, level switches, individual discharge piping with fittings and valves to nearest plant drain including pipes etc. upto disposal point. Two (2) nos. sump pumps (1W+1S) near the tail pulley of MRC-1 and two (2) nos. sump pumps (1W+1S) near the head pulley of MRC-1.

Sump pumps along with level switches & piping upto nearest employer's drain (max upto 50.0 mtrs. from outside the building) shall be provided at all locations wherever natural drainage is not possible. The capacity of each pump shall not be less than 50 m3/hr. minimum 10% margin on capacity and 20% margin on computed head shall be considered for selection of pumps. size of the drain pit shall not be less than 2.0 meters x 2.0 meters x 1.8 meters deep. one no. of settling pit shall also be provided before sump pit so that water without heavy coal particles goes into sump pump pit. high and low level switches shall be provided in the sump pump pit. the sump pumps shall be of wet pit types, vertical shaft and impeller shall be specially designed to pass large solids or unscreened liquids. the construction and material shall be suitable for pumping coal/dust contaminated water with a minimum of maintenance. all bearings of the pump shall be located above the water level.

Material of Construction for Sump Pumps

- a) Casing and rotor housing: Ni-Cast Iron (350 BHN)
- b) Rotor: Ni-Cast Iron (350 BHN)
- c) Shaft: Medium carbon steel
- d) Gland: Bronze
- e) Wearing rings: Stainless steel
- f) Shaft enclosing tube: Carbon steel

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Belt protection equipment

- a. Emergency stop switch system - pull cord type (manually reset), @ 30 m pitching.
- b. Belt sway switches - Limit switch snap action type, one pair at 50 m interval (minimum 2 pairs).
- c. Zero speed switches - proximity switch, mounted on bend pulley of GTU.

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Monorail and Hoists

The Monorails & Hoists shall conform to the latest edition of the following standards & codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.

For the Hoists with more than 2.0 tonne lifting capacity or more than 10.0 M lift, with the exception of hoists for G T U and bend pulleys, motor operated hoist blocks for both long travel and lift shall be provided. Other hoist blocks shall be of hand operated type for both travel and lift. all monorails coming out of the buildings shall be provided with electric hoist blocks, irrespective of load and lift. Minimum 3meter length of cantilever from edge of building/cladding, shall be provided in monorails coming out of the building to lower the equipment to ground level clearing the building sidewalls i cladding and any other facilities beneath the floor upto ground level. clear height shall be maintained when handling one equipment over other, in such case dismantling of any equipment shall not be permitted. the center line of monorail shall not deviate by more than 500 mm from the center of gravity of any equipment that is to be lifted.



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Mandatory Spares

S. No.	Description	Quantity
1	SUMP DRAINAGE PUMPS	
i)	Impeller	2 Nos. of each type
ii)	Pump and motor bearings	1 Sets of each type
iii)	Casing Liners	2 Sets of each type
2	CONTROL PANELS	
i)	Control supply transformer (if any)	1 no. of each type and rating
ii)	Relays and timers	2 no. of each type and rating
iii)	Contactors	3 no. of each type and rating
iv)	LEDs	5 nos. of each type and rating
v)	Control switches	1 no. of each type
vi)	Selector switches	1 no. of each type
vii)	Push buttons (complete with contact elements)	2 nos. of each type and colour
viii)	Any special meters	1 no. of each type

Note:

a)	Unless stated otherwise, a 'set' means item or sub-items required for each type/ size, range of assembly/ sub- assembly required for complete replacement in one equipment system; it is further intended that the assembly/ sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in marinating two different sets of spares to be used for subject assembly/ sub assembly, these shall be considered as different type of assembly/ sub assembly.
b)	Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by the vendor shall be the specified percentage (%) of total population required to meet the specification requirements. In case the quantity of mandatory spares so calculated happens to be in fraction, the same shall be rounded off to next higher whole number.
c)	Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc, these shall cover all the items supplied and installed and the breakup of these shall be furnished by the vendor during detail engineering.
d)	In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to the offered design with quantities generally in line with the approach followed in the above list.
e)	Wherever bidder has indicated an item as not applicable, the same will have to be supplied free of cost, in case it is found applicable during detail engineering.

SUB-SECTION-IV-C

DETAILED TECHNICAL SPECIFICATION (CIVIL)

CLAUSE NO.	CIVIL WORKS 			
1.00.00 1.01.00 1.02.00 1.03.00 1.04.00 1.05.00 1.06.00 1.07.00 1.08.00 1.09.00	GENERAL This section of the Technical Specification covers the technical requirements for Design, preparation of General Arrangement Drawings, Design Drawings, supply of labour, materials, plant & equipment, construction, fabrication and erection of Civil and Structural works included in Contractor's scope. Description of various items of work under this Specification and nature of work in detail are given hereinafter. The complete works under this Specification is referred to as "Civil Works". The work to be performed under this Specification shall also include Design, Engineering and providing of all Labour, Materials, Plant & Equipment, Consumables, Construction Facilities and all Incidental Items though not shown or specified but are reasonably implied and / or are necessary for the completion and proper functioning of the Plant, Systems and Facilities, all in strict accordance with the Specifications, including revisions and amendments thereto. The specifications specified hereunder are intended for the general description of the work, quality and workmanship. The specification are however, not intended to cover the minutest details. Minimum specified requirements are furnished in the Technical specification. The work shall be executed covering atleast these requirements, according to the relevant latest Indian Standards / Codes, TAC norms, requirements of various statutory bodies. In absence of these, work shall be executed according to the best prevailing central Public works department practices or to the recommendations of the relevant latest American and British Standards or to the instructions of the Engineer and complete satisfaction of the owner. List of I. S. Codes to be followed is given elsewhere in the Technical Specifications. The Bidder is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Owner in respect of interpretation of any portions of this document. All Materials required for works under the Bidder's scope shall be arranged and supplied by the Bidder. All support structures (as covered under the Scope) including those for pipes/cables/ducts above Foundation Level or Grade Level, whichever is lower shall be of Steel and shall be supplied and provided by the Contractor. All mono-rails required for equipment handling, etc. shall be supplied and provided by the Contractor. ESP, Collector tank tower, ESP Control room building, Compressor house, MCC /switchgear rooms and control room structure shall be supported by Bidder on Foundation through Foundation Bolt assemblies installed at the time of first stage concreting. The ESP Control room building shall be steel framed structure having brick cladding with RCC roofing. The Compressor house, MCC /switchgear rooms and control room etc. for compressor house shall be steel framed structure having brick cladding for 1m above FFL and single skin sheeting metal cladding over it with metal deck roofing (filled with RCC supported on main steel truss/girders). Anchor Fasteners shall be used for supporting equipments, where the Static and Dynamic Load due to Equipment is within the safe Load carrying capacity of the Anchor Fasteners.			
KAHALGAON SUPER THERMAL POWER STATION STAGE -I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 1 of 77

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1.10.00	The work shall be carried out according to the Design / Drawings, to be developed by the Contractor and got approved by the Employer. For all Plant, Systems, Facilities, Structures, etc., necessary Layout and details are to be developed by the Contractor keeping in view the statutory and functional requirements and providing enough space and access for Operation, use and Maintenance. The Bidder's work shall cover the complete requirements as per IS Codes, requirements of various Statutory Bodies, International Standards, best prevailing practices and to the complete satisfaction of the Employer.				
1.11.00	The Bidder shall make the Layout and Levels of all Structures from the general grid of the plot and the nearest GSI Benchmark or other acceptable Benchmark of Government Department, as per the directions of the Employer. The Bidder shall be solely responsible for the correctness of the layout and levels and shall also provide necessary instruments, materials, access to works, etc., to the Employer for general checking of the correctness of the Civil works.				
1.12.00	All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to.				
1.13.00	The Bidder shall fully appraise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and Site specific parameters and shall provide for all such conditions and contingent measures, including those which may not have been specifically brought out in the Specifications but required for successful execution of work.				
1.14.00	In case of any conflict between stipulations in various portions of the Specification, most stringent stipulation would be applicable for implementation by the Contractor without any extra cost to the Employer.				
1.15.00	All Civil works mentioned in the civil specification or elsewhere in the specification are under the scope of the contractor.				
1.16.00	All Structural Steel work shall be Shop fabricated outside the Plant area.				
2.00.00	SUBMISSIONS				
2.01.00	Commencement of Fabrication, Erection and Construction shall be done after approval of the relevant Design Documents and Drawings. All Drawings shall be of standard sizes (Metric System) and shall be made under AutoCAD, whereas all Documents shall be made either in MS Excel or in MS Word.				
2.02.00	The Design Documents and Drawings shall be submitted for approval of the Employer.				
2.03.00	The Design Documents and Drawings submitted by the Bidder shall contain at least the following Minimum information: a. General Arrangement for Equipment, Piping / Cables / Ducts. b. Loading Plans indicating Floor Imposed Loads, Equipment Loads, Piping / Cables / Ducts Loads. c. General Arrangement of Foundations including Loading Data, Bolt Details, Pocket Details, etc.				
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CLAUSE NO.	CIVIL WORKS 			
	d. Insert Details, Anchor Fastener Details along with their General Arrangements. e. Architectural floor plans, elevations, cross - sections view in colour of all buildings and facilities buildings. f. Drawings of all architectural works including finish schedule, colour scheme (both internal and external), doors & windows, flooring including architectural fascia and projections, miscellaneous architectural details, coping, flashing, khurras, water proofing, fillet, surface drain, rain water down comer, sanitary, plumbing etc. g. General Notes which will be included in construction drawings. h. Scheme of de-watering, steel erection etc. to Engineer at site, for his reference. i. Material Test Certificates to Engineer at site, for his reference. j. As built drawings with quantities of R. C. C., Reinforcement and Structural Steel, after execution of work for information / record including two soft copies of all as-built drawings on Compact Disk (CD) k. Shop drawings / fabrication drawings of all structural steel works (only for reference). l. Project Design Intent Document covering Design Criteria including Loading assumptions, references, structural idealisation / Mathematical Model, Load Cases, Load Combinations, etc. m. Analysis and Structural Design Calculations. n. 3-D Modelling of Structures, including Typical 2-D Structural Frame Analysis. o. Details of Corrosion Protection Measures. p. Any other submission, as indicated elsewhere in this Specification and / or as required by the Employer.			
3.00.00	DESIGN CRITERIA			
3.01.00	General			
3.01.01	The Design criteria given herein are applicable for all Structures.			
3.01.02	Structures shall be Designed for the most critical Combinations of Dead Loads, Imposed Loads, Equipment Loads, Crane Loads (if any), Pipe Loads (Static, Friction and Dynamic), Cable / Ducts Loads, Ash Loads, Dust Loads, Wind Loads, Seismic Loads, Temperature Loads, Erection Loads, Loads due to Differential Settlement, etc.			
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3.02.0 3.02.01 3.02.02 3.02.03 3.02.04 3.02.05 3.02.06	Material For Civil, Structural and Architectural works Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification. Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Mild Steel a) Rolled sections shall conform to grade designation E250, Quality A/BR and shall be semi-killed/ killed conforming to IS: 2062. Plates shall be of Grade designation E250, Quality BR, killed, tested for impact resistance conforming to IS: 2062. Plates beyond 12mm thickness and upto 40mm thickness shall be Normalized rolling. Plates beyond 40mm thickness shall be Vacuum degased & Furnace normalized and shall also be ultrasonically tested as per ASTM-A578 level B-S2. b) Pipes for hand rail shall conform to IS: 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240. d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062. Medium and High Tensile Steel Rolled Sections and plates shall be of grade designation E350, Quality B0, Killed, conforming to IS: 2062. Plates beyond 12mm thickness and upto 40mm thickness shall be normalised rolling. Plates beyond 40mm thickness shall be vacuum degased & furnace normalized and shall also be ultrasonically tested as per ASTM-A578 level B-S2. All other Materials shall be as per applicable Standards and Codes. All Materials brought for incorporation in works shall be of best quality as per IS, unless specified otherwise. Cement Fly ash based Portland pozzolona cement conforming to IS: 1489 Part - I shall preferably be used. Reinforcement steel shall conform to: a) Mild steel grade I of IS: 432 Part – I and grade A of IS: 2062. b) High yield deformed TMT bar of IS: 1786 (Fe. 500) with minimum 14.5 percent elongation.			
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3.02.08	Bricks / Hollow Concrete Blocks Fly ash lime bricks conforming to IS : 12894 or burnt clay fly ash bricks conforming to IS : 13757 shall generally be used. Hollow concrete blocks shall have minimum compressive strength of 50kg / cm2 for works above plinth level. For works below plinth level, solid concrete blocks of minimum compressive strength of 100 kg / cm2 shall be used. The hollow concrete blocks shall conform to IS : 2185C (Part - 1). The mortar used in construction of concrete blocks shall be composite mortar (1 cement : 1 lime : 8 sand). In same structure / building only one type of units (same type of materials shall be used.																
3.03.00	Loading																
3.03.01	Dead Loads (a) Dead Loads are permanent Loads which shall include the weight of Structure complete with finishes, fixtures, partitions, etc. and shall be taken as per IS : 875 (Part-I).																
3.03.02	Imposed Loads (a) Imposed Loads in different areas shall include Live Loads, Erection, Operation and Maintenance Loads. (b) Equipment Loads (which constitute all Loads of Equipment to be supported, as given by Equipment Supplier), Pipe Loads (Static, Friction and Dynamic), Cable / Ducts Loads, Ash Loads, Dust Load, wherever applicable, are not included in the Imposed Loads as furnished below and these Loads shall be considered in addition to Imposed Loads. (c) For consideration of Imposed Loads on Structures, IS : 875 (Part 2) in general shall be followed. However, for the following areas, minimum imposed loads as indicated below shall be considered for the design. If the actual expected Imposed Load is more than the specified Minimum Imposed Load, then actual Imposed Load shall be considered. <table><tr><th>Sl. No.</th><th>Locations / Areas</th><th>Imposed Loads (T. / Sq.m)</th></tr><tr><td>a)</td><td>MCC, AHU Room, Battery Room, Air Washer Room, Compressor House, Operating Floor</td><td>1.50</td></tr><tr><td>b)</td><td>RCC (other floors)</td><td>1.0</td></tr><tr><td>c)</td><td>Covers for Channels Trenches</td><td>0.40 (General) or a central load of 75 Kg., and as per IRC standard at road crossings for vehicular traffic. Trench covers near entry or at crossing shall be designed for</td></tr></table>					Sl. No.	Locations / Areas	Imposed Loads (T. / Sq.m)	a)	MCC, AHU Room, Battery Room, Air Washer Room, Compressor House, Operating Floor	1.50	b)	RCC (other floors)	1.0	c)	Covers for Channels Trenches	0.40 (General) or a central load of 75 Kg., and as per IRC standard at road crossings for vehicular traffic. Trench covers near entry or at crossing shall be designed for
Sl. No.	Locations / Areas	Imposed Loads (T. / Sq.m)															
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			10T wheel load at center.	
	d)	Cable/Pipes/Ducts Supports		0.40 for walkway (in addition friction loads as applicable) Note: Additionally load for cable/piping /ducting shall be considered, as applicable.
	e)	Equipment Lay down Loads.		As per Equipment supplier or 1.00, whichever is more.
	f)	General (Unless Specified Otherwise)		
		i)	Stairs, Landings and Balconies	0.50
		ii)	Toilets	0.20
		iii)	Walkways	0.50
	g)		Roof / Penthouse	
			Non – accessible (with no Equipment)	0.075
		ii)	Accessible	0.150
		iii)	Dust loads	Equivalent to 0.15M of Ash Deposit
3.03.03	Equipment, Piping / Cables / Ducts and associated Loads The Equipment, Piping / Cables / Ducts and associated Loads shall be considered as given by the supplier. Equipment Loads, which are of permanent nature, shall be treated as Dead Loads.			
3.03.04	Crane Loads For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame, according to the provisions of IS : 875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.			
3.03.05	Seismic Loads All Structures shall be designed for Seismic forces adopting the criteria specified in Annexure-I to this Sub-Section of Specification.			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 7 of 77

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3.03.06	Wind Loads All Structures shall be designed for Wind forces as per the criteria specified in Annexure-II to this Sub-Section of specification.																
3.03.07	Temperature Loads (a) For temperature loading, the total temperature variation shall be considered as 2 / 3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily Minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The Structure shall be Designed to withstand Stresses due to 50% of the total temperature variation. (b) Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS : 800 for Steel Structures. (c) Frictional forces due to temperature variation shall be considered between the Pipes and the supporting Structures along Longitudinal direction.																
3.03.08	Ash Density (a) Following Ash density shall be considered for the Design : <table><tr><th>Sl.No.</th><th>Description</th><th>Density (Kg/Cu. M.)</th></tr><tr><td>a)</td><td>Dry Fly Ash for dry fly ash Pipeline Supporting Structures (Pipe to be Considered full)</td><td>1000</td></tr><tr><td>b)</td><td>For ESP supporting structures</td><td>1350</td></tr><tr><td>c)</td><td>For existing ESP Supporting Structures</td><td>1050</td></tr></table>					Sl.No.	Description	Density (Kg/Cu. M.)	a)	Dry Fly Ash for dry fly ash Pipeline Supporting Structures (Pipe to be Considered full)	1000	b)	For ESP supporting structures	1350	c)	For existing ESP Supporting Structures	1050
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3.03.09	Ash Loads a) For New ESP, all ESP Hoppers filled up with ash up to the top of the hopper/ partition plane or the bottom of electrodes (whichever is more) along with additional ash build-up from the end of the third field up to the inlet Duct bottom level at a natural repose angle (not less than 30 degree to horizontal in any case) shall be considered for the Design of ESP supporting Structures. For existing ESPs including proposed additional fields, all ESP Hoppers filled up with ash up to 50% capacity shall be considered for the Design of ESP supporting Structures.																
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3.03.10	b) Ash load over pent house/ roof of ESP shall be considered. Load Dispersion Dispersion of load in any direction through soil shall be as per IS : 8009 (relevant part). Dispersion of load through concrete shall be considered at an angle of 45 degree with horizontal from the edge of contact area.			
3.03.11	Additional Loads due to Employer Facilities (For New ESP) Following Minimum additional Loads supporting the Employer's Facilities shall be considered in the Design of ESP Structures, for the supporting of the Employer's Facilities. (a) Cantilever Loads of not less than 2000 Kg / M at a distance of 1200 mm from the external face of the columns, on both sides of the ESP, for Cable trays and Walkways. (b) Dry Fly Ash Piping Loads. (c) Ash Water Piping Loads. (d) Service Air and Instrument Air Piping. (e) Service Water Piping.			
3.04.00	Design Concepts			
3.04.01	Individual members of the frame shall be Designed for the worst Combination of forces such as bending moment, axial force, shear force, torsion, etc.			
3.04.02	The different Load Combinations shall be taken as per IS : 875 (Part-5) and other relevant IS Codes. (a) Wind and Seismic forces shall not be considered to act simultaneously. (b) Frictional forces from the Pipes and supporting Structure in Longitudinal direction need not be considered along with Seismic or Wind forces. (c) The Structures shall be Designed for most unfavourable Combination of Dead Loads, Imposed Loads, Equipment Loads, Piping/Cables/Ducts Loads, Wind/Seismic Loads, Temperature Loads, Ash Loads, and other applicable Loads without exceeding the Permissible Stresses. (d) Permissible Stresses for different Load Combinations shall be taken as per IS : 800. (e) For checking against uplift/tension case, 75% of Dead Loads with no Imposed Loads shall be considered along with other Loads.			
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	(f) In all Loading Combinations, the Loads that have reduction effect shall not be taken into account in the Combination concerned. (g) Where Wind is the main Load acting on the Structure, no increase in Stresses is to be considered for Design of Structures and Foundation Bolts. (h) Dynamic Piping Loads need not be considered acting simultaneously with Wind or Seismic Loads. Increase in Permissible Stresses shall be allowed in Load Combinations where Dynamic Piping Loads are considered and shall be as permitted under Seismic Load conditions. (i) For the Design of New ESP Supporting Structures for Seismic loads, Ash Load in Hoppers filled up to the top of the Hoppers or bottom of the electrode (whichever is higher) shall be considered as permanent Loads along with other applicable Loads. For the Design of existing ESP Supporting Structures for Seismic loads, Ash Load in Hoppers filled up with ash up to 50% capacity shall be considered as permanent Loads along with other applicable Loads. (j) For the Design of ESP Supporting Structures for Wind, Ash Loads as specified shall be considered as permanent Loads along with other applicable Loads. (k) The plinth / finished floor level of all buildings shall be kept at least 500 mm above existing G. L. / Formation level. (l) Buildings with brickwork cladding shall have minimum one brick or minimum 200 mm thick hollow concrete block cladding on exterior face. (m) Suitable expansion joints shall be provided in the longitudinal direction with provision of twin columns wherever necessary. The maximum distance of the expansion joint shall be as per the provisions of IS : 800 and IS : 456 for steel and concrete structures respectively. (n) All buildings shall be architecturally designed to meet the norms of National building code and local building bye – laws. (o) Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (1 : 1.5 : 3) nominal mix followed by 12 mm thick 1 : 4 cement sand plaster. 3.04.03 The Design of Steel Structures shall be done by Working Stress Method. Design shall be as per the provisions of IS : 800 and other relevant IS standards. For Design of Hoppers IS : 9178 Parts - I, II & III shall be followed. For Design of RCC structures, IS : 456 and other relevant IS standards shall be followed. 3.04.04 Liquid retaining / conveying structures All RCC liquid retaining / conveying structures shall be designed as cracked sections with reduced steel stresses, in accordance with IS : 3370 (Part 1 to 4) by working stress method. The thickness of base slab in liquid retaining / carrying structures shall be minimum 150mm.			
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3.04.05	The minimum reinforcement in each direction shall not be less than 0.24% of the gross cross - sectional area.																	
	All liquid retaining structures shall be tested for water tightness as per the provisions of IS : 3370 and IS : 6494.																	
	Underground structures																	
3.04.06	For design of all underground structures, foundations, ground water table shall be assumed at the finished ground level.																	
	Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest. Coefficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.																	
	Footing																	
3.04.07	Footing of all major structure shall be so proportioned so as to minimize the differential settlement.																	
	All block foundations supporting rotating equipments resting on soil or piles shall be designed using the elastic half space theory. The mass of the RCC block shall not be less than three times the mass of the machine. Dynamic analysis shall be carried out to calculate natural frequencies in all the modes including coupled modes and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down in the relevant codes and / or by machine manufacture whichever is more stringent shall be satisfied. Minimum reinforcement shall be governed by IS : 2974 and IS : 456.																	
	For the foundations supporting minor rotating equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors etc. suitable vibration isolation shall be provided by means of springs, neoprene pads etc. and such vibration isolation system shall be designed suitably.																	
3.04.07	Deflection Criteria																	
	The maximum Deflection for various Structures shall not exceed and be limited to the following:																	
	<table><thead><tr><th>Sl. No.</th><th>Description</th><th>Maximum value of</th></tr></thead><tbody><tr><td>1.</td><td>For all Structures</td><td>Span / 325 or Height / 325, as the case may be unless noted otherwise.</td></tr><tr><td>2.</td><td>For all beams directly supporting Equipment</td><td>Span / 500</td></tr><tr><td>3.</td><td>For all Purlin, Cladding Runners, Roofing / Cladding Sheets</td><td>Span / 250</td></tr><tr><td>4.</td><td>For all Grating / Chequered Plates</td><td>Span / 250</td></tr></tbody></table>				Sl. No.	Description	Maximum value of	1.	For all Structures	Span / 325 or Height / 325, as the case may be unless noted otherwise.	2.	For all beams directly supporting Equipment	Span / 500	3.	For all Purlin, Cladding Runners, Roofing / Cladding Sheets	Span / 250	4.	For all Grating / Chequered Plates
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	(However, the maximum vertical Deflection of Grating / Chequered Plate shall be limited to 6 mm).			
3.04.08	All Structures of the Bidder shall be independent of Employer's Structures unless otherwise specified.			
3.04.09	Welding shall be used for fabrication and Erection. Site connections shall be with Welding / Bolts. For Bolt connection, IS : 4000, IS : 3757, IS : 6623 and IS : 6649 shall be followed. For Welding of Structures IS : 814, IS : 816, IS : 1024, IS : 4353 and IS : 9595 shall be followed.			
3.04.10	RCC Pipe Supports a) For overground pipes supported on R. C. C. pedestals, footing shall be placed at a depth of minimum 1.0M below existing ground level or on weathered / hard rock. b) The top of R. C. C. pedestal shall be at least 500 mm above ground level, unless otherwise specified. c) All ground road crossing unless otherwise specified shall be with R. C. C. culvert with the culvert top generally not more than 100 mm above the road top. Suitable hump with slope of 1:35 shall be provided on the road. Necessary modification, if required, for roadside drains and shoulders shall have to be done. d) For other water body crossings, such as local Nallah, local water bodies, local drains etc. suitable structural arrangement with 800 mm wide walkway shall be provided. Minimum clearance of the bottom of pipeline for all such locations shall be 1.50 M above the High flood level (H. F. L.). e) For any boundary wall crossings, pipe shall be laid through casing pipe / R. C. C. culvert. After laying the pipe, boundary wall shall be restored. f) All pipe crossings with Railway Lines including M. G. R. lines shall be laid by thrust boring for existing lines & by RCC culvert for future envisaged lines. The railway track crossings are to be designed in accordance with railway Standard/RDSO guidelines and all necessary approvals from the concerned Railway authorities shall be obtained by the contractor, without any financial implications to the owner. g) All other road crossings inside the plant area can be either underground or over head road crossings with necessary headroom clearance.			
3.04.11	Pipes, Cables and Ducts Supports (a) All Pipes, Cables and Ducts shall generally be routed above ground.			
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	(b) A Minimum clearance (clear Headroom) of 8 m shall be kept for all over-ground. Pipes / Cables / Ducts for all road / rail crossings. For other areas, the requirement of Minimum clearance shall be as specified elsewhere in the Specifications. Pipes / Cables / Ducts supports shall be provided with continuous walkway of Minimum 750 mm Width with handrails and toe-guards, all along the length with approach ladders near roads, passageways, etc. Before and after the road / rail crossings, a barrier of suitable Height shall be constructed so as to prevent the approach of Cranes (having Height more than 8 m) etc., up to the Pipes / Cables / Ducts supports. (c) In case any main Steel framed Structure of the Employer is existing in close vicinity of the Bidder's Pipes / Cables / Ducts supports, support only from the main framing Structure of the Employer may be permitted by the Employer to the Contractor, for supporting his Pipes / Cables / Ducts. Levels and detail of such supports shall be finalised by the Contractor in consultation with the Employer during his detailed Engineering stage. The Contractor shall supply and provide all such supports. 3.04.12 Whenever Bidder is taking any support from any of the Employer's Structures, the Bidder shall ensure that no damage is done, to the Employer's Structures including Painting thereof. In case of any damage to the Employers Structure and / or Painting, then the Bidder shall rectify the same to the complete satisfaction of the Employer. 3.04.13 Supporting Structures shall be so configured that the temperature of Steel does not exceed 60⁰C unless specified otherwise. 3.04.14 Each ESP Hopper shall be supported at four corners, by providing four columns. ESP Hopper outlet flanges shall be terminated at a height of not less than 3.50M above the finished paving level. 3.04.15 The bracing in Structures shall be provided such that under no circumstances normal / convenient access to any points is blocked or obstructed. 3.04.16 Finished Floor Level of ESP/Collector tank area Paving shall be matched with the existing area paving. 3.04.17 All Base Plates shall be encased. Top of the encasement Concrete shall match with the surrounding finish Paving Level. All stiffeners provided with Base Plate shall also be fully encased and for this purpose the top Level of stiffeners shall be kept by Contractor at least 200 mm below the surrounding finish Paving Level. 3.04.18 Propping / supporting of any Beam on the bracing members shall not be permitted. 3.04.19 All Structures close to railway line shall have clearance conforming to Railway norms. 3.04.20 All Stairs shall have a maximum Riser Height of 180 mm and a Minimum Tread Width of 250 mm. Minimum clear Width of Stairs shall be 1200 mm, unless specified otherwise. 3.04.21 Minimum headroom (free Height) under all Floors, walkways and Stairs shall be 02.30 M.			
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3.04.22	All Foundation Bolts shall conform to IS : 5624.			
3.05.00	Electrodes			
3.05.01	The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium / high tensile steel and for mild steel plate thickness above 20 mm.			
3.05.02	All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.			
3.05.03	Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.			
3.05.04	Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.			
3.05.05	Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.			
3.05.06	The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.			
3.06.00	Edge Preparation for Welding			
3.06.01	Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.			
3.07.00	Pre Heating and Post Heating			
3.07.01	Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.			
3.07.02	Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to at least 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat temperature and this temperature shall be maintained as minimum inter-pass temperature while welding is in progress			
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	TABLE - 1 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL				
	Welding Using				
	Thickness of thicker part at Point of welding	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode		
	Upto and including 20mm	None	None		
	Over 20mm and up to and including 40mm	20°C	Not allowed		
	Over 40mm and up to and including 63mm	66°C	Not allowed		
	Over 63mm	110°C	Not allowed		
	Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.				
	TABLE - 2 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL				
	Welding Using				
	Thickness of thicker part at Point of welding	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode		
	Up to and including 20mm	None	Not Allowed		
	Over 20mm	120°C - 140°C	Not Allowed		
	Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.				
3.07.03	Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.				
3.07.04	Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.				
3.07.05	All butt welds with plates thicker than 50mm shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600°C and rate of application shall be 200°C per hour.				
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3.07.06	The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.			
3.08.00	DISMANTLING WORKS Dismantling of existing structure shall be carried out carefully to prevent damage to other nearby structures/areas. The scope of work under these items shall include making all necessary arrangement for accessing the various areas at height, all tools & tackles required for carrying out the work, taking all safety measures for existing building and other facilities. Before carrying out any dismantling activities, the various existing electrical fittings/fixtures and other existing facility if any are to be suitably removed carefully taking all safety precautions as per the directions of Engineer and the same to be returned to the owner store. The scope of work also includes making good the damaged surface with PCC M20 or as directed by the Engineer without any additional cost to Owner. All serviceable material received from dismantling to be stacked neatly within a lead of 1 km and all un-serviceable material to be disposed off as directed by Engineer.			
4.00.00	MISCELLANEOUS REQUIREMENTS			
4.01.00	Corrosion Protection			
4.01.01	General (a) All structures in the bidder's scope of work and painting of employer's structures which are damaged/ modified by the bidder shall be painted as per the requirements specified in this section of the specification. (b) All equipment, pipes etc. shall be painted as per the requirements specified in other relevant section of the specification. (c) All painting shall be done as per approved Painting scheme of the Vendors/ Manufacturers, which shall be submitted by the bidder and as approved by the Employer. Painting scheme shall also include item codification/ Description of all Coats of Paints as per manufacturer's specification, from whom the paint is intended to be procured.			
~~4.01.02~~	For reinforced concrete work. ~~a. The protection for concrete sub - structure shall be provided based on aggressiveness of the soil, chemical analysis of soil / sub - soil water and presence of harmful chemicals / salts.~~ ~~b. The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion. This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover and use of specified type of cement, reinforcement, coating concrete surface.~~			
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4.01.03	Painting of Steel Surfaces embedded in Concrete. (a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT). (b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.			
4.01.04	Painting of Steel Surfaces (other than those embedded in Concrete) The surfaces shall be cleaned by wire brushing/ mechanical power tool cleaning. Primer coat shall consist of 2 coats of red-oxide zinc-chromate primer (minimum 25 micron Dry Film Thickness – DFT each). Intermediate (Under) coat (minimum 60 micron DFT) shall be of synthetic enamel paint of approved shade and colour as per accepted standards. Top / Finish coat (minimum 50 micron DFT) shall be of synthetic enamel paint of approved shade and colour with glossy finish as per accepted standards.			
4.01.05	Gratings All gratings shall be shot blast cleaned to Sa 2 ½ finish of Swedish standard SIS-05-5900 or cleaned by acid pickling and shall be hot dip galvanised at the rate of 610 Gms / Sq.M.			
4.01.06	Hand Railings and Ladders All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736.			
4.01.07	Sea Worthiness All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.			
4.02.00	Hand Railing			
4.02.01	Minimum 1000 mm high hand railing shall be provided around all Openings, projections / balconies, walkways, platforms, Steel Stairs, etc., All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class).			
4.02.02	Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100 mm high and 6 mm thick).			
4.03.00	Cage Ladders / Ladder It shall be of steel with minimum 20° inclination with the vertical and minimum width of 500mm with pipe 32 mm dia M.S hand rail.			
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4.04.00	GRATING				
4.04.01	All gratings shall be Electro-forged type. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation.				
4.04.02	The Opening size shall not be more than 30 mm X 100 mm. The Minimum thickness of the main bearing bar shall be 5 mm.				
4.04.03	Cutting of gratings shall not be carried out at Site. Any cutting of gratings required to provide passage for Columns / Pipes / Cables / Ducts etc shall be done by the Bidder in Shop and cut edges of Grating shall be suitably reinforced with binding strips.				
4.05.00	FIRE EXITS				
4.05.01	All fire exits shall be Painted with P O Red / signal Red colour shade, which shall not be used anywhere except to indicate the emergency or safety measures. Fire safety norms shall be followed as per National Building Codes and requirements of various statutory bodies shall be followed for providing Fire Exits, Escape Stairs and Fire Fighting Equipment.				
4.06.00	GROUTING				
4.06.01	Non-shrink cementitious flowable grout shall be used for Grouting of pockets and under-pinning work below Base Plate of columns. Nominal thickness of grout shall be 50 mm. Non-shrink cum plasticizer admixture shall be added in the grout. Crushing Strength of the grout shall generally be one grade higher than that of the base Concrete. Minimum grade of grout shall be M30.				
4.06.02	However, for Equipment Foundations, high Strength (Minimum Characteristic Compressive Strength of 60 N / mm ² at 28 days) ready mixed non-shrink, Chloride free, Cement based, free flowing, non-metallic grout as recommended by Equipment manufacturer shall be used. The ready mix grout shall be of reputed make as approved by the Employer.				
4.06.03	The surface to be grouted shall be properly cleaned by using compressed air. Contractor shall provide the required shim plates.				
4.07.00	ROOFING / CLADDING / DECKING SHEETS				
4.07.01	Material a) Wall Cladding & Roofing Material Troughed permanently colour coated sheet of approved shade and colour shall be i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per				
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4.07.02	AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS: 737 and IS:1254. b) Metal Deck Roof Material Troughed permanently colour coated metal decking sheets shall be i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275. Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS:737 and IS:1254 can also be used for metal decking. Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.			
	Colour Coating Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728. Design Criteria For wall cladding insulated / uninsulated and conveyor gallery sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm.			
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4.07.04	For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS: 801 for satisfying the deflection and strength requirements. For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS: 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.				
	Fasteners Side cladding/roofing/decking sheets shall be fixed to the runner/purlins/beams using self-drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location. The profiled metal deck sheets shall be fixed to the structural steel secondary beams/ Purlins using Headed shear anchor studs. The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.				
4.07.05	Miscellaneous Details To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing. Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners.				
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	Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS: 277 Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer. All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer.			
4.08.00	NUTS AND BOLTS			
4.08.01	M. S. Nuts and Bolts shall conform to IS:1363, IS:1364, IS:1367.			
4.08.02	High Tensile fixing with Bolts and nuts shall respectively be as per IS:3757 and IS:6623.			
4.08.03	Washers shall conform to IS:5369, IS:5370, IS:5372, IS:5374, IS:6610, IS:6649, as appropriate.			
~~4.09.00~~	Trenches All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings top level shall be 200 mm above G. L. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover, treads of RCC stairs. Ash slurry trench walls shall be minimum 150 mm thick with reinforcement provided on both inside and outside faces of the wall. The same shall be designed for earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside. 4.10.00 RCC Roof Details Roof slab shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.			
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4.14.04 4.16.01	Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose. Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the materials are mostly rock boulders, these shall be broken into pieces not larger than 150 mm size. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer. In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be paid for utilisation of borrow areas.			
	Architectural Features All architectural features of buildings like control rooms, etc. shall be detailed by contractor's qualified architect. Necessary projections, fins etc. in addition to the minimum specified elsewhere in this specification shall be provided as required. The Contractor for Employer's approval shall submit detailed architectural drawings along with colour schemes. Nothing extra shall be payable for any changes required while getting the drawings / schemes approved and for executing the same. In case structural column base plates are proposed below the floor level, the same shall be encased with adequate cover up to the finished floor level with minimum M - 20 grade concrete. Dowels shall be left from the pedestals to be lapped to the skin reinforcement of the encasing. Glazing Window / ventilator glazing for various locations shall be as below: (i) In transfer houses, crusher house and pump houses etc: a) 6mm thk. multi wall Polycarbonate sheet in tinted shade for inaccessible areas. b) 6mm thk. Toughened glass in plain shade for accessible areas. (ii) In Switchgear / M. C. C. buildings (a) In air conditioned (A / C) areas: Glazing shall consist of clear float glass of 6mm thick on one side and tinted glass 6mm thick on the other side and the two are separated by 12 mm air gap, hermetically sealed by beading of anodized aluminium.			
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4.16.04	~~Bitumastic compound shall conform to IS: 9510. Where the height of bitumastic layer on vertical surface is more than 2.0 m, the bitumastic layer shall be reinforced with diamond pattern expanded metal steel sheets conforming to IS: 412.~~ ~~A. R. tiles shall conform to IS: 4457. 20 mm thk tiles shall be used for battery room.~~ Mortar: Potassium silicate and resin type mortars shall conform to IS : 4832 Parts – I and II respectively.			
	FINISHING SCHEDULE The contractor's scope also includes all doors, windows, glazing, rolling shutters, finishes, damp proofing, inserts, anchor bolts, embedments, stairs, nosing, railings, toe - guards, ladders, edge protection angles, etc. The Contractor shall adhere to the finishing schedule as given. 4.16.05 Flooring I. P. S. (cement concrete flooring) with metallic hardener topping shall be provided for M. C. C. rooms, cable vault / cable spreader rooms, maintenance and unloading areas, general storage areas and all other areas in plant buildings where heavy duty flooring is required. Dust pressed ceramic Tiles (300x300x7 mm thk.) shall be provided for toilets, pantry and general circulation area. Vitrified Ceramic Tiles shall be homogeneous and compact throughout the entire body and shall be fully vitrified. Mirror polished Vitrified ceramic tiles (min 9.5mm thick) with 3mm groove joints as per approved pattern pointed neatly with white cement. Sizes of the tiles shall be as under: a) 600 mm x 600 mm b) 800mm x 800mm Vitrified Ceramic tiles (600x600x9 mm thk.) shall be provided for Office room, C&I control room and conference room. Well polished Kota stone shall be provided for staircases, passages, lobbies and general circulation areas. Concrete chequered tiles (200x200x22 mm thk.) shall be provided for maintenance pathways (min 1.0m wide) on roof and interconnecting pathways (min 2.0m wide) between various facilities. Wherever required, removable metallic false flooring system shall be provided. Nominal height of the false flooring shall be 600 mm. The same shall comprise of special grade steel panels (of size 600x600mm). without any dimensional tolerance 1.2mm thick die cast to shape having 1mm thick top MS sheet spot welded together to form a composite steel panel, sitting on aluminium die casted heads & mounted on steel pedestals of 25mm diameter rod of adjustable height and supporting 1.2mm thick channel frame work at-top and 2mm thick 150x150mm base plate. The top finish shall be 2mm thick antistatic PVC sheet or High pressures laminate. Cavity area below the false flooring shall be made dust proof by using Polyurethane paint.			
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4.16.06	Wherever specified metallic hardener topping shall be minimum 12mm thickness consisting of mix 1 : 2 (1 cement hardner (min) : 2 stone aggregate of 6mm nominal size) by volume, cement hardner mix comprising of 1 part metallic hardner : 4 part of cement mixed dry by weight. Under bed 1 : 2 : 4 PCC with average thickness of 38mm. using uniformly graded iron particles, properly treated. It shall be laid in alternate panels of maximum size of 1mx1m. The topping shall be laid while the underbed is green the underbed surface shall be roughened before laying the topping. Heavy duty (grade-5) dust pressed ceramic tiles (300mmx300mm). Designer ceramic wall tiles of size 300 mm x 200 mm. It shall conform to IS : 13755. Paving details shall be similar to grade slab excluding metallic hardener. Skirting in general shall be 150 mm high. Dado in toilets and pantries shall be up to 2.1 m height from finished floor level. Skirting shall match with the floor finish.						
	Interior Wall / Ceiling Finish For all air - conditioned areas minimum 2 coat of acrylic emulsion paint of approved make and shade. Polymer based water resistant putty (wall putty) shall be used for punning over cement plastered surfaces. The finish Surface shall be smooth and shall be of 2mm nominal thickness. For toilets and pantries Designer ceramic wall tiles of size 300 mm x 200 mm of approved make and shade with approved pattern up to 2.10 m. height from finished floor level shall be provided. 2 coat of Acrylic distemper over one coat of matching primer above 2.10 m height shall be provided. For all other areas 2 coat of Acrylic distemper (IS : 428) of approved shade shall be provided. 2 coats of fire resistant paint (Silicate type) as per IS : 162 shall be provided for all fire doors. For battery room and other areas coming in contact with acid / alkali fumes, chemical resistant chlorinated rubber paint over a coat of primer shall be provided above 2.1 m height. Up to 2.1 m height from finished floor level acid alkali resistant tiles shall be provided as specified elsewhere. All R. C. C. ceilings shall have two coats of Acrylic distemper over one coat of matching primer. 2 coats of Fire resistant paint (silicate type) as per IS:162 shall be provided on all fire doors.						
4.16.07	Exterior Finish The cladding sheets shall be coated with silicon modified paint as specified elsewhere. EXTERIOR PAINTING ON Wall (PREMIUM ACRYLIC SMOOTH EXTERIOR PAINT WITH SILICON ADDITIVES)) The paint shall be (premium acrylic smooth exterior paint with silicon additives) of						
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	approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Employer. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Employer. Preparation of Surface For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Employer after inspection before painting is commenced. Application of Base Coat Base coat shall be of water proofing cement paint. Preparation of Mix for Base Coat Cement Paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement Paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement Paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement Paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously. The lids of cement Paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement Paint rapidly becomes air set due to its hygroscopic qualities. In case of cement Paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere. Application of Base Coat The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work. The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted. For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade.			
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4 16.08	Precaution Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces. If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement. Application of exterior paint Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Employer shall be followed meticulously. The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.			
	TOILET One Toilet shall be provided in building having offices or control room or as required by the owner. Each toilets shall be provided with following fittings. 1No. WC Indian type (Orissa pan, 580 x 440mm IS : 2556 Part - 3) with all fittings including flushing valve of appropriate capacity and type (WC to be European type in case of attached toilets). 1 No. lipped urinal (IS : 2556 part - 6 / sec – 1) with all fittings with photo voltaic control flushing cistern and vitreous china partition slab (IS : 2556 part - 6 / Sec - 1). 1 No. Wash basin oval shape with all fittings as per IS : 2556 to be fixed on concrete platform finished with one piece 18mm thick polished granite stone and float glass mirror (1200 x 900 x 5.5mm) with beveled edges. - Stainless steel towel rods 600mm x 20mm – 1 No. - Stainless steel Liquid soap holder cum dispenser – 1 No. - Stainless Steel paper holder-1No. - Stainless Steel hand drier – 1 No.			
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5.00.00	STATUTORY REQUIREMENTS			
5.01.00	Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules, Water Act for pollution control, Explosives Acts, etc.			
5.02.00	Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include railing, fire escape, etc.			
5.03.00	Provisions for Fireproof Doors, number of Staircases, etc. shall be made according to the requirements of Statutory Bodies.			
5.04.00	Statutory clearances and norms of State Pollution Control Board shall be followed.			
6.00.00	PERMISSIBLE TOLERANCES			
6.01.01	Tolerances on dimensions for fabrication of Steel Structures shall be according to IS:7215.			
6.01.02	Tolerances on dimensions for Erection of Steel Structures shall be according to IS:12843.			
6.01.03	Tests on Welds shall be as per ASTM standards, IS:816 and IS:9595.			
6.01.04	Dimensional and weight tolerance of Rolled Steel shapes shall be as per IS:1852.			
7.00.00	LIST OF CODES AND STANDARDS			
7.00.01	All applicable standards, references, Specifications, Codes of practice, etc., shall be the latest edition including all applicable official amendments and revisions. A complete set of all these documents shall be available at Site with Bidder.			
7.00.02	EXCAVATION AND FILLING IS : 2720 (Part - II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils – determination for water content etc. IS : 4701 Code of practice for earth work on canals. IS : 9758 Guide lines for Dewatering during construction IS : 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub - grade.			
7.00.03	PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIALS			
7.00.04	CAST - IN - SITU CONCRETE AND ALLIED WORKS IS : 280 Specification for mild steel wire for general engineering purposes. IS : 456 Code of practice for plain and reinforced concrete.			
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	IS : 457 Code of practice for general construction of plain & reinforced concrete for dams & other massive structures. IS : 516 Method of test for strength of concrete. IS : 650 Specification for standard sand for testing of cement. IS : 1199 Methods of sampling and analysis of concrete. IS : 1791 General requirements for batch type concrete mixers. IS : 1838 Specification for preformed fillers for expansion (Part - I) joints in concrete pavements and structures (non - extruding and resilient type). IS : 2438 Specification for roller pan mixer. IS : 2502 Code of practice for bending and fixing of bars for concrete reinforcement. IS : 2505 General requirements for concrete vibrators, immersion type. IS : 2506 General requirements for concrete vibrators, screed board type. IS : 2514 Specification for concrete vibrating tables. IS : 2645 Specification for Integral cement water proofing compounds. IS : 2722 Specification for portable swing weigh batches for concrete. (single and double bucket type) IS : 2750 Specification for Steel scaffolding. IS : 2751 Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction. IS : 3025 Methods of sampling and test waste water. IS : 3366 Specification for Pan vibrators. IS : 3370 (Part I to IV) Code of practice for concrete structures for the storage of liquids. IS : 3414 Code of practice for design and installation of joints in buildings. IS : 3550 Methods of test for routine control for water used in industry. IS : 3558 Code of practice for use of immersion vibrators for consolidating concrete.			
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	IS : 4014 (Parts I & II) Code of practice for steel tubular scaffolding. IS : 4326 Code of practice for earthquake resistant design and construction of buildings. IS : 4656 Specification for form vibrators for concrete. IS : 4925 Specification for batching and mixing plant. IS : 4990 Specification for plywood for concrete shuttering work. IS : 5256 Code or practice for sealing joints in concrete lining on canals. IS : 5525 Recommendations for detailing of reinforcement in reinforced concrete work. IS : 5624 Specification for foundation bolts. IS : 6461 Glossary of terms relating to cement concrete. IS : 6494 Code of practice for water proofing of underground water reservoirs and swimming pools. IS : 6509 Code of practice for installation of joints in concrete pavements. IS : 7861 Code of practice for extreme weather concreting. (Parts I & II) IS : 9012 Recommended practice for shot concreting. IS : 9103 Specification for admixtures for concrete. IS : 9417 Recommendations for welding cold worked steel bars for reinforced concrete construction. IS : 10262 Recommended guidelines for concrete mix design. IS : 11384 Code of practice for composite construction in structural steel and concrete. IS : 12118 Specification for two - parts poly sulphide. IS : 12200 Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams. IS : 13311 Method of non - destructive testing of concrete. Part - 1 Ultrasonic pulse velocity. Part - 2 Rebound hammer.			
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7.00.05	SP : 23	Handbook of concrete mixes		
	SP : 24	Explanatory Handbook on IS : 456 - 1978		
	SP : 34	Handbook on concrete reinforcement and detailing.		
	PRECAST CONCRETE WORKS			
	SP : 7 (PartVI / Sec.7)	National Building Code - Structural design of prefabrication and systems building.		
7.00.06	IS : 10297	Code of practice for design and construction of floors and roofs using precast reinforced / prestressed concrete ribbed or cored slab units.		
	IS : 10505	Code of practice for construction of floors and roofs using pre - cast reinforced concrete units.		
	MASONRY AND ALLIED WORKS			
	IS : 1905	Code of Practice for Structural Safety of Buildings – Masonry walls.		
	IS : 2212	Code of Practice for Brickwork.		
7.00.07	IS : 2250	Code of Practice for Preparation and use of Masonry Mortar.		
	SP : 20	Explanatory hand book on masonry code.		
	FABRICATION AND ERECTION OF STRUCTURAL STEEL WORK			
	IS : 2016	Specification for plain washers.		
	IS : 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.		
	IS : 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.		
	IS : 3502	Specifications for chequered plate.		
	IS : 6911	Specification for stainless steel plate, sheet and strip.		
	IS : 3757	Specification for high strength structural bolts		
	IS : 6623	Specification for high strength structural nuts.		
	IS : 6649	High Tensile friction grip washers.		
	IS : 800	Code of practice for use of structural steel in general building construction.		
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW) BIDDING DOC. NO.: CS-4210-104A(R&M)-2 TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP PART – B SUB-SECTION-IV-C CIVIL Page 38 of 77				

CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC		
7.00.08	IS : 816	Code of practice for use of Metal Arc Welding for General Construction.			
	IS : 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.			
	IS : 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.			
	IS : 817	Code of practice for Training and Testing of Metal Arc Welders.			
	IS : 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).			
	IS : 7215	Tolerances for fabrication steel structures.			
	IS : 12843	Tolerance for erection of structural steel.			
	IS : 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.			
	SP : 6 (Part 1 to 7)	ISI Hand book for structural Engineers.			
	IS : 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.			
	IS : 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube			
	IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.			
	IS : 2595	Code of Practice for Radio graphic testing.			
	IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.			
	IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.			
	IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.			
	IS : 3658	Code of practice for Liquid penetrant Flaw Detection.			
	IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.			
		PLASTERING AND ALLIED WORKS			
	IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 39 of 77

CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC			
7.00.09	IS : 1661 Application of cement and cement lime plaster finishes. IS : 2333 Plaster - of - paris. IS : 2402 Code of practice for external rendered finishes. IS : 2547 Gypsum building plaster. IS : 3150 Hexagonal wire netting for general purpose.			
	WATER SUPPLY, DRAINAGE AND SANITATION IS : 458 Specification for concrete pipes. IS : 554 Dimensions for pipe threads, where pressure tight joints are made on thread. IS : 651 Specification for salt glazed stoneware pipes. IS : 774 Flushing cisterns for water closets and urinals. IS : 775 Cast iron brackets and supports for wash basins and sinks. IS : 778 Copper alloy gate, globe and check valves for water works purposes. IS : 781 Cast copper alloy screw down bib taps and stop valves for water services. IS : 782 Caulking lead. IS : 783 Code of practice for laying of concrete pipes. IS 805 Code of Practice for Use of Steel in Gravity Water Tanks IS : 1172 Basic requirements for water supply, drainage and sanitation. IS : 1230 Cast iron rain water pipes and fittings. IS : 1239 Mild steel tubes, tubulars and other wrought steel fittings. IS : 1536 Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage. IS : 1537 Vertically cast iron pressure pipes for water, gas and sewage. IS : 1538 Cast iron fittings for pressure pipe for water, gas and sewage.			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 40 of 77

CLAUSE NO.	CIVIL WORKS 			
	IS : 1703 Ball valves (horizontal plunger type) including float for water supply purposes. IS : 1726 Cast iron manhole covers and frames. IS : 1729 Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories. IS : 1742 Code of practice for building drainage. IS : 1795 Pillar taps for water supply purposes. IS : 1879 Malleable cast iron pipe fittings. IS : 2064 Code of practice for selection, installation and maintenance of sanitary appliances. IS : 2065 Code of practice for water supply in building. IS : 2326 Automatic flushing cisterns for urinals. IS : 2470 (Part - I & II) Code of practice for installation of septic tanks. IS : 2501 Copper tubes for general engineering purposes. IS : 2548 Plastic seat and cover for water - closets. IS : 2556 (Part 1 to 15) Vitreous sanitary appliances (vitreous china). IS : 2963 Non - ferrous waste fittings for wash basins and sinks. IS : 3114 Code of practice for laying of cast iron pipes. IS : 3311 Waste plug and its accessories for sinks and wash basins. IS : 3438 Silvered glass mirrors for general purposes. IS : 3486 Cast iron spigot and socket drain pipes. IS : 3589 Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter). IS : 3989 Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories. IS : 4111 (Part I to IV) Code of practice for ancillary structure in sewerage system. IS : 4127 Code of practice for laying of glazed stone - ware pipes.			
KAHALGAON SUPER THERMAL POWER STATION STAGE -I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 41 of 77

CLAUSE NO.	CIVIL WORKS		एन टी पी सी NTPC		
7.00.10	IS : 4764	Tolerance limits for sewage effluents discharged into inland - surface waters.			
	IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.			
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.			
	IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.			
	IS : 5822	Code of practice for laying of welded steel pipes for water supply.			
	IS : 5961	Cast iron grating for drainage purpose.			
	IS : 7740	Code of practice for road gullies.			
	IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.			
	IS : 8934	Cast copper alloy fancy pillar taps for water services.			
	IS : 9762	Polyethylene floats for ball valves.			
	IS : 10446	Glossary of terms for water supply and sanitation.			
	IS : 10592	Industrial emergency showers, eye and face fountains and combination units.			
	IS : 12592	Specification for precast concrete manhole covers and frames.			
	IS : 12701	Rotational moulded polyethylene water storage tanks.			
	SP : 35	Hand book on water supply and drainage.			
	-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.			
		DOORS, WINDOWS AND ALLIED WORKS			
	IS : 204	Tower Bolts			
	Part – I	Ferrous metals.			
	Part – II	Nonferrous metals.			
	IS : 208	Door Handles.			
	IS : 281	Mild steel sliding door bolts for use with padlocks.			
	IS : 362	Parliament Hinges.			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 42 of 77

CLAUSE NO.	CIVIL WORKS एन टी पी सी NTPC			
	IS : 420 Specification for putty, for use on metal frames. IS :1003 (Part-I) Specification for timber panelled and glazed shutters - Part - I door shutters. IS : 1038 Steel doors, windows and ventilators. IS : 1081 Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators. IS : 1341 Steel butt hinges. IS : 1361 Steel windows for industrial buildings. IS : 1823 Floor door stoppers. IS : 1868 Anodic coatings on Aluminium and its alloys. IS : 2202 (Part - II) Specification for wooden flush door shutters (solid core type) : particle board face panels and hard board face panels IS : 2209 Mortice locks (vertical type). IS : 2553 Safety glass IS : 2835 Flat transparent sheet glass. IS : 3548 Code of practice for glazing in buildings. IS : 3564 Door closers (Hydraulically regulated). IS : 3614 Fire check doors; plate, metal covered and rolling type. IS : 4351 Steel door frames. IS : 5187 Flush bolts. IS : 5437 Wired and figured glass IS : 6248 Metal rolling shutters and rolling grills. IS : 6315 Floor springs (hydraulically regulated) for heavy doors. IS : 7196 Hold fasts. IS : 7452 Hot rolled steel sections for doors, windows and ventilators. IS : 10019 Mild steel stays and fasteners. IS : 10451 Steel sliding shutters (top hung type). IS : 10521 Collapsible gates.			
KAHALGAON SUPER THERMAL POWER STATION STAGE -I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 43 of 77

CLAUSE NO.	CIVIL WORKS 			
7.00.11	ROOF WATER PROOFING AND ALLIED WORKS IS : 1203 Methods of testing tar and bitumen. IS : 1322 Specification for bitumen felts for water proofing and damp proofing. IS : 1346 Code of practice for water proofing of roofs with bitumen felts. IS : 1580 Specification for bituminous compound for water proofing and caulking purposes. IS : 3067 Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings. IS : 3384 Specification for bitumen primer for use in water proofing and damp proofing.			
7.00.12	FLOOR FINISHES AND ALLIED WORKS IS : 1237 Specification for cement concrete flooring tiles. IS : 1443 Code of practice for laying and finishing of cement concrete flooring tiles. IS : 2114 Code of practice for laying in - situ terrazzo floor finish. IS : 2571 Code of practice for laying in - situ cement concrete flooring. IS : 3462 Specification for unbacked flexible PVC flooring. IS : 4971 Recommendations for selection of industrial floor finishes. IS : 5318 Code of practice for laying of flexible PVC sheet and tile flooring. IS : 8042 Specification for white portland cement. IS : 13801 Specification for chequered cement concrete flooring tiles.			
7.00.13	PAINTING AND ALLIED WORKS IS : 162 Specification for fire resisting silicate type, brushing, for use on wood, colour as required. IS : 1477 Code of practice for painting of ferrous metals in buildings. Part – I Pretreatment. Part - II Painting.			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 44 of 77

CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC		
7.00.14	IS : 1650	Specification for colours for building and decorative finishes.			
	IS : 2074	Specification for red oxide - zinc chrome, priming, ready mixed paint air drying.			
	IS : 2338	Code of practice for finishing of wood and wood based materials.			
	Part - I	Operations and workmanship			
	Part - II	Schedules			
	IS : 2395	Code of practice for painting concrete, masonry and plaster surfaces.			
	Part - I	Operations and workmanship.			
	Part - II	Schedule.			
	IS : 2524	Code of practice for painting of nonferrous metals in buildings.			
	Part - I	Pretreatment.			
	Part - II	Painting.			
	IS : 2932	Specification of synthetic enamel paint, exterior, under - coating and finishing.			
	IS : 2933	Specification enamel paint, under coating and finishing.			
	IS : 4759	Code of practice for hot dip zinc coating on structural steel and other allied products.			
	IS : 5410	Specification for cement paint			
	IS : 5411 (Part - I)	Specification for plastic emulsion paint - for exterior use			
	IS : 6278	Code of practices for white washing and colour washing.			
	IS : 10403	Glossary of terms relating to building finishes.			
	PILING AND FOUNDATION				
	IS : 1080	Code of practice for design and construction of simple spread foundations.			
IS : 1904	Code of practice for design and construction of foundations in Soils; General Requirements.				
KAHALGAON SUPER THERMAL POWER STATION STAGE -I (4 x 210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 45 of 77

CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC			
	IS : 2950 (Part-I) Code of practice for designs and construction of Raft foundation. IS : 2974 (Part-I TO V) Code of practice for design and construction of machine foundations. IS : 6403 Code of practice for determination of Allowable Bearing pressure on Shallow foundation. IS : 8009 Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads. Part - I Shallow foundations. Part - II Deep foundations. IS : 12070 Code of practice for design and construction of shallow foundations on rocks. DIN : 4024 Flexible supporting structures for machines with rotating machines. VDI : 2056 Criteria for assessing mechanical vibrations of machines. VDI : 2060 Criteria for assessing rotating imbalances in machines.			
7.00.15	STOP LOG AND TRASH RACK IS : 4622 Recommendations for fixed - wheel gates structural design. IS : 5620 Recommendations for structural design criteria for low head slide gates. IS : 11388 Recommendations for design of trash rack for intakes. IS : 11855 General requirements for rubber seals for hydraulic gates.			
7.00.16	ROADS IRC : 5 Standard specifications and Code of practice for road bridges, section - I general Features of Design. IRC : 14 Recommended practice of 2cm thick bitumen and tar carpets. IRC : 16 Specification for priming of base course with bituminous primers. IRC : 19 Standard specifications and code of practice for water bound macadam.			
KAHALGAON SUPER THERMAL POWER STATION STAGE -I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 46 of 77

CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC		
7.00.17	IRC : 21	Standard specifications and Code of practice for road bridges, section - III - Cement concrete (plain and reinforced).			
	IRC : 37	Guidelines for the Design of flexible pavements.			
	IRC : 86	Geometric Design standards for urban roads in plains.			
	IRC : SP : 13	Guidelines for the design of small bridges & culverts.			
	IRC – Publication	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.			
	IS : 73	Specification for paving bitumen			
	Loading				
	IS : 875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.			
	IS : 1893	Criteria for earthquake resistant design of structures.			
	IS : 4091	Code of Practice for design and construction of foundation for transmission line towers & poles.			
7.00.18	IRC : 6	Standard specifications & code of practice for road bridges, Section - II Loads and stresses.			
	M.O.T.	Deptt. of railways Bridge Rules.			
	SAFETY				
	IS : 3696 (Part I & II)	Safety code for scaffolds and ladders.			
	IS : 3764	Safety code for excavation work.			
	IS : 4081	Safety code for blasting and related drilling operations.			
	IS : 4130	Safety code for demolition of buildings.			
	IS : 5121	Safety code for piling and other deep foundations.			
	IS : 5916	Safety code for construction involving use of hot bituminous materials.			
	IS : 7205	Safety code for erection on structural steelwork.			
	IS : 7293	Safety code for working with construction machinery.			
	IS : 7969	Safety code for handling and storage of building materials			
	IS : 11769	Guidelines for safe use of products containing asbestos.			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 47 of 77

CLAUSE NO.	CIVIL WORKS 			
7.00.19	Indian Explosives Act. 1940 as updated. Acid and Alkali Resistant Lining IS : 158 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali && heat resisting. IS : 412 Expanded metal steel sheets for general purpose. IS : 4441 Code of practice for use of silica type chemical resistant mortars. IS : 443 Code of practice for use of resin type chemical resistant mortars. IS: 4456 (Part 1&2) Method of test for chemical resistant mortars. IS : 4457 Ceramic unglazed vitreous acid resisting tiles. IS : 4832 Specification for chemical resistant mortars. Part – 1 Silicate type Part – 2 Resin type Part – 3 Sulphur type IS : 48660 Acid resistant bricks IS : 9510 Bitumen mastic acid resisting grade.			
7.00.20	Architectural design of buildings National building code			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 48 of 77

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-A.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-A includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a) Steel structures	:	2%
b) Reinforced Concrete structures	:	5%
c) Reinforced Concrete Stacks	:	3%
d) Steel stacks	:	2%



Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.

For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B .

Design/Detailing for Ductility for Structures

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.



KAHALGAON STPP

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

- 1) Peak ground horizontal acceleration : 0.28g
- 2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra
 - a) for moment resisting steel frames designed and detailed as per IS:800 and moment resisting RC frames designed and detailed as per IS:456 : 0.07
 - b) for braced steel frames designed and detailed as per IS:800 : 0.053
 - c) for moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.042
 - d) for design of structures not covered under 2 (a) to 2 (c) above and under 3 below : 0.07
- 3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.14

Notes:

1. g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.



APPENDIX – A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS In units of 'g' for KAHALGAON STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.50%	2%	3%	5%
0.000	1.000	1.000	1.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000	1.000	1.000	1.000
0.050	1.796	1.760	1.686	1.626	1.537	1.416
0.050	1.796	1.760	1.686	1.626	1.537	1.416
0.100	3.974	3.792	3.427	3.146	2.753	2.270
0.100	3.974	3.792	3.427	3.146	2.753	2.270
0.119	4.842	4.597	4.094	3.713	3.186	2.556
0.120	4.842	4.627	4.130	3.742	3.209	2.570
0.122	4.842	4.627	4.206	3.802	3.254	2.600
0.125	4.842	4.627	4.206	3.879	3.321	2.643
0.129	4.842	4.627	4.206	3.879	3.340	2.700
0.134	4.842	4.627	4.206	3.879	3.340	2.776
0.150	4.842	4.627	4.206	3.879	3.340	2.776
0.200	4.842	4.627	4.206	3.879	3.340	2.776
0.250	4.842	4.627	4.206	3.879	3.340	2.776
0.300	4.842	4.627	4.206	3.879	3.340	2.776
0.350	4.842	4.627	4.206	3.879	3.340	2.776
0.400	4.842	4.627	4.206	3.879	3.340	2.776
0.450	4.842	4.627	4.206	3.879	3.340	2.776
0.500	4.842	4.627	4.206	3.879	3.340	2.776
0.550	4.842	4.627	4.206	3.879	3.340	2.776
0.594	4.842	4.627	4.206	3.879	3.340	2.776
0.598	4.806	4.627	4.206	3.879	3.340	2.776
0.600	4.793	4.615	4.206	3.879	3.340	2.776
0.611	4.707	4.532	4.205	3.879	3.340	2.776
0.632	4.551	4.381	4.065	3.878	3.340	2.776
0.654	4.395	4.231	3.926	3.745	3.340	2.776
0.671	4.286	4.127	3.829	3.653	3.258	2.776
0.700	4.109	3.956	3.670	3.501	3.123	2.661
0.750	3.835	3.692	3.425	3.268	2.915	2.484
0.800	3.595	3.461	3.211	3.064	2.733	2.329
0.850	3.384	3.258	3.022	2.884	2.572	2.192
0.900	3.196	3.077	2.854	2.723	2.429	2.070
0.950	3.027	2.915	2.704	2.580	2.301	1.961
1.000	2.876	2.769	2.569	2.451	2.186	1.863
1.050	2.739	2.637	2.447	2.334	2.082	1.774

APPENDIX – A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for KAHALGAON STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.50%	2%	3%	5%
1.100	2.615	2.517	2.335	2.228	1.987	1.694
1.150	2.501	2.408	2.234	2.131	1.901	1.620
1.200	2.397	2.308	2.141	2.043	1.822	1.553
1.250	2.301	2.215	2.055	1.961	1.749	1.490
1.300	2.212	2.130	1.976	1.885	1.682	1.433
1.350	2.130	2.051	1.903	1.816	1.619	1.380
1.400	2.054	1.978	1.835	1.751	1.561	1.331
1.450	1.983	1.910	1.772	1.690	1.508	1.285
1.500	1.917	1.846	1.713	1.634	1.457	1.242
1.550	1.855	1.786	1.657	1.581	1.410	1.202
1.600	1.798	1.731	1.606	1.532	1.366	1.164
1.650	1.743	1.678	1.557	1.485	1.325	1.129
1.700	1.692	1.629	1.511	1.442	1.286	1.096
1.750	1.643	1.582	1.468	1.401	1.249	1.065
1.800	1.598	1.538	1.427	1.362	1.214	1.035
1.850	1.555	1.497	1.389	1.325	1.182	1.007
1.900	1.514	1.457	1.352	1.290	1.151	0.981
1.950	1.475	1.420	1.317	1.257	1.121	0.955
2.000	1.438	1.385	1.285	1.226	1.093	0.932
2.050	1.403	1.351	1.253	1.196	1.066	0.909
2.100	1.370	1.319	1.223	1.167	1.041	0.887
2.150	1.338	1.288	1.195	1.140	1.017	0.867
2.200	1.307	1.259	1.168	1.114	0.994	0.847
2.250	1.278	1.231	1.142	1.089	0.972	0.828
2.300	1.250	1.204	1.117	1.066	0.950	0.810
2.350	1.224	1.178	1.093	1.043	0.930	0.793
2.400	1.198	1.154	1.070	1.021	0.911	0.776
2.450	1.174	1.130	1.049	1.000	0.892	0.760
2.500	1.150	1.108	1.028	0.980	0.874	0.745
2.550	1.128	1.086	1.007	0.961	0.857	0.731
2.600	1.106	1.065	0.988	0.943	0.841	0.717
2.650	1.085	1.045	0.969	0.925	0.825	0.703
2.700	1.065	1.026	0.951	0.908	0.810	0.690
2.750	1.046	1.007	0.934	0.891	0.795	0.677
2.800	1.027	0.989	0.918	0.875	0.781	0.665
2.850	1.009	0.972	0.901	0.860	0.767	0.654



APPENDIX – A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS In units of 'g' for KAHALGAON STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.50%	2%	3%	5%
2.900	0.992	0.955	0.886	0.845	0.754	0.642
2.950	0.975	0.939	0.871	0.831	0.741	0.632
3.000	0.959	0.923	0.856	0.817	0.729	0.621
3.050	0.943	0.908	0.842	0.804	0.717	0.611
3.100	0.928	0.893	0.829	0.791	0.705	0.601
3.150	0.913	0.879	0.816	0.778	0.694	0.591
3.200	0.899	0.865	0.803	0.766	0.683	0.582
3.250	0.885	0.852	0.790	0.754	0.673	0.573
3.300	0.872	0.839	0.778	0.743	0.662	0.565
3.350	0.859	0.827	0.767	0.732	0.653	0.556
3.400	0.846	0.814	0.756	0.721	0.643	0.548
3.450	0.834	0.803	0.745	0.710	0.634	0.540
3.500	0.822	0.791	0.734	0.700	0.625	0.532
3.550	0.810	0.780	0.724	0.690	0.616	0.525
3.600	0.799	0.769	0.714	0.681	0.607	0.518
3.650	0.788	0.759	0.704	0.672	0.599	0.510
3.700	0.777	0.748	0.694	0.662	0.591	0.504
3.750	0.767	0.738	0.685	0.654	0.583	0.497
3.800	0.757	0.729	0.676	0.645	0.575	0.490
3.850	0.747	0.717	0.666	0.637	0.568	0.484
3.900	0.737	0.699	0.649	0.628	0.561	0.478
3.950	0.728	0.681	0.633	0.604	0.553	0.472
4.000	0.719	0.664	0.617	0.589	0.547	0.466



CLAUSE NO.	CIVIL WORKS				एनटीपीसी NTPC												
	ANNEXURE-II CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Appendix – B for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a)</td><td>Welded steel structures</td><td>1.0%</td></tr><tr><td>b)</td><td>Bolted steel structures</td><td>2.0%</td></tr><tr><td>c)</td><td>Reinforced concrete structures</td><td>1.6%</td></tr><tr><td>d)</td><td>Steel stacks</td><td>As per IS:6533 & CICIND Model Code whichever is more critical.</td></tr></table>					a)	Welded steel structures	1.0%	b)	Bolted steel structures	2.0%	c)	Reinforced concrete structures	1.6%	d)	Steel stacks	As per IS:6533 & CICIND Model Code whichever is more critical.
a)	Welded steel structures	1.0%															
b)	Bolted steel structures	2.0%															
c)	Reinforced concrete structures	1.6%															
d)	Steel stacks	As per IS:6533 & CICIND Model Code whichever is more critical.															
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 55 of 77													

CLAUSE NO.	CIVIL WORKS			एन टी पी सी NTPC
	APPENDIX-B			
	SITE SPECIFIC DESIGN PARAMETERS			
	The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:			
	a)	The basic wind speed “V _b ” at ten metres above the mean ground level	47 metres/second	
	b)	The risk coefficient “K ₁ ”	1.07	
c)	Category of terrain	Category-2		
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-IV-C CIVIL	Page 56 of 77

SUB-SECTION-II-E

**DETAILED TECHNICAL SPECIFICATION
(ELECTRICAL SYSTEMS)**

SUB-SECTION-II-E-02

MOTORS

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	MOTORS			
1.00.00	GENERAL REQUIREMENTS			
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.			
1.02.00	All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.			
1.03.00	Contractor shall provide fully compatible electrical system, equipments, accessories and services.			
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.			
1.05.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.			
1.06.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances for contractors equipment and systems shall be under the contractor scope.			
1.07.00	Degree of Protection			
	Degree of protection for various enclosures as per IS:4691, IEC60034-05 shall be as follows :-			
	i)	Indoor motors	-	IP 54
	ii)	Outdoor motors	-	IP 55
	iii)	Cable box-indoor area	-	IP 54
	iv)	Cable box-Outdoor area	-	IP 55
2.00.00	CODES AND STANDARDS			
	1)	Three phase induction motors	:	IS:325, IEC:60034
	2)	Single phase AC motors	:	IS:996, IEC:60034
	3)	Crane duty motors	:	IS:3177, IEC:60034
	4)	DC motors/generators	:	IS:4722, IEC:60034
	5)	Energy Efficient motors	:	IS 12615, IEC:60034-30
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-02 MOTORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
3.00.00 3.01.00 3.02.00 4.00.00 5.00.00 6.00.00 6.01.00 6.01.01 6.01.02	TYPE AC Motors: a) Squirrel cage induction motor suitable for direct-on-line starting. b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement. DC Motors Shunt wound. RATING (a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. (b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations. (c) For BFP motors starting MVA shall be restricted to 60 MVA. TEMPERATURE RISE Air cooled motors 70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation. Water cooled 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation. OPERATIONAL REQUIREMENTS Starting Time For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time. For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-02 MOTORS	Page 2 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.			
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.			
6.02.00	Torque Requirements			
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.			
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.			
6.03.00	Starting voltage requirement (a) Up to 85% of rated voltage for ratings below 110 KW (b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW (c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW (d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW (e) Up to 75 % of rated voltage for ratings above 4000KW Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.			
7.00.00	DESIGN AND CONSTRUCTIONAL FEATURES			
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.			
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below (a) Fuel oil area : Group – IIB (b) Hydrogen generation :Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-02 MOTORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
7.03.00	Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (c) 6.6 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better				
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.				
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.				
7.06.00	Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.				
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.				
7.08.00	Motor body shall have two earthing points on opposite sides.				
7.09.00	HT motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. In case cable box is offered, then contractor shall provide termination kit. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.				
7.11.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-02 MOTORS	Page 4 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS																
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.																
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.																
7.15.00	6.6 KV Terminal Box shall be suitable for fault level of 500MVA for 0.12 second. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.																
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor. <table border="0"> <tr> <td>(a) Below 110KW</td><td>:</td><td>10.0</td></tr> <tr> <td>(b) From 110 KW & upto 200 KW</td><td>:</td><td>9.0</td></tr> <tr> <td>(c) Above 200 KW & upto 1000KW</td><td>:</td><td>10.0</td></tr> <tr> <td>(d) From 1001KW & upto 4000KW</td><td>:</td><td>9.0</td></tr> <tr> <td>(e) Above 4000KW</td><td>:</td><td>6 to 6.5</td></tr> </table>	(a) Below 110KW	:	10.0	(b) From 110 KW & upto 200 KW	:	9.0	(c) Above 200 KW & upto 1000KW	:	10.0	(d) From 1001KW & upto 4000KW	:	9.0	(e) Above 4000KW	:	6 to 6.5	
(a) Below 110KW	:	10.0															
(b) From 110 KW & upto 200 KW	:	9.0															
(c) Above 200 KW & upto 1000KW	:	10.0															
(d) From 1001KW & upto 4000KW	:	9.0															
(e) Above 4000KW	:	6 to 6.5															
9.00.00	CW Motor shall be designed with minimum power factor of 0.8 at design point.																
10.00.00	TYPE TEST																
10.01.00	HT MOTORS																
10.01.01	The contractor shall carry out the type tests as listed in this specification on the equipment 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- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.																
10.01.02	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall 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.																
10.01.03	In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the employer for waiver of conductance of such 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																
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP															
PART – B SUB-SECTION II- E-02 MOTORS	Page 5 of 9																

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC
10.01.04	conducted at an independent laboratory or should have been witnessed by a client. The employer 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. Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED "and carried out within last ten years 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. However if the 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 employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.				
10.01.05	LIST OF TYPE TESTS TO BE CONDUCTED The following type tests shall be conducted on each type and rating of HT motor (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test (subject to test bed constraint) (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.				
10.01.06	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of HT motor (a) Degree of protection test for the enclosure followed by IR, HV and no load run test. (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-02 MOTORS	Page 6 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15				
10.02.00	LT Motors				
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for employer’s approval the reports of all the type tests as listed in this specification and carried out within last <i>ten</i> years 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.				
10.02.02	However if the 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 employer either at third party lab or in presence of client/ employer’s representative and submit the reports for approval.				
10.02.03	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip. 5. Temperature rise test. 6. Momentary excess torque test. 7. High voltage test. 8. Test for vibration severity of motor. 9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section) 10. Test for degree of protection and				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-02 MOTORS	Page 7 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS				
11. Overspeed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1 10.03.00 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. 10.04.00 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.					
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-02 MOTORS	Page 8 of 9	

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC																																		
	TABLE - I DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS <table><tr><th>Motor MCR in KW of</th><th>Minimum distance between centre stud and gland plate in mm As per manufacturer's practice.</th></tr><tr><td>UP to 3 KW</td><td></td></tr><tr><td>Above 3 KW - upto 7 KW</td><td>85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td>115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td>167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td>196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td>249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td>277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td>331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td>203</td></tr><tr><td colspan="2">For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.</td></tr><tr><td colspan="2">PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:</td></tr><tr><td colspan="2">NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:</td></tr><tr><td>Motor MCR in KW</td><td>Clearance</td></tr><tr><td>UP to 110 KW</td><td>10mm</td></tr><tr><td>Above 110 KW and upto 150 KW</td><td>12.5mm</td></tr><tr><td>Above 150 KW</td><td>19mm</td></tr></table>					Motor MCR in KW of	Minimum distance between centre stud and gland plate in mm As per manufacturer's practice.	UP to 3 KW		Above 3 KW - upto 7 KW	85	Above 7 KW - upto 13 KW	115	Above 13 KW - upto 24 KW	167	Above 24 KW - upto 37 KW	196	Above 37 KW - upto 55 KW	249	Above 55 KW - upto 90 KW	277	Above 90 KW - upto 125 KW	331	Above 125 KW-upto 200 KW	203	For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.		PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:		NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:		Motor MCR in KW	Clearance	UP to 110 KW	10mm	Above 110 KW and upto 150 KW	12.5mm	Above 150 KW	19mm
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	NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:																																						
	Motor MCR in KW	Clearance																																					
	UP to 110 KW	10mm																																					
	Above 110 KW and upto 150 KW	12.5mm																																					
Above 150 KW	19mm																																						
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-02 MOTORS	Page 9 of 9																																			

SUB-SECTION-II-E-06

LT POWER CABLE

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC
1.00.00	CODES & STANDARDS				
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:				
	IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.			
	IS : 3961	Recommended current ratings for cables			
	IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.			
	IS : 5831	PVC insulation and sheath of electrical cables.			
	IS : 8130	Conductors for insulated electrical cables and flexible cords.			
	IS : 10418	Specification for drums for electric cables.			
	IS : 10810	Methods of tests for cables.			
	ASTM-D –2843	Standard test method for density of smoke from the burning or decomposition of plastics.			
	IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.			
	IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).			
2.00.00	TECHNICAL REQUIREMENTS				
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.				
2.02.00	All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.				
2.03.00	Conductor of control cables shall be made of stranded, plain annealed copper.				
2.04.00	PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.				
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)–2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-07 LT CONTROL CABLES	Page 1 of 6

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC														
2.06.00	than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831. For multicore armoured cables, the armouring shall be of galvanised steel as follows: <table><thead><tr><th>Calculated nominal dia of cable under armour</th><th>Size and Type of armour</th></tr></thead><tbody><tr><td>Upto 13 mm</td><td>1.4mm dia GS wire</td></tr><tr><td>Above 13 upto 25 mm</td><td>0.8 mm thick GS formed wire / 1.6 mm dia GS wire</td></tr><tr><td>Above 25 upto 40 mm</td><td>0.8mm thick GS formed wire / 2.0mm dia GS wire</td></tr><tr><td>Above 40 upto 55mm</td><td>1.4 mm thick GS formed wire/2.5mm dia GS wire</td></tr><tr><td>Above 55 upto 70 mm</td><td>1.4mm thick GS formed wire / 3.15mm dia GS wire</td></tr><tr><td>Above 70mm</td><td>1.4 mm thick GS formed wire / 4.0 mm dia GS wire</td></tr></tbody></table> The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.					Calculated nominal dia of cable under armour	Size and Type of armour	Upto 13 mm	1.4mm dia GS wire	Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	Above 40 upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire	Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire
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2.07.00	Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29. (As per IS 10810 Part-58) (b.) Acid gas emission of max. 20% (As per IEC-754-I) (c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM D-2843.																		
2.08.00	Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted. <table><tbody><tr><td>1 core -</td><td>Red, Black, Yellow or Blue</td></tr><tr><td>2 core -</td><td>Red & Black</td></tr><tr><td>3 core -</td><td>Red, Yellow & Blue</td></tr><tr><td>4 core -</td><td>Red, Yellow, Blue and Black</td></tr><tr><td>5 core -</td><td>Red, Yellow, Blue, Black and Grey</td></tr></tbody></table>					1 core -	Red, Black, Yellow or Blue	2 core -	Red & Black	3 core -	Red, Yellow & Blue	4 core -	Red, Yellow, Blue and Black	5 core -	Red, Yellow, Blue, Black and Grey				
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KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-07 LT CONTROL CABLES	Page 2 of 6														

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC										
2.09.00	For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.														
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath: (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed. The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.														
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.														
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.														
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.														
2.14.00	Cable selection & sizing Control cables shall be sized based on the following considerations: (a) The minimum conductor cross-section shall be 1.5 sq.mm. (b) The minimum number of spare cores in control cables shall be as follows: <table><tr><td>No. of cores in cable</td><td>Min. No. of spare cores</td></tr><tr><td>2C, 3C</td><td>NIL</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-12C</td><td>2</td></tr><tr><td>14C & above</td><td>3</td></tr></table>					No. of cores in cable	Min. No. of spare cores	2C, 3C	NIL	5C	1	7C-12C	2	14C & above	3
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC			
2.14.01	Cable lengths shall be considered in such a way that straight through cable joints are avoided.				
2.14.02	Cables shall be armoured type if laid directly buried.				
3.00.00	CONSTRUCTIONAL FEATURES				
3.01.00	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).				
3.02.00	1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm.				
4.00.00	CABLE DRUMS				
	(a.) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.				
	(b.) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.				
	(c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths.				
5.00.00	TESTS				
	All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years 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.				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)--2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-07 LT CONTROL CABLES	Page 4 of 6

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	However if the 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 Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval. 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 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.				
5.01.00	TYPE TESTS				
5.01.01	The reports for the following type tests shall be submitted for one size of control cables. Size shall be decided by the employer during detailed engineering				
	S. No.	Type Test	Remarks		
		For Conductor			
	1.	Resistance test			
		For Armour Wires / Formed Wires (If applicable)			
	2.	Measurement of Dimensions			
	3.	Tensile Test			
	4.	Elongation test			
	5.	Torsion test	For round wire only		
	6.	Wrapping test	For aluminium wires / formed wires only.		
	7.	Resistance test			
	8(a).	Mass of zinc Coating test	For GS wires/formed wires only		
	8(b).	Uniformity of zinc coating	For GS wires/formed wires only		
	9.	Adhesion test	For GS wires/formed wires only		
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)--2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-07 LT CONTROL CABLES	Page 5 of 6

CLAUSE NO.	TECHNICAL REQUIREMENTS					
5.02.00	S. No.	Type Test		Remarks		
	For PVC insulation & PVC Sheath					
	10.	Test for thickness				
	11.	Tensile strength and elongation test	before ageing and after ageing			
	12.	Ageing in air oven				
	13.	Loss of mass test		For PVC insulation and sheath only		
	14.	Hot deformation test		For PVC insulation and sheath only		
	15.	Heat shock test		For PVC insulation and sheath only		
	16.	Shrinkage test				
	17.	Thermal stability test		For PVC insulation and sheath only		
	18.	Oxygen index test		For outer sheath only		
	19.	Smoke density test		For outer sheath only		
	20.	Acid gas generation test		For outer sheath only		
	For completed cables					
	21.	Insulation resistance test(Volume resistivity method)				
	22.	High voltage test				
	23.	Flammability test as per IEC-332 Part-3 (Category-B)				
	Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.					
	KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)--2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-07 LT CONTROL CABLES	Page 6 of 6

SUB-SECTION-II-E-07

LT CONTROL CABLE

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.00.00 1.01.00	CODES & STANDARDS All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes: IS :1554 - I PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V. IS : 3961 Recommended current ratings for cables IS : 3975 Low carbon galvanised steel wires, formed wires and tapes for armouring of cables. IS : 5831 PVC insulation and sheath of electrical cables. IS : 8130 Conductors for insulated electrical cables and flexible cords. IS : 10418 Specification for drums for electric cables. IS : 10810 Methods of tests for cables. ASTM-D –2843 Standard test method for density of smoke from the burning or decomposition of plastics. IEC-754 (Part-I) Tests on gases evolved during combustion of electric cables. IEC-332 Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC														
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC										
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2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath: (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed. The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.														
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.														
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC			
2.14.01	Cable lengths shall be considered in such a way that straight through cable joints are avoided.				
2.14.02	Cables shall be armoured type if laid directly buried.				
3.00.00	CONSTRUCTIONAL FEATURES				
3.01.00	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).				
3.02.00	1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm.				
4.00.00	CABLE DRUMS				
	(a.) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.				
	(b.) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.				
	(c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths.				
5.00.00	TESTS				
	All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years 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.				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-07 LT CONTROL CABLES	Page 4 of 6

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	However if the 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 Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval. 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 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.				
5.01.00	TYPE TESTS				
5.01.01	The reports for the following type tests shall be submitted for one size of control cables. Size shall be decided by the employer during detailed engineering				
	S. No.	Type Test	Remarks		
		For Conductor			
	1.	Resistance test			
		For Armour Wires / Formed Wires (If applicable)			
	2.	Measurement of Dimensions			
	3.	Tensile Test			
	4.	Elongation test			
	5.	Torsion test	For round wire only		
	6.	Wrapping test	For aluminium wires / formed wires only.		
	7.	Resistance test			
	8(a).	Mass of zinc Coating test	For GS wires/formed wires only		
	8(b).	Uniformity of zinc coating	For GS wires/formed wires only		
	9.	Adhesion test	For GS wires/formed wires only		
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC	
5.02.00	S. No.	Type Test		Remarks		
	For PVC insulation & PVC Sheath					
	10.	Test for thickness				
	11.	Tensile strength and elongation test	before ageing and after ageing			
	12.	Ageing in air oven				
	13.	Loss of mass test		For PVC insulation and sheath only		
	14.	Hot deformation test		For PVC insulation and sheath only		
	15.	Heat shock test		For PVC insulation and sheath only		
	16.	Shrinkage test				
	17.	Thermal stability test		For PVC insulation and sheath only		
	18.	Oxygen index test		For outer sheath only		
	19.	Smoke density test		For outer sheath only		
	20.	Acid gas generation test		For outer sheath only		
	For completed cables					
	21.	Insulation resistance test(Volume resistivity method)				
	22.	High voltage test				
	23.	Flammability test as per IEC-332 Part-3 (Category-B)				
	Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.					
	KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-07 LT CONTROL CABLES	Page 6 of 6

SUB-SECTION-II-E-08

CABLING, EARTHING & LIGHTNING

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC																																		
1.00.00	CODES AND STANDARDS																																						
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable . <table><tr><td>IS:513</td><td>Cold rolled low carbon steel sheets and strips.</td></tr><tr><td>IS:802</td><td>Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.</td></tr><tr><td>IS:1079</td><td>Hot Rolled carbon steel sheet & strips</td></tr><tr><td>IS:1239</td><td>Mild steel tubes, tubulars and other wrought steel fittings</td></tr><tr><td>IS:1255</td><td>Code of practice for installation and maintenance of power cables upto and including 33 KV rating</td></tr><tr><td>IS:1367 Part-13</td><td>Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).</td></tr><tr><td>IS:2147</td><td>Degree of protection provided by enclosures for low voltage switchgear and control gear</td></tr><tr><td>IS:2309</td><td>Code of Practice for the protection of building and allied structures against lightning.</td></tr><tr><td>IS:2629</td><td>Recommended practice for hot dip galvanising of iron & steel</td></tr><tr><td>IS:2633</td><td>Method for testing uniformity of coating on zinc coated articles.</td></tr><tr><td>IS:3043</td><td>Code of practice for Earthing</td></tr><tr><td>IS:3063</td><td>Fasteners single coil rectangular section spring washers.</td></tr><tr><td>IS:6745</td><td>Methods for determination of mass of zinc coating on zinc coated iron & steel articles.</td></tr><tr><td>IS:8308</td><td>Compression type tubular in- line connectors for aluminium conductors of insulated cables</td></tr><tr><td>IS:8309</td><td>Compression type tubular terminal ends for aluminium conductors of insulated cables.</td></tr><tr><td>IS:9537</td><td>Conduits for electrical installation.</td></tr><tr><td>IS:9595</td><td>Metal - arc welding of carbon and carbon manganese steels - recommendations.</td></tr></table>					IS:513	Cold rolled low carbon steel sheets and strips.	IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.	IS:1079	Hot Rolled carbon steel sheet & strips	IS:1239	Mild steel tubes, tubulars and other wrought steel fittings	IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating	IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).	IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear	IS:2309	Code of Practice for the protection of building and allied structures against lightning.	IS:2629	Recommended practice for hot dip galvanising of iron & steel	IS:2633	Method for testing uniformity of coating on zinc coated articles.	IS:3043	Code of practice for Earthing	IS:3063	Fasteners single coil rectangular section spring washers.	IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.	IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables	IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.	IS:9537	Conduits for electrical installation.	IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	IS:13573 Joints and terminations for polymeric cables. BS:476 Fire tests on building materials and structures IEEE:80 IEEE guide for safety in AC substation grounding IEEE:142 Grounding of Industrial & commercial power systems DIN 46267 (Part-II) Non tension proof compression joints for Aluminium conductors. DIN 46329 Cable lugs for compression connections, ring type ,for Aluminium conductors BS:6121 Specification for mechanical Cable glands for elastomers and plastic insulated cables. Indian Electricity Act. Indian Electricity Rules. 1.02.00 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison. 2.00.00 DESIGN AND CONSTRUCTIONAL FEATURE 2.01.00 Inter Plant Cabling 2.01.01 Interplant cabling for main routes shall be laid along overhead trestles/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly buried cables, if essential ,shall not have concentration of more than 4 cables in one route. All buried cables, Cables for switchyard and CHP shall be armoured 2.01.02 Transformer yard In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing. 2.01.03 Trenches PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
2.01.04	No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.			
2.01.05	Cable Vault Clear access passage of at least 750mm wide & 2.1 mt clear heights shall be provided at entrances and along the cable trays in cable vault. Wherever the passage is through cable routes & across the cable tray the clear height shall not be less than 1.5 mts. Cable vaults shall be provided with adequate drainage facilities for drainage of fire water. Each cable vault should have at least two doors. Exit signs shall be provided near doors for personnel escape in case of emergency Boiler Area Two separate cable routes one on each side shall be provided for each boiler unit. Cables for on set of auxiliaries such as ID, FD, PA fan & half of the coal mills shall be routed in one route & for other set of auxiliaries through other route. Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor. Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area. Turbine Hall Area a)Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries. OffSite Area For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be preferably followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering. Cable trenches provided shall be separated from fuel oil area to avoid oil accumulation. 2.01.09 The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling. 2.01.10 Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable. 2.01.11 Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to: • Meet all safety requirements			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	- Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc 3.00.00 EQUIPMENT DESCRIPTION 3.01.00 Cable trays, Fittings & Accessories 3.01.01 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables. 3.01.02 Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter. 3.01.03 Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm. 3.01.04 Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm 3.02.00 Support System for Cable Trays 3.02.01 Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings. 3.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder - Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. - The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanized. - The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which			
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	the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation. e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below: The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079. f. Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position. g. Support system shall be able to withstand • weight of the cable trays • weight of the cables (75 Kg/Metre run of each cable tray) • Concentrated load of 75 Kg between every support span. • Factor of safety of minimum 1.5 shall be considered. 3.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid. 3.03.04 FOR COAL HANDLING PLANT THE FOLLOWING SHALL ALSO BE APPLICABLE: a) All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route. b) Cable trenches shall be provided only in Switchgear/MCC rooms.			
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	c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc. d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.				
3.04.00	Pipes, Fittings & Accessories				
3.03.01	Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria				
3.03.02	GI Pipes shall be of medium duty as per IS: 1239				
3.03.03	Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.				
3.03.04	Hume pipes shall be NP3 type as per IS 458.				
3.04.00	Junction Boxes				
3.04.01	Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:- (a) Impact resistance for impact energy of 2 Joules (IK07) as per BS EN50102 (b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb. (c) Class of protection shall be IP 55. (d) HV test.				
3.04.02	Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.05.00 3.05.01 3.05.02 3.05.03 3.06.00 3.06.01 3.07.00 3.07.01 3.08.00 3.08.01	Terminations & Straight Through Joints Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter). Straight through joint and termination shall be capable of withstanding the fault level for the system. 1.1 KV grade Straight Through Joint shall be of proven design. Cable glands Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected. Cable lugs/ferrules Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to IS/DIN standards. Trefoil clamps Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts,			
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	washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the peak value of maximum system short circuit current. 3.09.00 Cable Clamps & Ties 3.09.01 The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements. 3.10.00 Receptacles 3.10.01 Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break, AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity. 3.11.00 Cable Drum Lifting Jack The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation. 3.12.00 Galvanising 3.12.01 Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots. 3.12.02 The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified				
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.13.00	Welding				
3.13.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595				
4.00.00	INSTALLATION				
4.01.00	Cable tray and Support System Installation				
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.				
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.				
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.				
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.				
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.				
4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.				
4.02.00	Conduits/Pipes/Ducts Installation				
4.02.01	The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable				
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	trenches made for conduit installation shall be sealed and made water proof by the Contractor.														
4.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.														
4.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. 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 with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material														
4.02.04	Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise <table><tr><th>Conduit /pipe size (dia).</th><th>Spacing</th></tr><tr><td>Upto 40 mm</td><td>1 M</td></tr><tr><td>50 mm</td><td>2.0 M</td></tr><tr><td>65-85 mm</td><td>2.5 M</td></tr><tr><td>100 mm and above</td><td>3.0 M</td></tr></table>					Conduit /pipe size (dia).	Spacing	Upto 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm and above	3.0 M
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Upto 40 mm	1 M														
50 mm	2.0 M														
65-85 mm	2.5 M														
100 mm and above	3.0 M														
4.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.														
4.03.00	Junction Boxes Installation														
4.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.														
4.04.00	Cable Installation														
4.04.01	Cable installation shall be carried out as per IS:1255 and other applicable standards.														
4.04.02	For Cable unloading, pulling etc following guidelines shall be followed in general: a) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. 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														
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	direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture. b) While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager. 4.04.03 Cables shall be laid on cable trays strictly in line with cable schedule 4.04.04 Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend. Fibre Optical cable shall be laid in trenches/trays or as decided by Employer. 4.04.05 Bending radii for cables shall be as per manufacturer's recommendations and IS:1255. 4.04.06 Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe. 4.04.07 No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length. 4.04.08 In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.				
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4.04.09	Wherever few cables are branching out from main trunk route troughs shall be used.											
4.04.10	Wind loading shall be considered for designing support as well Cable trays wherever required.											
4.04.11	Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.											
4.04.12	The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.											
4.04.13	Separation At least 300mm clearance shall be provided between: - HT power & LT power cables, - LT power & LT control/instrumentation cables,											
4.04.14	Segregation 1) Segregation means physical isolation to prevent fire jumping. 2) All cables associated with the unit shall be segregated from cables of other units. 3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set. 4) In switchyard, control cables of each bay shall be laid on separate racks/trays.											
4.04.15	Minimum number of spare cores required to be left for interconnection in control cables shall be as follows: Minimum number of spare cores required to be left for interconnection in control cables shall be as follows: <table><tr><td>No. of cores in cable</td><td>No. of spare cores</td></tr><tr><td>2C,3C</td><td>NIL</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-10C</td><td>2</td></tr></table>				No. of cores in cable	No. of spare cores	2C,3C	NIL	5C	1	7C-10C	2
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4.04.16 4.04.17 4.04.18 4.05.00 4.05.01 4.05.02	14C and above 3 Directly Buried Cables a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details. b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker. 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, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables. While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray. Cable Terminations & Connections The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site. Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.			
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4.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.			
4.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.			
4.05.05	All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.			
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.			
5.00.00	EARTHING SYSTEM			
5.01.00	The earthing system shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 50 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year. Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All areas under contractor scope of supply shall be interconnected together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system. All the columns shall be earthed by nearby risers and earthmat grid spacing shall be minimum 10 mts. Minimum two nos of risers shall be provided for each equipment in SG area. Separate dedicated riser shall be provided for C&I earthing purpose and also for Lightning down conductor connection purpose. Sufficient nos of risers near the equipment shall be provided as per the system requirement.			
5.02.00	The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects			
5.03.00	The material of the earthing conductors shall be as follows:			
	1)	Conductors above ground level and in built up trenches.	-	Galvanized steel
	2)	Conductors buried in earth	-	Mild steel
	3)	Earth electrodes	-	Mild steel rod
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5.04.00	The sizes of earthing conductors for various electrical equipments shall be as below: <table><thead><tr><th>Equipment</th><th>Earth conductor buried in earth</th><th>Earth conductor above ground level & in built-up trenches</th></tr></thead><tbody><tr><td>a) Main earth grid</td><td>40 mm dia. MS rod</td><td>65 x 8mm GS flat</td></tr><tr><td>b) 33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear</td><td>---</td><td>65 x 8mm GS flat</td></tr><tr><td>c) 415 V MCC/ Distribution boards / Transformers</td><td>---</td><td>50 x 6mm GS flat</td></tr><tr><td>d) LT Motors above 125 KW</td><td>---</td><td>50 x 6mm GS flat</td></tr><tr><td>25 KW to 125 KW</td><td>---</td><td>25 x 6mm GS flat</td></tr><tr><td>1KW to 25 KW</td><td>---</td><td>25 x 3mm GS flat</td></tr><tr><td>Fractional House power motor</td><td>---</td><td>8 SWG GS wire</td></tr><tr><td>e) Control panel & control desk</td><td>---</td><td>25 x 3 mm GS flat</td></tr><tr><td>f) Push button station / Junction Box</td><td>---</td><td>8 SWG GI wire</td></tr><tr><td>g) Columns, structures, cable trays and bus ducts enclosures</td><td>---</td><td>50 x 6mm GS flat</td></tr><tr><td>h) Crane, rails, rail tracks & other non-current carrying metal parts</td><td></td><td>25 x 6mm GS flat</td></tr></tbody></table>				Equipment	Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches	a) Main earth grid	40 mm dia. MS rod	65 x 8mm GS flat	b) 33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	---	65 x 8mm GS flat	c) 415 V MCC/ Distribution boards / Transformers	---	50 x 6mm GS flat	d) LT Motors above 125 KW	---	50 x 6mm GS flat	25 KW to 125 KW	---	25 x 6mm GS flat	1KW to 25 KW	---	25 x 3mm GS flat	Fractional House power motor	---	8 SWG GS wire	e) Control panel & control desk	---	25 x 3 mm GS flat	f) Push button station / Junction Box	---	8 SWG GI wire	g) Columns, structures, cable trays and bus ducts enclosures	---	50 x 6mm GS flat	h) Crane, rails, rail tracks & other non-current carrying metal parts		25 x 6mm GS flat
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5.05.00	Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.																																							
5.06.00	Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not																																							
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	exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground 5.07.00 Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors. 5.08.00 Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level. 5.09.00 Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound. 5.10.00 Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor. 5.11.00 Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding. 5.12.00 Resistance of the joint shall not be more than the resistance of the equivalent length of conductors. 5.13.00 Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. 5.14.00 Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover. 5.15.00 A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same. 5.16.00 Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively. 5.17.00 Earth pit shall be of treated type & shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal as per IS:3043. Test links shall be provided with bolted arrangement alongwith each earth pit, in order to facilitate measurement of earth resistance as & when required. 5.18.00 On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be				
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	measured and recorded. All equipment required for testing shall be furnished by contractor.			
5.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.			
5.20.00	Other Requirements of Earthing System:			
	Standard/Code	IEEE 80, IS 3043		
	Earthing System			
	Life expectancy	40 Years		
	System Fault Level	System Fault Level 50 KA for 1 sec		
	Soil resistivity	Actual as per site conditions.		
	Min. Steel corrosion	0.12mm/year		
	Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.		
	Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.		
	Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.			
	Surface resistivity - Gravel	3000 ohm-meter		
	- Concrete	500 ohm-meter		
6.00.00	LIGHTNING PROTECTION SYSTEM			
6.01.01	Lightning protection system shall be in strict accordance with IS:2309 .			
6.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system			
6.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.			
6.02.00	Down Conductors			
	1. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.			
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	2. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. 3. All joints in the down conductors shall be welded type. 4. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval. 5. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm. 6. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system. 7. Lightning conductors shall not pass through or run inside GI Conduits. 8. Testing link shall be made of galvanized steel of size 25x 6mm. 9. Pulser system for lightning shall not be accepted. 10. Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.				
7.00.00	TESTS				
7.01.01	All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years 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.				
7.01.02	However if the 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 Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.				
7.01.03	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.				
7.01.04	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.				
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7.02.00 7.02.01	Type Test reports shall be furnished for the following Type tests on Cable Trays support system a) Test 1A: On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 meter length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals: i) Working load ii) Working load + point load iii) Off load iv) Proof load + point load v) Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied. B) Test 1B: Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2 Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides a) Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals. i) Working load			
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	ii) Working load + Point load iii) Off load iv) Proof load + Point load v) Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied b) Test 2 B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side. Test 3 : Tests on Channel Fixed on Beam/Floor A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below a) Test 3A : A length of steel structure shall be rigidly supported. It should be fitted on a meter length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place. b) Test 3B: With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place. c) Test 3C: With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line. The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded. Test 4 : Channel Insert Test A 2.5 m length of C1 channel fixed to the concrete wall/ steel structure as per actual site installation conditions. 6 nos. of 750 mm cantilever arms shall be attached to C1 channel as shown in enclosed drawing. Each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	i) Working Load ii) Working Load + Point Load iii) Off Load iv) Proof Load + Point Load v) Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied Test 5 : Channel nut slip characteristics (what ever applicable) Tests 5A1,5A2,5A3 : A length of channel C1 section 200mm long shall have fitted bracket with the two bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting. A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM. Tests 5B1,5B2,5B3: The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting. A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM. Test 6 Weld Integrity Test After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any. 7.02.02 Cable termination kit and straight through joints should have been tested as per IS:13573 for 3.3kV grade & above. 7.03.00 Routine/ Acceptance Tests 7.03.01 Routine Tests a) Routine tests as per specification and applicable standards shall be carried out on all requirements/items covered in the specification.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
7.03.02	b) Physical & dimensional check on all equipments as per approved drawings/standards c) HV/IR as applicable. d) Check/measurement of thickness of paint/zinc coating/nickel-chrome plating as per specification & applicable standard. Acceptance Test a) Galvanising Tests as per applicable standards b) Welding checks c) Deflection tests on cable trays: d) One piece each of 2.5m length of cable tray of 300mm & above shall be taken as sample from each offered lot. It shall be supported at both end & loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm. d) Proof load tests on cable tray support system i) Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test. ii) Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done. iii) Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test. The procedure for carrying out tests at “d” above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity. e) The above acceptance tests shall be done only on one sample from each offered lot.			
8.00.00	COMMISSIONING			
8.01.01	The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers or else required for satisfactory performance..			
8.01.02	Cables a) Check for physical damage			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	b) Check for insulation resistance before and after termination/jointing. c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning. d) Check of continuity of all cores of the cables. e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor. f) Check for correct polarity and phasing of cable connections. g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc. h) Check for provision of correct cable tags, core ferrules, tightness of connections. 8.02.00 Cable trays / supports and accessories 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories. 2) Check for continuity of cable trays over the entire route. 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports. 4) Check for earth continuity and earth connection of cable trays. 8.03.00 Earthing and Lightning protection system 1) Earth continuity checks. 2) Earth resistance of the complete system as well as sub-system.			
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SUB-SECTION-II-E-09

ILLUMINATION

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.00.00	GENERAL			
1.01.00	This specification covers the general description of design, manufacture and construction features, testing, supply, installation and commissioning of the Lighting system equipment.			
2.00.00	CODES AND STANDARDS			
2.01.00	All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards & codes.			
2.02.00	Lighting Fixtures and Accessories IS:1913 General and safety requirements for luminaires. IS:2148 Flame proof enclosures of electrical apparatus. IS:418 Tungsten filament general service electric lamps. IS:1258 Bayonet lamp holders. IS:1534 Ballast for fluorescent lamps. IS:1569 Capacitors for use in tubular fluorescent, high pressure mercury vapour and low pressure sodium vapour discharge lamp circuit. IS:1777 Industrial luminaire with metal reflectors. IS:2215 Starters for fluorescent lamps. IS:2418 Tubular fluorescent lamps for general lighting services. IS:3323 Bi-pin lamp holders for tubular fluorescent lamps. IS:3324 Holders for starters for tubular fluorescent lamps. IS:4013 Dust-tight electric lighting fittings. IS:8224 Electric Lighting fittings for Division 2 areas. IS:10276 Edison screw lamp holders. IS:10322 Luminaires. IS:13021 AC Supplied Electronic Ballasts for tubular fluorescent lamps.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.03.00	Lighting Panels, Switch-boxes, Receptacles and Junction Boxes IS:2147 Degree of protection provided by enclosures for low-voltage switchgear and control gear. IS:1293 Plugs & socket outlets of rated voltage upto and Including 250volts & rated current upto and including 16 Amps. IS:2551 Danger notice plates. IS:13947 Low voltage switchgear and controlgear IS:3854 Switches for domestic and similar purposes. IS:6875 Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto and including 1000 V AC and 1200 V DC. IS:13703 Low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.			
2.04.00	Conduits, Pipes and Accessories IS:2667 Fittings for rigid steel conduit for electrical wiring. IS:3837 Accessories for rigid steel conduits for electrical wiring. IS:9537 Conduits for electrical installations.			
2.05.00	Lighting Wires/Cables IS:694 PVC insulated cables for working voltages upto and including 1100 V IS:3961 Recommended current ratings for cables.(PVC Insulated and PVC sheathed heavy duty cables and light duty cables). IS:8130 Conductors for insulated electric cables and flexible cords. IS:10810 Methods of tests for cables.			
2.06.00	LED Luminaries 16101:2012 General Lighting. LEDs and LED modules Terms and definitions 16102(Part 1):2012 Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements. 16102(Part 2):2012 Self Ballasted LED Lamps for General lighting Services. Part-2 Performance Requirements.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
2.07.00	16103(Part I):2012	LED modules for General lighting Safety Requirements.		
	15885(Part 2/Sec. 13) :2012	Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c.		
	16104:2012	Supplied Electronic control gear for LED modules d.c. or a.c. Supplied Electronic control gear for LED modules - Performance Requirements.		
	16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED) Sources.		
	16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products		
	16107:2012	Luminaires Performance		
	16108:2012	Photobiological safety of Lamps and Lamp Systems		
	IS 513	Cold rolled low carbon steel sheets and strips		
	IS 12063	Classification of degree of protection provided by enclosures.		
	IS 14700	Electro magnetic compatibility (EMC) – Limits (Part 3/Sec. 2)for Harmonic current emission – THD < 15% (equipment, input current < 16 Amps. per phase.		
	IS 9000 (Part 6)	Environment testing: Test Z – AD: composite temperature/humidity cyclic test.		
	IS 15885	Lamp control gear: particular requirements for (Part 2/Sec. 13) DC or AC supplied electronic control gear IS 16004 – 1 and 2) for LED modules.		
	IS 4905	Method for random sampling		
	Electrical Installation Practices & Miscellaneous IS:1944 Code of practice for lighting of public thorough fare IS:3646 Code of practice for interior illumination. IS:5572 Classification of Hazardous areas (other than Mines) having flammable gases and Vapours for electrical installation			
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CLAUSE NO.	एनटीपीसी NTPC TECHNICAL REQUIREMENTS			
4.00.00	S:6665 Code of practice for industrial lighting. . National Electrical Code - Indian Electricity Rules. IS:5 Indian Electricity Act Colour for ready mixed paints & enamels. IS:280 Mild steel wires for general engineering purposes. IS:374 Electric ceiling type fans & regulators. IS:732 Code of practice for electrical wiring installations. IS:1255 Code of practice for installation and maintenance of power cables Upto and including 33KV rating. IS:2062 Steel for general structural purposes IS:2629 Recommended practice for hot-dip galvanizing of iron and steel. IS:2633 Methods for testing uniformity of coating of zinc coated articles. IS:2713 Tubular steel poles for overhead power lines. IS:3043 Code of practice for earthing IS:5216 Guide for safety procedures and practices in electrical work. IS:5571 Guide for selection of electrical equipments for hazardous areas. BS:6121 Mechanical cable glands			
	DESIGN PHILOSOPHY - A comprehensive illumination system shall be provided in the entire areas. - All outdoor lighting system shall be automatically controlled by synchronous timer. Provision to bypass the timer shall be provided in the panel. - The system shall include distribution boards, normal/ emergency lighting panels, lighting fixtures, junction boxes, receptacles, switch boards, lighting pole/masts, conduits, cables and wires, etc. The system shall cover all interior and exterior lighting such as area lighting etc. The constructional features of lighting distribution boards shall be similar to			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	AC/DC distribution boards described in chapter of LT Switchgear. Outgoing circuits in LPs shall be provided with MCBs of adequate ratings. 4. The illumination system shall be designed on the basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The lighting fixtures shall be designed for minimum glare. The design shall prevent glare/luminous patch seen on VDU/ Large video screens, when viewed from an angle. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection. The diffusers/ louvers used in fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period. The Lux levels to be adopted for various area are indicated at Annexure - A. (placed at the end of this Chapter). 5. While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations. 6. LED Luminaires: LED Luminaires shall be used for the lighting of all the indoor & outdoor areas in bidder's scope. However for DC lighting, hazardous areas lighting etc. conventional type luminaires shall be used. In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type. The individual lamp wattage for LED shall be upto 3 watt. Fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall be not less than 70 Lm/W. Suitable heat sink shall be designed & provided in the luminaire. The LED used in the luminaires shall have colour rendering index (CRI) of Min 70. Colour designation of LED shall be "cool day light" (min 5700K) type for indoor areas. However for outdoor areas, the colour temperature of LED shall be min. 4000K, including rough & dust prone areas. LED shall conform to the LM 80 requirements. The max. junction temperature of LED shall be 85 deg C. Further the lumen maintenance at this temperature shall be min 90%. The THD of LED Luminaires shall be less than 10%. Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire & safety requirements of luminaire shall be as per IS standards. Suitable heat sink with proper thermal management shall be designed & provided in the luminaire. The connecting wires used inside the system, shall be low smoke halogen free, fire retardant type and fuse protection shall be provided in input side specifically for LED luminaires. Care shall be taken in the design that there is no water stagnation anywhere in the housing of luminaire. The entire housing shall be dust and water proof protection as per IS 12063.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC												
	7. Driver Circuit LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED chip manufacturer. LED Drivers shall have following control & protections:- - Suitable precision current control of LED. - Open Circuit Protection - Short Circuit Protection - Over Temperature Protection - Overload Protection 8. Apart from maintenance factor as given below, Temperature correction factor shall be considered in the lighting design for fixtures located in non air conditioned area.<table><tr><td>(a.) Office area (air conditioned)</td><td>:</td><td>0.8</td></tr><tr><td>(b.) Office area (non air conditioned) and other indoor area</td><td>:</td><td>0.7</td></tr><tr><td>(c.) Dust prone indoor and outdoor area</td><td>:</td><td>0.6</td></tr><tr><td>(d.) Coal Handling area, Ash Handling Conveyor /Transfer Points etc.</td><td>:</td><td>0.5</td></tr></table> 9. All lighting fixtures and control gears shall be powder coated. All outdoor fixtures shall be weather proof and of min. IP55 degree of protection. 10. Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have min. IP55 degree of protection. 11. Wires of different phase shall normally run in separate conduit. 12. Power supply shall be fed from 415 / 240 V normal AC supply, emergency AC supply and 220V DC supply through suitable number of conveniently located lighting distribution boards (LDB) and lighting panels (LP). AC lighting supply shall be isolated from main supply by 2x100% isolation transformers of max. rating of 100KVA for 10/15 nos. outgoing feeder with changeover switch facility. The isolation transformer shall be fed from two different bus sections of MCC and fault level restricted to 3 KA at Lighting Panels. 13. Atleast one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc. Further 20A, 240V AC industrial receptacle with switch shall be provided strategically in all industrial areas. Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for entire plant for welding purposes, particularly near all major equipment and at an average distance of 50m. Atleast one 63A, 3ph,					(a.) Office area (air conditioned)	:	0.8	(b.) Office area (non air conditioned) and other indoor area	:	0.7	(c.) Dust prone indoor and outdoor area	:	0.6	(d.) Coal Handling area, Ash Handling Conveyor /Transfer Points etc.	:	0.5
(a.) Office area (air conditioned)	:	0.8															
(b.) Office area (non air conditioned) and other indoor area	:	0.7															
(c.) Dust prone indoor and outdoor area	:	0.6															
(d.) Coal Handling area, Ash Handling Conveyor /Transfer Points etc.	:	0.5															
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	415V AC receptacle shall be provided in each floor of off-site buildings/ structures. 14. In the hazardous areas like Hydrogen generation plant, fuel oil handling areas or any other gas/ liquid fuel storage/ handling areas in bidder's scope, lighting shall be flame proof. 15. The type of fixtures, LP, JB, and receptacle used in Hydrogen generation plant building shall be suitable for group II C as per IS: 2148 or class I, Division II as per NEC 70-428. 16. All flourescent fixtures, shall have energy efficient 'T5' type flouresent lamps except the flouresent fixtures used for division 2 hazardous area. The louvers of these fixtures shall be designed for 'T5' type flouresent lamps. All flouresent lamps shall be have "Cool day light" colour designation. The mirror optics type flouresent fixtures shall have no iridescence effect. Fixtures with better efficiency and upgraded proven system may also be considered In candescent lamps may be used only with DC Lighting. 17. Aviation warning lights shall be provided as per the recommendations of ICAO and Director general of civil aviation, India. The arrangement of light should be marked such that the object is indicated from every angle in azimuth. The aviation warning lighting system shall also conform to the latest Indian standard IS 4998. 18. Contractor shall demonstrate the average lux level achieved for different areas as per specification requirements, after completion of the lighting work, at site to the satisfaction of engineer-in-charge. 19. In the Off site area / buildings DC lighting shall be provided by self-contained 90 minutes duration Emergency lighting fixtures. Each shall be provided with Ni-cd battery, battery Charger & 2x10 W fluorescent lamps			
4.01.00	Ballasts			
4.01.01	All fluorescent fixtures except for Class-I, Div-II fittings/ increased safety fittings (Div-II/Hazardous Area) shall be provided with electronic ballasts.			
4.02.00	All luminaires and their accessories and components shall be of type readily replaceable by available Indian makes.			
4.03.00	Fans & Regulator			
4.03.01	Ceiling Fans, to be provided in non air-conditioned office/control room area. Further tentatively one (1) no. ceiling fan shall be provided for 10 sq.m area, at suitable mounting height. The ceiling fans shall be suitable for operation on 240 V +/-10%, 50 Hz, AC supply comprising of class 'E' or better insulated copper wound single phase motor, 1200mm sweep, aerodynamically designed well balanced AL blades (3 Nos.), down rod, die cast aluminium housing, capacitor, suspension hook, canopies etc. finished in stove enameled white or with electro static powder coating. Power factor of fans shall not be less than 0.9. Fan			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
4.04.00	regulators shall be stepped electronic type suitable for operation on 240V +/-10% AC supply. Junction Boxes, Conduits, Fitting & Accessories, Pull Out Boxes: Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. Junction boxes for street lighting poles and lighting mast if applicable , shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55. All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox & plate. Conduits, Pipes and Accessories Galvanised heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered. Rigid steel conduits shall be heavy duty type, hot dip galvanised conforming to IS : 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside. Flexible conduit shall be water proof and rust proof made of heat resistant lead coated steel. Pull out boxes shall be provided at suitable interval in a conduit run .Boxes shall be suitable for mounting on Walls, Columns, Structures, etc.. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes used outdoor shall be weather proof type suitable for IP: 55 degree of protection and those used indoor shall be suitable for IP: 52 degree of protection. Pull out box & its cover shall be hot dip galvanized.			
4.05.00	Lighting Wires			
4.05.01	Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. Colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R, Y, B phases & neutral, respectively and white & grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5 sq.mm. for copper and 4 sq.mm. for aluminium.			
4.06.00	Lighting Poles			
4.06.01	The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. The Poles shall be mounted above ground using base plate and minimum height of pole shall be 8 mtrs The poles shall be hot-dip galvanized as per IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding			
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	the appropriate wind load etc as per IS 875 considering prevailing soil/ site condition considering all accessories mounting on pole.				
	The street light poles shall have loop in loop out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB.				
5.00.00	TESTS				
5.01.00	For LED Fixture				
	a) The contractor shall carry out the type tests as listed in this specification on the following types of LED fixtures to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of bid document and the same shall be considered for the evaluation of the bids. LED fixtures (Type test shall be conducted on one rating each of following type of LED fixtures. Rating for test conduction shall be decided by the employer during detailed engineering) a) High bay fixture. b) Well glass fixture. c) Street light fixture d) Surface mounted type fixture. e) Recessed mounted type fixture. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.				
	b) The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall 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.				
	c) In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the owner for waiver 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.				
5.02.00	For all other lighting equipment:				
	a) All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports				
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	of all the type tests as listed in this specification and carried out within last ten years 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. b) However if the 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.																														
5.03.00	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.																														
5.04.00	Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant IS																														
5.05.00	Type test reports of the following items as per technical specification requirements/ standards shall be submitted for approval. <table><tr><th>SL NO.</th><th>DESCRIPTION</th></tr><tr><td>i.</td><td>Lighting fixtures of each type</td></tr><tr><td>ii.</td><td>Lighting panel of each type (Degree of Protection)</td></tr><tr><td>iii.</td><td>Junction Box of each type.</td></tr></table> Type test reports for LED as per standards for following shall be submitted for approval. <table><tr><td>1. Visual and Dimension check</td></tr><tr><td>2. Proof of procurement of LEDs</td></tr><tr><td>3. Safety tests</td></tr><tr><td> a) Marking</td></tr><tr><td> b) Construction</td></tr><tr><td> c) Provision for Earthing</td></tr><tr><td> d) External and Internal wiring</td></tr><tr><td> e) Protection against electrical shock</td></tr><tr><td> f) Endurance and Thermal</td></tr><tr><td> g) Insulation resistance & electrical strength</td></tr><tr><td> h) Resistance to heat fire & tracking</td></tr><tr><td> i) Resistance to Humidity</td></tr><tr><td>4. Fire Retardant test</td></tr><tr><td>5. Performance tests (electrical, Photometric color and Life)</td></tr><tr><td>6. Burn-in Test</td></tr><tr><td>7. Power Cycling</td></tr><tr><td>8. Temperature rise test</td></tr><tr><td>9. Emission Tests</td></tr></table>					SL NO.	DESCRIPTION	i.	Lighting fixtures of each type	ii.	Lighting panel of each type (Degree of Protection)	iii.	Junction Box of each type.	1. Visual and Dimension check	2. Proof of procurement of LEDs	3. Safety tests	a) Marking	b) Construction	c) Provision for Earthing	d) External and Internal wiring	e) Protection against electrical shock	f) Endurance and Thermal	g) Insulation resistance & electrical strength	h) Resistance to heat fire & tracking	i) Resistance to Humidity	4. Fire Retardant test	5. Performance tests (electrical, Photometric color and Life)	6. Burn-in Test	7. Power Cycling	8. Temperature rise test	9. Emission Tests
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	a) Radiated & conducted emission b) Harmonics & flickers 10. Immunity tests			
	In addition, following test reports to be submitted for LED chip/LED luminaire: a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer. b) LM 80/IS: 16105 report. c) LM 79/IS: 16106 report. 5.06.00 Acceptance Test and Routine Test 5.06.01 All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards. 5.06.02 Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks also. 5.07.00 Galvanizing Tests 5.07.01 The quality of galvanizing shall be smooth, continuous, free from flux stains and shall be inspected visually. 5.07.02 In addition following tests shall be conducted as acceptance tests. (a) Uniformity of coating - The coating of any article shall withstand for one (1) minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal. (b) The quality of cadmium/zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually. (c) In addition, the plating thickness shall be determined microscopically/chemically or electronically.			
6.00.00	COMMISSIONING CHECKS 1. On completion of installation work, the Contractor shall request the Project manager for inspection and test with minimum of fourteen (14) days advance notice. 2. The Project manager shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor. 3. The installation shall be then tested and commissioned in presence of the Project manager. 4. The contractor shall provide all, men material and equipment required to carry out the tests.			
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	5. All rectifications, repair or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor without any extra cost. The handing over the lighting installation shall be effected only after the receipt of written instruction from the Employer/his authorized representative. 6. The testing shall be done in accordance with the applicable Indian Standards and codes of practices. The following tests shall be specifically carried out for all lighting installation. (a) Insulation Resistance. (b) Testing of earth continuity path. (c) Polarity test of single phase switches. (d) Functional checks. 7. The lighting circuits shall be tested in the following manner: (a) All switches ON and consuming devices in circuit, both poles connected together to obtain resistance to earth. (b) Insulation resistance between poles with lamps and other consuming devices removed and switches ON.			
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	ANNEXURE-A <table><tr><th>SI No.</th><th>Location**</th><th>Average Illumination Level (Lux)</th><th>Type of Fixture</th></tr><tr><td>(a)</td><td>Switchgear rooms, Charger, Rectifier room</td><td>200</td><td>Industrial type LED Luminaire</td></tr><tr><td>(b)</td><td>Control room, computer room, control equipment room</td><td>350</td><td>LED luminaire equivalent to Mirror optics with anti-glare features or downlighter.</td></tr><tr><td>(c)</td><td>Offices, conference rooms, etc.</td><td>300</td><td>Decorative mirror optics Type LED luminaire or LED downlighter</td></tr><tr><td>(d)</td><td>Battery rooms</td><td>100</td><td>totally enclosed corrosion Proof LED Luminaire</td></tr><tr><td>(e)</td><td>Transformer Area</td><td>20 (general) 50 (on equipment)</td><td>LED Luminaire</td></tr><tr><td>(f)</td><td>Diesel generating room /enclosure, Compressor room, pump house etc.</td><td>150</td><td>LED medium bay/ Industrial type LED Luminaire</td></tr><tr><td>(g)</td><td>Cable galleries/vault</td><td>50</td><td>Industrial type LED Luminaire</td></tr><tr><td>(h)</td><td>Street lighting- primary roads secondary roads</td><td>20 10</td><td>LED street lights</td></tr><tr><td>(i)</td><td>Outdoor storage handling and unloading area</td><td>20</td><td>LED Luminaire</td></tr><tr><td>(j)</td><td>Cement stores</td><td>150</td><td>Industrial dust proof type LED Luminaire</td></tr><tr><td>(k)</td><td>Chemical stores/House</td><td>150</td><td>Corrosion proof LED Luminaire</td></tr><tr><td>(l)</td><td>Permanent stores</td><td>150</td><td>LED high/medium bay / Industrial trough LED Luminaire</td></tr><tr><td>(m)</td><td>Workshop. Building</td><td>150</td><td>LED high/medium bay / Industrial trough LED Luminaire</td></tr><tr><td>(n)</td><td>Laboratory General Analysis area</td><td>150 300</td><td>Corrosion proof LED Luminaire</td></tr></table>				SI No.	Location**	Average Illumination Level (Lux)	Type of Fixture	(a)	Switchgear rooms, Charger, Rectifier room	200	Industrial type LED Luminaire	(b)	Control room, computer room, control equipment room	350	LED luminaire equivalent to Mirror optics with anti-glare features or downlighter.	(c)	Offices, conference rooms, etc.	300	Decorative mirror optics Type LED luminaire or LED downlighter	(d)	Battery rooms	100	totally enclosed corrosion Proof LED Luminaire	(e)	Transformer Area	20 (general) 50 (on equipment)	LED Luminaire	(f)	Diesel generating room /enclosure, Compressor room, pump house etc.	150	LED medium bay/ Industrial type LED Luminaire	(g)	Cable galleries/vault	50	Industrial type LED Luminaire	(h)	Street lighting- primary roads secondary roads	20 10	LED street lights	(i)	Outdoor storage handling and unloading area	20	LED Luminaire	(j)	Cement stores	150	Industrial dust proof type LED Luminaire	(k)	Chemical stores/House	150	Corrosion proof LED Luminaire	(l)	Permanent stores	150	LED high/medium bay / Industrial trough LED Luminaire	(m)	Workshop. Building	150	LED high/medium bay / Industrial trough LED Luminaire	(n)	Laboratory General Analysis area	150 300	Corrosion proof LED Luminaire
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CLAUSE NO.	एनटीपीसी NTPC TECHNICAL REQUIREMENTS			
	(o) Garage/Car Parking 50 Industrial type LED Luminaire (p) Transfer points, Sheds, tunnels, bunker house, Conveyor Gallery etc. in bidders scope 100 LED Dust tight/Well glass type Luminaire (q) Facility building, canteen etc. 150 Industrial type LED Luminaire (r) Corridors, Walkways 50 LED Luminaire (s) Building Periphery Lighting 10 LED Street Light fixture (t) ESP platform 150 LED well glass fixtures			
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SUB-SECTION-II-E-10

CONTROL PANELS

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	CONTROL PANELS 1.00.00 CODES AND STANDARDS Programmable Logic Controller IEC: 1131 2.00.00 CONTROL TYPE PLC based 3.00.00 PANEL CONFIGURATION 3.01.00 PC based OWS (Operator Work Station) of PLC shall be mounted on table type control desk to house PC/ keyboards/ mouse etc. The profile and dimension shall be decided during detailed engineering and shall be subject to Owner's approval. Scrolling Mimic of complete Proposed ash handling system shall be configured on OWS. It shall be possible to control / monitor / operate the system from OWS. 3.02.00 Separate, vertical, free standing PLC panels with Perspex/glass door for visual access to LEDs shall be provided for high concentration slurry disposal system. 3.03.00 Power distribution equipment i.e. Transformers/ UPS/Power Supplies/Backup Batteries/ MCBs etc shall be housed in a separate free standing vertical panel. 4.00.00 SYSTEM CONFIGURATION 1). The control and sequential operation of the all the drives and equipment within the Proposed ash handling system shall be done by field proven Programmable Logic Controller (PLC) system. 2). The PLC system shall be provided with 2x100% processors in hot standby mode. Standby processor shall be energized and continuously monitored for healthiness. In case of failure of working processor, the standby processor shall take over the operation automatically by bump less transfer and necessary failure alarm shall be provided. Both the work stations of PLC system shall be suitable for operation and also for programming hence software shall be provided accordingly. The processor along with their accessories shall be housed in a free standing vertical type PLC panel separate from control desks and shall be located in the control room. The OWS shall consist of PC (latest model), TFT monitor with key board, mouse etc 3). The processors along with OWS, printer etc. and control panels shall be interlinked through independent dual data highway and dual I/O communication links.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
5.00.00 6.00.00	4). Mimic of entire Proposed ash handling system shall be provided on PLC graphic. Group annunciation shall be provided for various abnormal conditions through PLC. The list of required annunciations shall be finalized during detail engineering. Detailed alarm lists shall be displayed on TFT. 5). The PLC shall provide supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc. and also perform self monitoring and diagnostic functions. CONTROL PHILOSOPHY 1). Normal / local mode of operation shall be selected from the key board. (a) In normal mode of operation, which shall be the default mode, all drives shall be operated from control desk through keyboard. Whenever required for maintenance, the maintenance mode will be selected from the keyboard of the operation, except trip interlocks is locked using a unique password. After maintenance, the drives shall be started from operator's station through all process interlocks, by re-entering the password. Normal mode of operation can be selected then. Irrespective of any PLC mode of operation, the running equipment can be stopped from keyboard or from desk/panel or from emergency stop push button. TRAINING Further to the relevant clause regarding training specified elsewhere, Bidder's experienced personnel/engineers shall also provide training courses on offered PLC system to Employer's engineers in the following areas: (a.) Operator training (b.) Hardware Maintenance training (c.) Software training (d.) Any other specialized training as required for system operation and maintenance. The maintenance training shall include lectures and hands on experience on similar type of equipment / system at manufacturer works and recently commissioned operating plant and / or training simulator. The Owner shall require training of two hardware and two software engineers and the duration of each course shall be minimum two weeks. The details of hardware and software training shall be finalized during detailed engineering and shall be subject to Employer's approval.			
	KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-10 CONTROL PANEL Page 2 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
7.00.00 7.01.00	PLC EQUIPMENT AND SYSTEM REQUIREMENTS PLC system shall consist of redundant processors, Industrial PCs with TFT (latest version with latest application software) & keyboard, I/O modules, UPS/power supply with battery backup, printer etc. Each PC based operating and programming workstation shall be fully equipped for operation and control of the entire Proposed ash handling system. The configuration of PLC shall be as per enclosed drawing. Details of various components shall be as given below: a) Processor Two (2) numbers. one as hot standby b) Memory Non volatile EPROM, Lithium or Ni-Cd battery for 360 hours backup, 20% spare capacity for future use. c) Selection Normal/Test/Programmed/Off facility shall be provided. In test mode all outputs shall be blocked. d) Monitor & Keyboard Twenty inches (20 inches) TFT flat monitors with resolution of 1280 x 1024 pixels non interfaced, refresh rate min. 75Hz, with flat membrane type keyboard/ mouse. Provision for erasing and duplicating the user program and long storage facility, forcing facility for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements shall be provided. The numbers of OWS shall be as per PLC configuration diagram. e) Processors & I/O racks Modular design. Possible to change any module without disconnection of any wire. Keying in of individual wire connectors shall be provided to ensure that only the correct card is plugged on the I/O module. Wiring between I/O cards & terminal blocks shall be through prefab cables. Twenty (20%) percent spare capacity in input output and CPU memory modules shall be provided in each rack over and above system requirement. The number and location of I/O panels shall be subject to Employer approval during detailed engineering. All Output cards shall be sourcing type and Input cards shall be sinking type. f) Isolation between Input, Output and controller 1.5 KV with opto couplers.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	g) Indication Individual signal status of each Input / Output, power supply status. h) Fail safe mode On power supply failure / both PLCs failure / communication failure etc. the output shall be automatically switched over to fail safe mode. In CPU, memory should exist where the sequence was aborted. Further, in case of such failures, operating drives / equipment shall be tripped or kept running as per a pre-determined programmable requirement finalized during detail engineering. i) Fusing philosophy Individual fuses with blown fuse indicator for each output. Individual fuses for each input/ group of inputs, keeping in view of system availability. j) Switching capacity Output modules shall be rated to switch on/off coupling relays of 2.5 VA at 24V DC and solenoid valves at 110 V AC. Coupling relays are provided in Switchgears. k) HMI/CPU and Input output communication link Hundred percent redundant Communication links through cables routed in separate GI conduits. l) Printer Color laser printer shall be suitable for A4 size paper, 4 pages per minute, 600 dpi (black) and heavy duty(>_ 30000 pages per month) Number of printers shall be as shown in the tender drawing. m) Power supply i) Two (2) nos 415V AC feeders shall be provided for each control panel / desk panels. ii) Power supply to control system i.e., PCs, printer etc. shall be fed through 2x100% UPS with battery back-up rated for 30 minutes at full load. The UPS shall be smart type line interactive complete with software & hardware for remote management along with features of surge suppression & AVR facility. The UPS and batteries shall be rated for 20% spare capacity.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	iii) For PLC (processor) panels, redundant 24 V DC power supply shall be provided. Separate power supplies shall be provided for separately mounted I/O racks. Necessary redundant transformers and redundant chargers with 24 V DC battery back-up rated for 30 minutes shall be provided to derive power from 415 V redundant power supply . Power supply modules shall be of ample capacity with 20% spare capacity for future use. All voltage supplies shall be monitored. iv) The batteries shall be sealed maintenance free NI-CD type. n) Command hierarchy Manual command shall prevail over auto command. Protection command shall have priority over all other commands. o) Data bus Hundred percent redundant. Necessary interface hardware and software for dual fibre optic connectivity and interconnection with station wide LAN for two way transfer of signals shall also be provided for integration with Employer's DCS through OPC compliant Ethernet link following TCP/IP standards. p) Time Synchronisation system. To be synchronized with DCS. q) Date Insensitivity No disturbance due to change of date/year. r) System reaction time Less than 100 msec. from input signal to output signal including logic processing. s) Display response Max 1 sec for control related displays. 2 to 3 sec for other displays. t) Feedback/field interrogation By 24V DC. Status feedback from MCC/field shall be in the form of one changeover contact. Discrepancy shall be alarmed. All analog signals shall be routed through analog cards.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	u) Programming format v) Long time storage & retrieval w) Software x) Accessories y) Software license z) Software upgrades <td> Flow chart/Block logic ladder diagram. The same shall be submitted for owner's review before programming of the system. 168 hours latest data on hard disc. Data to be stored: i) Alarm list. ii) Five analog points at scan rate. iii) Fifteen analog points at one secs rate. iv) Balance analog points at 5 minutes rate. v) Binary points on status change. vi) Log reports. All application software with locks and passwords for PLC functioning like input/output scanning, acquisitions, condition processing, control and communication, operator interface of monitors, display trends, curves, bar charts, historical storage/ retrieval and alarm functions. Complete set of documents for modifications / editing / additions/ deletions of features in software. Comprehensive list of all application/system software. Industrial grade furniture shall be provided along with control desk/OWS/printer. The contractor shall provide software license for all software being used in PLC based control system including HMI. The software licenses shall be provided for the project and shall not be hardware/machine specific. All licenses shall be valid for the continuous service life of the plant. As a customer support the contractor shall periodically inform the designated officer of the employer about the software upgrades / new releases that would be taking place after the system is commissioned so that if required, same can be procured and implemented at site. </td> <td></td> <td></td>	Flow chart/Block logic ladder diagram. The same shall be submitted for owner's review before programming of the system. 168 hours latest data on hard disc. Data to be stored: i) Alarm list. ii) Five analog points at scan rate. iii) Fifteen analog points at one secs rate. iv) Balance analog points at 5 minutes rate. v) Binary points on status change. vi) Log reports. All application software with locks and passwords for PLC functioning like input/output scanning, acquisitions, condition processing, control and communication, operator interface of monitors, display trends, curves, bar charts, historical storage/ retrieval and alarm functions. Complete set of documents for modifications / editing / additions/ deletions of features in software. Comprehensive list of all application/system software. Industrial grade furniture shall be provided along with control desk/OWS/printer. The contractor shall provide software license for all software being used in PLC based control system including HMI. The software licenses shall be provided for the project and shall not be hardware/machine specific. All licenses shall be valid for the continuous service life of the plant. As a customer support the contractor shall periodically inform the designated officer of the employer about the software upgrades / new releases that would be taking place after the system is commissioned so that if required, same can be procured and implemented at site.			
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8.00.00	PANEL CONSTRUCTION				
	a)	Type	Fabricated from cold rolled sheet steel		
			Frame thickness	2.0 mm	
			Enclosure thickness	1.6 mm	
			Gland plate thickness	3.0 mm	
	b)	Switches	AC22 category		
	c)	Fuses	HRC cartridge with visual operation indicator.		
	d)	Name Plates & Labels	Each panel shall be identified by a name plate. Panel internal equipment shall be identified by paint marking. Nameplates shall be non rusting metal or 3-ply lamicaid, with engraved lettering and shall be subjected to Owner's approval.		
	e)	Grounding	25 x 3 mm copper ground bus to be provided for each panel		
	f)	Space heater	240V AC, single phase, thermostatically controlled space heaters to be provided.		
	g)	Terminal block	650V grade. clip-on type.		
	h)	Type	Elmex - CATD type for CTs. Elmex - CSLT for other application.		
	i)	Spare	20 percent.		
j)	Wiring	650V grade. PVC insulated stranded copper wire.			
k)	Panel Lighting	Each free standing panel shall be provided with a door switch operated fluorescent lamp and a 240V AC plug point.			
l)	Painting	Treatment as per IS:6005. Two coats of lead oxide primer followed by powder painting with final paint shade of RAL 9002.			
m)	Degree of enclosure protection	For panels located in i) Air conditioned areas : IP-32			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-10 CONTROL PANEL	Page 7 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
9.00.00	ii)Other indoor areas : IP-52 iii)Outdoor areas : IP-55 iv)Dusty areas like : IP-65 ash silos etc. n) Anti vibration pads Cushy foot type anti vibration pads to be provided for all the panels to be mounted on the machines.			
	ANNUNCIATION SYSTEM i) Facia Translucent glass/plastic window with engraving. ii) Operation Through PLC. a) On occurrence of trouble Audible horn and flashing of facia lamp. b) Acknowledge button pressed Audible horn and flashing of facia lamp shall stop. Facia lamp will become steady. c) Reset button pressed If fault is removed then facia lamp will go off. d) Test button pressed All lamps will glow. iii) Monitoring Power supply to annunciator shall be monitored.			
10.00.00	TYPE TESTS (a.) All equipments to be supplied shall be of type tested design. During detailed 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 from the date of bid opening. These reports should be for the tests 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. (b.) However if the 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 case the 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. (c.) All acceptance and routine tests as specified below and in relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-10 CONTROL PANEL	Page 8 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
10.02.00 10.02.01 10.02.02	(d.) <i>The type test reports once approved for any projects shall be treated as reference. For subsequent projects if 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</i> Programmable logic controller Following test reports shall be submitted for the equipment: - a). Dry heat withstand test - b). Variation of temperature immunity test - c). Variation immunity test - d). Temperature cycle test - e). Noise immunity test - f). Dielectric test. Following tests shall be conducted under this contract as routine tests: - a). Tests on internal and external wiring. - b). Incoming power supply voltage and frequency variation test. - c). Test for verification of functional characteristics of I/Os. - d). Task transition test (for each task, the contractor will list out the user accessible conditions which shall be used in the simulation of the task). - e). Functional testing of software and hardware in accordance with the approved block logic diagram with simulation of the system with switches, relays and solenoid valves etc. or equivalent loads.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION II- E-10 CONTROL PANEL	Page 9 of 9

SUB-SECTION-III-C&I

**DETAILED TECHNICAL SPECIFICATION
(CONTROL & INSTRUMENTATION SYSTEMS)**

SUB-SECTION-III-C&I-01

MEASURING INSTRUMENTS
(PRIMARY AND SECONDARY)

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) 1.00.00 MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) 1.01.00 Bidder shall supply instruments as specified in part – A complying with the relevant clauses of this section. Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, and makes/numbers as approved by the Employer during detailed engineering. 1.02.00 Every panel-mounted instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus. Screwed type terminals can also be used for signal connection instead of plug in socket type terminals for instruments & solenoids mounted in the equipment skids or panels if it is the standard and proven design of equipment manufacturer. 1.03.00 All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided on as required basis within the quoted lump sum price. For bidding purpose, tentative minimum instruments have been indicated on the P&IDs. However, contractor shall supply any additional local gauges /switches /transmitters / sensors for reasons mentioned above without any additional cost to the Employer. 1.04.00 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 1 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS		एन टी पी सी NTPC																
	these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.																		
1.05.00	All instruments envisaged for sea water application shall be provided with wetted parts made of Monel/ Hastelloy C or any other better material (if proven ness experience of the proposed material for such applications is established by contractor)																		
1.06.00	For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.																		
2.00.00	SPECIFICATION FOR TRANSMITTERS																		
2.01.00	Specification for Electronic Transmitters for Press, Diff Press, DP based Flow, Level measurement.																		
	<table><tr><th>Sr.No</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><tr><td>1.</td><td>Type of Transmitter</td><td>: Microprocessor based 2 wire type (loop powered), HART protocol compatible.</td></tr><tr><td>2.</td><td>Accuracy</td><td>: ± 0.1% of calibrated span (minimum)</td></tr><tr><td>3.</td><td>Output signal</td><td>: 4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)</td></tr><tr><td>4.</td><td>Turn down ratio (minimum)</td><td>: 10:1 for vacuum/very low pressure applications. (i.e. pressure <= 200mmWC). 5:1 for very high pressure applications (i.e. pressure >= 200 Kg/cm2). 30:1 for other applications.</td></tr></table>				Sr.No	Features	Essential/Minimum Requirements	1.	Type of Transmitter	: Microprocessor based 2 wire type (loop powered), HART protocol compatible.	2.	Accuracy	: ± 0.1% of calibrated span (minimum)	3.	Output signal	: 4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)	4.	Turn down ratio (minimum)	: 10:1 for vacuum/very low pressure applications. (i.e. pressure <= 200mmWC). 5:1 for very high pressure applications (i.e. pressure >= 200 Kg/cm2). 30:1 for other applications.
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	5.	Stability	:	$\pm 0.1\%$ of calibrated span for six months for Ranges up to and including 70 Kg/cm ² (g). $\pm 0.25\%$ of calibrated span for six months for Ranges more than 70 Kg/cm ² (g).	
	6.	Zero and span drift	:	+/- 0.015% per deg.C at max span. +/-0.11% per deg.C at min. span.	
	7.	Load impedance	:	500 ohm (min.)	
	8.	Housing	:	Weather proof as per IP-65, metallic housing with durable corrosion resistant coating.	
	9.	Over Pressure	:	150% of max. Operating pressure.	
	10.	Electrical connection	:	Plug and socket type.	
	11.	Process connection	:	1/2 inch NPT (F)	
	12.	Span and Zero adjustment	:	Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility.	
	13.	Accessories	:	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & Gauge pressure transmitters, 3-valve manifold for vacuum pressure transmitters & where DP transmitters are being used for pressure measurement and 5 valve manifolds for DP/Level/Flow application. -For hazardous area, explosions proof enclosure	
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 3 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC	
2.02.00				as described in NEC article 500.	
	14.	Diagnostics & Display	:	Self-Indicating feature and digital display on transmitter.	
	15.	Power supply	:	24V DC ± 10%.	
	16.	Adjustment/calibration/ maintenance	:	Using hand held HART calibrators	
	Notes				
	1) LVDT type is not acceptable.				
	2) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.				
	Specifcation for ULTRASONIC TYPE LEVEL TRANSMITTER				
	S.No.	Features	Essential/Minimum requirement		
	1.	Type of Transmitter	Non-contact Microprocessor based 2 wire (loop powered) type, HART protocol compatible Ultrasonic transmitter.		
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)			
3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.			
4.	Power supply	24 V DC +/-10%.			
5.	Temperature compensation	To be provided within transducer.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 4 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	6.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.	
	7.	Adjustment/calibration/maintenance	Using hand held HART calibrator	
	8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc..	
	9.	Sensor Material	Corrosion resistant material to suit individual application requirement.	
	10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.	
	11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.	
	12.	Display	Integral digital display	
	13.	Diagnostics	Loss of echo alarm etc.	
	14.	Load Impedance	500 ohms minimum	
	15.	Electrical Connection	Plug and socket	
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 5 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	16.	Accessories	- All weather canopy for protection from direct sunlight and direct rain. - All mounting accessories required for erection and commissioning shall be provided. - For hazardous area, explosion proof enclosure as described in NEC article 500	
Note: 1) Contractor can also provide Radar type transmitter in place of ultrasonic transmitters subject to approval by Employer during detailed Engineer. Sonic frequency based transmitters can also be provided under “ultrasonic transmitters” category for solid applications e.g. ash silo level etc. 2) The frequency used for Ultrasonic /sonic measurements shall be suitable for envisaged applications and this shall be supported by the standard product catalogue of the instrument manufacturer. 3) Four wire type transmitters can also be provided for applications where 2-wire transmitter has some technical limitations, subject to employer’s approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC. 4) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																				
2.03.00	NOT USED																																				
2.04.00	Specification for TEMP ELEMENTS																																				
2.04.01	Specification for Resistance Temperature Detector (RTD)																																				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC												
2.04.02	8	Standard	:	IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for thermo well.												
	NOTES :															
	1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.															
	2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.															
Specification for Thermocouples																
<table><tr><th>Sr.No</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><tr><td>1</td><td>Type of Thermocouple.</td><td>: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded type).</td></tr><tr><td>2</td><td>No. of element</td><td>: Duplex</td></tr><tr><td>3</td><td>Housing/Head</td><td>: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. Headless type of TE can be provided for special applications where equipment design limitations restrict the head type arrangement.</td></tr></table>					Sr.No	Features	Essential/Minimum Requirements	1	Type of Thermocouple.	: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded type).	2	No. of element	: Duplex	3	Housing/Head	: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. Headless type of TE can be provided for special applications where equipment design limitations restrict the head type arrangement.
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	4	Insulation and Sheathing of Thermocouple	: Swaged type mineral insulation (magnesium oxide) and SS316 sheath.	
	5	Calibration and accuracy	: As per IEC-584 /ANSI-C-96.1 (special class) for T/C.	
	6	Characteristic	: Linear with respect to temp, within $\pm 1/2$ percent of top range value.	
	7	Accessories	: Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.	
	8	Standard	: ANSI C 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well.	
	Notes :			
	1) The specifications for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice However type of thermocouples shall be K type.			
2.04.03	Specification for Thermo well			
	Thermo well shall be one piece solid bored type of 316 SS of step-less tapered design, (As per ASME PTC 19.3 1974).			
3.00.00	Hand held calibrator			
	The hand held type calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
4.00.00	Specification for Press Gauge, DP Gauge, Temp Gauge, Level Gauge				
		FEATURES	ESSENTIAL/ MINIMUM REQUIREMENTS		
			Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
	1	Sensing Element	Bourdon for high pressure measurement, Diaphragm/ Bellow for low press measurement.	Mercury in steel / inert gas actuated.	Tempered * toughened Borosilicate gauge glass , steel armoured reflex or transparent type.
	2	Body material	Die-cast aluminum.	Die-cast aluminum.	Forged carbon steel/ 304 SS.
	3	Dial size	150 mm.	150 mm	Tubular covering Process connection± 2%
	4	End connection.	1/2 inch NPT (F) as per ASME PTC.	1/2 inch or 3/4 inch NPT (M).	Process connection as per ASME PTC and drain/vent 15 NB.
	5	Accuracy	±1% of span	± 1% of span	± 2%
	6	Scale	Linear, 270° arc graduated in metric units.	Linear, 270° arc graduated in °C.	Linear vertical
	7	Range selection	Shall cover 125% of max operating press.	Shall cover 125% of max operating temp.	Shall cover max process level.
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनडीपीएल NTPC				
	8	Over range test	125% of FSD.	125% of FSD.	
	9	Housing	Weather and dust proof as per IP-55.	Weather and dust proof as per IP-55.	CS/ 304 SS leak proof.
	10	Zero/span adjustment	Provided	Provided	—
	11	Identification	Suitable metal service tag shall be provided.		
	12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal(if required by process) gauge isolation valve.	SS Thermo well	Gasket for all KEL-F shields for transparent type. Vent and drain valves of Steel/ SS as per CS/ Alloy process Requirement. For acid / alkali applications material of drain and vent valves shall be as suitable for these mediums.
	13	Material of sensor/ movement	316 SS / 304 SS	316 SS / 304 SS	
	Notes:- 1) *Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services. Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 11 of 18	

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																											
5.00.00	2) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. 3) Pressure/ Diff pressure gauges for very low press/ DP measurements can have sensor material other than SS316 e.g. silicon etc., if the offered material is suitable for that application and the offered product is standard product of the manufacture for very low pressure applications. 4) The specifications for gauges which are integral part of motor bearings can be as per their manufacturer standards.																														
	ROTAMETER																														
	<table><tr><th>Sr. No.</th><th>Features</th><th>Essential / minimum requirements</th></tr><tr><td>1.</td><td>Type</td><td>Variable area metal tube type.</td></tr><tr><td>2.</td><td>Fluid media</td><td>Water/oil</td></tr><tr><td>3.</td><td>Tube body</td><td>SS 316</td></tr><tr><td>4.</td><td>Material of float</td><td>316 SS</td></tr><tr><td>5.</td><td>Indicator</td><td>Linear scale.</td></tr><tr><td>6.</td><td>Accessories</td><td>Flange, orifice in case of bypass Rota meter (for line size above 50 100 mm).</td></tr><tr><td>7.</td><td>Housing protection class</td><td>IP-55</td></tr><tr><td>8.</td><td>Accuracy</td><td>+/- 2% of full range</td></tr></table>				Sr. No.	Features	Essential / minimum requirements	1.	Type	Variable area metal tube type.	2.	Fluid media	Water/oil	3.	Tube body	SS 316	4.	Material of float	316 SS	5.	Indicator	Linear scale.	6.	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 50 100 mm).	7.	Housing protection class	IP-55	8.	Accuracy	+/- 2% of full range
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KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 12 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS				
6.00.00	PROCESS ACTUATED SWITCHES				
	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS			
		Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches	
	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low press/ vacuum	Vapor pressure sensing type, Liquid filled bellow type with SS bulb and capillary (5 mtr minimum)	Capacitance types, Float type, Conductivity type, RF type, Ultrasonic type as per suitability to the application.	
	Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS	
	End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard	
	Over range proof pressure	150% of Design press.	-	150% of design press.	
	Repeatability	+/-0.5% of full range	+/-0.5% of full range.	+/-0.5% of full range.	
	No. of contacts	2 No+2NC SPDT snap action dry contact			
	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS or PLC)			
	Elect. Connection	Plug in socket			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 13 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC
	Set point adjustment	Provided over full range.			
	Dead band/ differential	Adjustable/ fixed as per requirement of application.			
	Enclosure	Weather and dust proof as per IP-55 , metallic housing.			
	Accessories	Syphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and other required accessories.	All mounting accessories	
	Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-	
	Notes : 1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. 2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 e.g. silicon etc., if the offered material is suitable for that application and the offered product is standard product of the manufacture for very low pressure applications. 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range. 4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 14 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
7.00.00	manufacturer shall submit the adequate supporting documents for establishing their standard practice			
	DEW POINT METER:-			
	Sensor			
	Type : Capacitance type with change in output proportional to moisture present.			
	Service : Dry Air			
	Range : -50 to 0 Degree Centigrade Dew-point.			
	Sensor Accuracy : Better than +/- 0.5 %			
	Operating Temperature : 0 to 50 degree C.			
	Operating Pressure : 0- 10 Kg/ Cm ² , suitable for process application.			
	Analyser			
	Input : Change in capacitance from dew point sensor.			
	Display : Combined enclosure with two three-digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.			
	Range : -50 to 0 Degree Centigrade Dew-point.			
	Display Accuracy : Better than +/- 2 Degree C.			
	Mounting : Table top/ Flush mounting, to be finalised during detailed engineering.			
	Power supply : 240 V AC, 50 Hz to be arranged by the contractor.			
	Output : 4-20 mA DC capable of driving a load impedance of 500 ohms minimum.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	4-20 mA DC Output signal is to be connected to control system. In case the system is not suitable for Direct online mounting, then all the required sampling system is to be provided by the contractor. All required accessories including cables, sensor holder, desiccant chambers, mounting fixtures etc. are to be supplied by the Contractor within his quoted lump sum price. Dew point meter to be provided with compressor can have some differences in specification w.r.t above mentioned specification. This will be acceptable if it is as per standard practice/accessory of compressor supplier.			
8.00.00	NOT USED			
9.00.00	Specification for Limit Switches of pneumatic actuators / manual valves Limit switches shall be silver plated with high conductivity and non corrosive type. Contact ratings shall be sufficient to meet the requirement of control system subject to a minimum 60V DC, 6VA rating. Protection class shall be IP-55.			
10.00.00	OPACITY MONITORS AT ESP OUTLET			
10.01.00	Each of the ESP gas streams shall be provided with one opacity monitor, installed on the ducting between ESP and the common duct at ID fan inlets. Sufficient straight duct length as recommended by the opacity monitor manufacturer shall be provided by the Bidder upstream of the proposed point of location to ensure laminar flow of the flue gas. Approach & Platform shall be provided for maintenance of each opacity monitor.			
10.02.00	The flue gas opacity monitors at ESP outlet shall meet the following specifications: i) The instrument shall be In-situ dry type visible light (through LED) based on transmission and absorption principle. ii) Separate isolated 4-20 mA DC signals shall be provided for indication in ESP control room and in Employer's DDCMIS. Dust emission in terms of mg/Nm³ shall be monitored. The system shall include all devices, software necessary for computing dust emission in mg/Nm³. iii) Compliance to standards: USEPA/ TUV/ MCERTS or equivalent standard. iv) The instrument shall automatically and continuously correct the measurement of variations in temperature, line voltage, ambient			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 16 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS																											
	illumination, lamp ageing, detector drift and associated shift in component characteristics. v) Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens and reflector during purge air failure. vi) The instrument shall be provided with automatic zero and span calibration capability with manual over-ride facility. The automatic calibration interval shall be selectable from the remote control unit. vii) Alignment indicator shall be provided in transceivers to permit visual observation of system alignment. viii) The opacity monitor shall be designed to operate with flue gas temperature between 100-200°C continuously. The temperature may exceed this value for a short time following failure of air heaters. The equipment shall not be damaged during such excursion. ix) The vendor shall, after installation at site, establish the correlations between the optical density output and particulate grain loading for display and recording of particulate grain loading. (x) Specification requirements:- <table><tr><td>(a) Accuracy</td><td>2% of FS or better</td></tr><tr><td>(b) Linearity</td><td>+/-1% of FS</td></tr><tr><td>(c) Repeatability</td><td><=1% of span</td></tr><tr><td>(d) Span drift</td><td><=1% measured value/ week</td></tr><tr><td>(e) Zero drift</td><td><=1% span/week</td></tr><tr><td>(f) Range</td><td>0 - 200 mg/Nm³ (programmable)</td></tr><tr><td>(g) Response time (upto 90% of FS)</td><td><=5 sec</td></tr><tr><td>(h) Zero & span adjustment</td><td>To be provided with range selection facility.</td></tr><tr><td>(i) Ambient temp</td><td>50 Deg C</td></tr><tr><td>(j) Enclosure type/ material</td><td>Weather and dust proof as per IP-55 / Die cast aluminum or SS</td></tr><tr><td>(k) Power Supply (nominal)</td><td>240V AC</td></tr><tr><td>(l) Indication</td><td>Digital alphanumeric display. Display of reading in engineering units shall be provided. Remote control unit shall</td></tr></table>				(a) Accuracy	2% of FS or better	(b) Linearity	+/-1% of FS	(c) Repeatability	<=1% of span	(d) Span drift	<=1% measured value/ week	(e) Zero drift	<=1% span/week	(f) Range	0 - 200 mg/Nm³ (programmable)	(g) Response time (upto 90% of FS)	<=5 sec	(h) Zero & span adjustment	To be provided with range selection facility.	(i) Ambient temp	50 Deg C	(j) Enclosure type/ material	Weather and dust proof as per IP-55 / Die cast aluminum or SS	(k) Power Supply (nominal)	240V AC	(l) Indication	Digital alphanumeric display. Display of reading in engineering units shall be provided. Remote control unit shall
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KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 17 of 18																								

CLAUSE NO.		TECHNICAL REQUIREMENTS			
			display reading in mg/Nm ³ as well as diagnostics and alarms.		
	(m) Type of Electronics		Microprocessor based with self-diagnostic feature. Status indication of in-situ equipment such as lamp, air filters, shutters, optical surfaces (windows and reflectors) and over range operation etc. shall be provided in remote control unit.		
	(m) Mean interval between maintenance cleaning		Not less than 90 days		
	(n) Auto calibration interval		1 to 24 hours (remote selectable)		
10.03.00	The bidder shall furnish his suggested installation details along with the proposal. These shall be subject to Employer's approval during detailed engineering stage. All accessories/ fittings/ tubing/ cables, etc. as required for installation of instrument shall be provided by the Contractor.				
10.04.00	The bidder shall clearly bring out in his offer the frequency of cleaning/ maintenance of the lenses and other components of the opacity monitors to ensure its trouble free, reliable continuous operation.				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	Page 18 of 18

SUB-SECTION-III-C&I-03

INSTRUMENTATION & POWER SUPPLY CABLES

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
1.00.00	INSTRUMENTATION CABLE, CONTROL & POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYS ETC)				
1.01.00	General requirements				
1.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.				
1.01.02	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope and ensuring completeness of the control system.				
1.01.03	Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.				
1.01.04	Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.				
1.01.05	Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.				
1.01.06	Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sump price without any further cost implication to the Employer.				
2.00.00	SPECIFICATION OF INSTRUMENTATION CABLE				
2.01.00	Common Requirements				
	S. No.	Property	Requirement		
	1	Opearting Voltage	225 V (peak value)		
	2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.		
	3.	Continuous operation suitability	At 70 deg. C for all types of cables, and at 205 Deg C for Type-C cables.		
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW) BIDDING DOC. NO.: CS-4210-104A(R&M)-2 TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP PART – B SUB-SECTION-III-C&I-03 INSTRUMENTATION & POWER SUPPLY CABLES Page 1 of 15					

CLAUSE NO.	TECHNICAL REQUIREMENTS																																												
2.02.00	<table><tr><th>S. No.</th><th>Property</th><th colspan="3">Requirement</th></tr><tr><td>4.</td><td colspan="4">Marking :- a.Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath. b.Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable c.Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath.</td></tr><tr><td>5.</td><td>Allowable Tolerance on overall diameter</td><td colspan="3">+/- 2 mm (maximum) over the declared value in data sheet</td></tr><tr><td>6.</td><td>Variation in diameter</td><td colspan="3">Not more than 1.0 mm throughout the length of cable.</td></tr><tr><td>7.</td><td>Ovality at any cross-section</td><td colspan="3">Not more than 1.0 mm</td></tr><tr><td>8.</td><td>CAGE-CLAMP suitability</td><td colspan="3">To be provided</td></tr><tr><td>9.</td><td>Color</td><td colspan="3">The outer sheath shall be of blue color.</td></tr><tr><td>10.</td><td>Others</td><td colspan="3">Repaired cables shall not be acceptable.</td></tr></table>					S. No.	Property	Requirement			4.	Marking :- a.Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath. b.Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable c.Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath.				5.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet			6.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.			7.	Ovality at any cross-section	Not more than 1.0 mm			8.	CAGE-CLAMP suitability	To be provided			9.	Color	The outer sheath shall be of blue color.			10.	Others	Repaired cables shall not be acceptable.		
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	Specification Requirements		Type-A cable	Type-B cable	Type F & G cable	Type-C cable																																							
	A. CONDUCTORS																																												
	Cross section area		0.5 sq. mm																																										
	Conductor material		ANSI type KX	ANSI type SX	Annealed bare copper	ANSI type KX																																							
	Colour code		Yellow-Red	Black-Red	As per VDE-815	Yellow-Red																																							
Conductor Grade		As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1																																								
No & dia of strands		7x0.3 mm (nom)																																											
No. of Pairs		2	2	2*/4/8/12/16/24/48 * 2 pair cable shall be used from Field to Local JB only.	2																																								
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनडीपीसी NTPC
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
				For connection between field and DDCMIS Marshalling cabinet minimum 4 Pair cable shall be used.	
	Max. conductor loop resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4	As per ANSI MC 96.1
	Reference Standard	As per ANSI MC 96.1		VDE : 0815	As per ANSI MC 96.1
	B. INSULATION				
	Material	Extruded PVC type YI 3			Teflon (i.e. extruded FEP)
	Thickness in mm (Min/Max)	0.25/0.35			0.4 / 0.50 (nominal)
	Volume Resistivity (Min) in ohm-cm	1 x 10 ¹⁴ at 20 deg. C & 1x10 ¹¹ at 70 deg. C.			2.8x 10 ¹⁴ at 20 deg. C & 2x10 ¹¹ at 205 deg. C.
	C. PAIRING & TWISTING				
	Max. lay of pairs (mm)	50			
	Single layer of binder tape on each pair provided	Each core printed with number or Numbered binder tape to provided on each pair	Yes		Each core printed with number or Numbered binder tape to be provided on each pair
	Bunch (Unit Formation) for more than 4P	N.A	To be provided		N.A
	Conductor /pair identification as per VDE0815	N.A.	To be provided		N.A.
	D. SHIELDING				
	Type of shielding	Al-Mylar tape			
	KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)~2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP		PART – B SUB-SECTION-III-C&I-03 INSTRUMENTATION & POWER SUPPLY CABLES

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनडीपीसी NTPC
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
	Individual pair shielding	No		To be provided for F-type cable	No
	Minimum thickness of Individual pair shielding	No		0.028mm (28 micron)	No
	Overall cable assembly shielding	To be provided			
	Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)			
	Coverage Overlapping	20%			
	Drain wire provided for individual shield	N.A.	Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper	N.A.	
	Drain wire provided for overall shield	Yes, Size- 0.5 sqmm, No of strands-7,Dia of strands-0.3mm,Annealed Tin coated copper			
	E. FILLERS (if applicable)				
	Non-hygroscopic, flame retardant	To be provided			
	F. OUTER SHEATH				
	Material	Extruded PVC compound YM1 with FRLS properties			Teflon (i.e. extruded FRP)
	Minimum Thickness at any point	1.8 mm			0.4 mm
	Nominal Thickness at any point	>1.8 mm			0.5 mm
	Resistant to water, fungus, termite & rodent attack	Required			
	Minimum Oxygen index as per ASTMD-	29 %			N.A.
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)--2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-03 INSTRUMENTATION & POWER SUPPLY CABLES	Page 4 of 15

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
	2863				
	Minimum Temperature index as per ASTMD-2863	250 deg.C			N.A.
	Maximum Acid gas generation by weight as per IEC-60754-1	20%			N.A.
	Maximum Smoke Density Rating as per ASTMD-2843	60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			N.A.
	Reference standard	VDE207 Part 5,VDE-816			VDE207 Part 6 ASTM D2116
	G. Electrical Parameters				
	Mutual Capacitance Between Conductors At 0.8 KHz (Max.)	200 nF/km	120 nF/km for F type 100 nF/km for G-type		200 nF/km
	Insulation Resistance (Min.)	100 M Ohm/Km			
	Cross Talk Figure (Min.) At 0.8 KHz	60 dB	60 dB		60dB
	Characteristic Impedance (Max) At 1 KHz	N.A.	320 OHM FOR F-TYPE 340 OHM FOR G-TYPE		N.A.
	Attenuation Figure At 1 KHz (Max)	N.A.	1.2 db/km		N.A.
	H. COMPLETE CABLE				
	Complete Cable	Shall pass Swedish Chimney test as per			N.A.
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-03 INSTRUMENTATION & POWER SUPPLY CABLES	Page 5 of 15

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
	assembly	SEN-SS 4241475 class F3.			
	Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			As per manufacturer's standard subject to employer's approval
	I. CABLE DRUM				
	Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to entire drum) or steel drum.			
	Length	1000 m $\pm$ 5% for up to & including 12 pairs 500 m $\pm$ 5% for above 12 pairs			
	Outermost cable layer covered with water proof paper	Yes			
	I. ACCESSORIES				
Cable accessories of flame retardant quality.	Yes. (Accessories such as harnessing components, markers, bedding, cable jointer, binding tape etc.)				
3.00.00	SPECIFICATION OF OPTICAL FIBER CABLES (OFC)				
3.01.00	Optic Fiber cable shall be 4/8/12 core, Electrolytically chrome plated corrugated steel taped (ECCST), fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacture, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.				
3.02.00	The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Dielectric central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum & crush resistance 4000 N minimum. The operating temperature shall be – 20 Deg. C to 70 Deg.C				
3.03.00	All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																						
3.04.00	Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fiber cables.																																						
3.05.00	Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.																																						
3.06.00	Spliced / Repaired cables are not acceptable.																																						
3.07.00	Penetration of water resistance and impact resistance shall be as per IEC standard.																																						
4.00.00	SPCIFICATION OF CONTROL & POWER SUPPLY CABLES Refer Electrical sub-sections.																																						
5.00.00	INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A. TABLE A: CABLE TERMINATION TO BE FOLLOWED																																						
<table><tr><th colspan="2">Application</th><th colspan="2">Type Of Termination</th><th rowspan="2">Type Of Cable</th></tr><tr><th>FROM (A)</th><th>TO (B)</th><th>END A</th><th>END B</th></tr><tr><td>Valves/dampers drives (Integral Junction box)</td><td>Marshalling / Marshalling – cum Termination Cubicle / local group JB</td><td>Plug in connector</td><td>Post mount cage clamp type.</td><td>G</td></tr><tr><td>Transmitters, Process Actuated switches mounted in LIE/LIR</td><td>Integral Junction box of LIE/LIR</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr><tr><td>RTD heads</td><td>Local junction box</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F</td></tr><tr><td>Thermocouple</td><td>Local junction box / CJC box (if applicable)</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>A, B, C*</td></tr><tr><td>Other Field mounted Instrument</td><td>Local JB / Group JB</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr></table>						Application		Type Of Termination		Type Of Cable	FROM (A)	TO (B)	END A	END B	Valves/dampers drives (Integral Junction box)	Marshalling / Marshalling – cum Termination Cubicle / local group JB	Plug in connector	Post mount cage clamp type.	G	Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F	Thermocouple	Local junction box / CJC box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A, B, C*	Other Field mounted Instrument	Local JB / Group JB	Plug in connector	Cage clamp (Rail mount) type.	F,G
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	Application		Type Of Termination		Type Of Cable
	FROM (A)	TO (B)	END A	END B	
	RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F
	Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A, B, C*
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR	Marshalling / Marshalling – cum Termination Cubicle	Cage clamp (Rail mount) type.	Cage clamp (Post mounted) type.	F,G
	Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp (Post mounted) type.	Plug-in connector / other system as per Mfr.'s Standard	Internal wiring
	Marshalling/ Termination System Cabinets	UCD mounted equipments	Cage clamp (Post mounted) type.	Plug in connector / Cage clamp type (rail mounted).	F,G (with plug-in connect or at one end)
	DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard
	Modulating electrical Actuator	Marshalling / Marshalling – cum Termination Cubicle / local group JB	Plug in connector/ Integral JB	Post mount cage clamp type.	F
Notes1 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables which shall be as per manufacturer's standard.					
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	Application		Type Of Termination		Type Of Cable
	FROM (A)	TO (B)	END A	END B	
	2 For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.				
	3 * For high temperature applications only.				
	6.00.00 TERMINAL BLOCKS				
	6.01.00 All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.				
	6.02.00 All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc.				
	6.03.00 The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.				
	6.04.00 For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.				
	6.05.00 The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.				
6.06.00 For ensuring proper connections, contractor shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalised as per application during detail engineering stage subject to employer's approval without any cost repercussions.					
6.07.00 Internal wiring in factory pre-wired electronic equipment cabinets may be installed according to the contractor's standard as to wire size and method of termination or internal equipment. Terminal blocks for connection of external circuits into factory prewired electronic equipment cabinets shall meet all the requirements as specified above.					
7.00.00 INTERNAL PANELS/ SYSTEM CABINETS WIRING					
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7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.			
7.02.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.			
7.03.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.			
7.04.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.			
7.05.00	All the special tools as may be required for solder less connections shall be provided by Bidder.			
7.06.00	Wiring to door mounted devices shall be done by 19 strand copper wire provided with adequate loop lengths of hinge wire so that multiple door opening shall not cause fatigue breaking of the conductor.			
7.07.00	Wire sizes to be utilised for internal wiring.			
	(i)	Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system.	0.5 Sq.mm.	
	(ii)	Power supply and internal illumination.	2.5Sq.mm. minimum (shall be as per load requirement.)	
8.00.00	INSTRUMENTATION CABLE INSTALLATION AND ROUTING			
8.01.00	All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.			
8.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:			
	From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm	
	From 415V tray system	-	610 mm	
	From control cable tray system	-	305 mm	
8.03.00	Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.			
8.04.00	Not in use			
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8.05.00	The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.				
9.00.00	CABLE LAYING AND ACCESSORIES				
9.01.00	CABLE LAYING				
	1	Cables shall be laid strictly in line with cable schedule.			
	2	Identification tags for cables.			
		Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.			
	3	Cable tray numbering and marking.			
		To be provided at every 10m and at each end of cable way & branch connection.			
	4	No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.			
	5	Buried cable protection			
		With concrete slabs; Route markers at every 20 Meters along the route & at every bend.			
	6	Road Crossings			
		Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between			
		- HT power & LT power cables,			
		- LT power & LT control/instrumentation cables,			
		Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.			
	7	Segregation (physical isolation to prevent fire jumping)			
	a	All cable associated with the unit shall be segregated from cables of other Units.			
	b	Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire.			
	8	Cable clamping			
		All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.			
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	9 Optical fiber cables (OFCs) : Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure Inside Building Area – to be laid on separate cable sub-trays While buried- in separate buried trench approx.1.0 meter depth, to be laid in 2” rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor; While crossing roads - to be laid in GI/rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete; While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe. 10 Laying of Network Cable (UTP/STP) : Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Tressle structure. Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.				
9.02.00	Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fiber Optic Card Cage, Fiber Optic Line Driver, Repeater / Modem (for Optical Fiber Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.				
9.03.00	Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, etc., which are required for maintenance of the system as per the type of termination used.				
9.04.00	Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.				
9.05.00	No splices shall be made in conductors for instrument and control circuits except where required at connections to devices equipped with factory installed pigtails. Such splices shall be made only in approved splicing boxes of fitting with removable cover. The splices shall be made with sufficient slack left in the wires to permit withdrawal of the splice from the splicing box for ease of future disconnection of the splices. All exposed conductor or connector surfaces shall be covered with a minimum of three half-lapped layers of all-weather vinyl plastic electrical tape. Taping shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the other insulation or connections requiring insulation.				
9.06.00	The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests. All the cables etc. required for grounding of all equipments supplied under this package are to be supplied by the Bidder.				
9.07.00	The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.				
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10.00.00	FIELD MOUNTED LOCAL JUNCTION BOXES (i) No. of ways 12/24/36/48/64/72/96/128 with 20% spares terminals. (ii) Material & Thickness 4mm thick Fiberglass Reinforced Polyester (FRP). (iii) Type Screwed at all four corners for door. Door gasket shall be of synthetic rubber. (iv) Mounting clamps and accessories Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply. (v) Type of terminal blocks Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm². An M6 earthing stud shall be provided. (vi) Protection Class IP-55 minimum for indoor & IP-65 minimum for outdoor applications. (vii) Grounding To be provided. (viii) Color 7035			
11.00.00	CONDUITS			
11.01.00	Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanized rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated steel, The temperature rating of flexible conduit shall be suitable for the following areas: (i) Mills (ii) Drum (iii) Main steam, RH steam (iv) Air Heaters (v) Furnace, BFPDTs For the remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided. And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided. The temperature rating of flexible conduit shall be suitable for actual application.			
11.02.00	The Bidder shall install conduits according to the general routing as approved by Employer and shall coordinate conduit locations with other works.			
11.03.00	All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductor. Conduit runs to individually mounted equipment shall be grounded to the Employer's cable tray grounding conductor with 12 AEG bare copper conductor. All grounding bushings, clamps and connectors shall be subject to approval of the Employer.			
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11.04.00	All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.			
11.05.00	All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one meter of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.			
11.06.00	Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main building framing to the control room framing.			
11.07.00	Conduit supports shall be furnished and installed in accordance with these specifications. Support material shall comply with the following requirements. i) Hanger rods shall be 12 mm diameter galvanized threaded steel rods. ii) Single conduit supports shall be one-hole cast metal straps and clamp backs unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.			
11.08.00	Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform to NEC requirements for the area classification.			
11.09.00	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilized for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.			
11.10.00	Conduits shall be securely fastened to all boxes and cabinets.			
12.00.00	CABLE SUB-TRAY & SUPPORT			
12.01.00	The cable sub-trays and the supporting system, to be generally used between Local/Group JB's and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).			
12.02.00	The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. The cable trays shall not have sharp edges, burrs or projections injurious to the insulation or outer sheath of the cables.			
12.03.00	The supporting arrangement of cable tray system shall be able to withstand the weight of the cable and cable tray system. The supporting interval shall not be more than the recommended span for the above loading for the type of cable tray selected. The tray shall			
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12.04.00	not overhang by more than one meter from the support at the dead end. As far as practicable the cable sub-tray system shall be supported from one side only, in order to facilitate installation and maintenance of cables. The Bidder shall furnish and install the estimated quantities and sizes of sub trays/troughs including all required fittings and adaptors on as required basis.			
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TYPE TEST REQUIREMENTS

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	TYPE TEST REQUIREMENTS 1.00.00 TYPE TEST REQUIREMENTS 1.01.00 General Requirements 1.01.01 The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipment/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard. (a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests. (b) For the rest, submission of type test results and certificate shall be acceptable provided. i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. ii. There has been no change in the components from the offered equipment & tested equipment. iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening. (c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account. 1.01.02 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer. 1.01.03 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion. 1.01.04 For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 																																																																																		
1.01.05	The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective test. If a test is waived off, then the cost shall not be payable.																																																																																		
2.00.00	TYPE TEST REQUIREMENT FOR C&I SYSTEMS <table border="1" data-bbox="225 443 1433 1877"> <thead> <tr> <th>Sl.No.</th><th>Item</th><th>Test requirement</th><th>Standard</th><th>Test to be specifically conducted?</th><th>NTPC's approval req. On test certificate?</th></tr> <tr> <th>Col 1</th><th>Col 2</th><th>Col 3</th><th>Col 4</th><th>Col 5</th><th>Col 6</th></tr> </thead> <tbody> <tr> <td>1</td><td>Thermocouple</td><td>Degree of protection test</td><td>IS-2147</td><td>No</td><td>No</td></tr> <tr> <td>2</td><td>RTD</td><td>As per standard (col 4)</td><td>IEC-751</td><td>No</td><td>No</td></tr> <tr> <td>3</td><td>Electronic transmitter</td><td>As per standard (col 4)</td><td>BS-6447 / IEC-60770</td><td>No</td><td>Yes</td></tr> <tr> <td>4</td><td>INSTRUMENTATION CABLES TWISTED & SHIELDED</td><td></td><td></td><td>No</td><td>Yes</td></tr> <tr> <td></td><td>-Conductor</td><td>Resistance test</td><td>VDE-0815</td><td></td><td></td></tr> <tr> <td></td><td></td><td>Diameter test</td><td>IS-10810</td><td></td><td></td></tr> <tr> <td></td><td></td><td>Tin Coating test (Persulphate test) applicable for drain wire only.</td><td>IS-8130</td><td></td><td></td></tr> <tr> <td></td><td>-Insulation</td><td>Loss of mass</td><td>VDE 0472</td><td></td><td></td></tr> <tr> <td></td><td></td><td>Aging in air ovens**</td><td>VDE 0472</td><td></td><td></td></tr> <tr> <td></td><td></td><td>Tensile strength and elongation**</td><td>VDE 0472</td><td></td><td></td></tr> <tr> <td></td><td></td><td>Heat shock</td><td>VDE 0472**</td><td></td><td></td></tr> </tbody> </table>					Sl.No.	Item	Test requirement	Standard	Test to be specifically conducted?	NTPC's approval req. On test certificate?	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	1	Thermocouple	Degree of protection test	IS-2147	No	No	2	RTD	As per standard (col 4)	IEC-751	No	No	3	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes	4	INSTRUMENTATION CABLES TWISTED & SHIELDED			No	Yes		-Conductor	Resistance test	VDE-0815					Diameter test	IS-10810					Tin Coating test (Persulphate test) applicable for drain wire only.	IS-8130				-Insulation	Loss of mass	VDE 0472					Aging in air ovens**	VDE 0472					Tensile strength and elongation**	VDE 0472					Heat shock	VDE 0472**		
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KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-04 TYPE TEST REQUIREMENTS	Page 2 of 5																																																																														

CLAUSE NO.	TECHNICAL REQUIREMENTS				
		Hot deformation	VDE 0472		
		Shrinkage	VDE 0472		
		Bleeding & blooming	IS-10810		
	-Inner sheath***	Loss of mass	VDE 0472		
		Heat shock	VDE 0472**		
		Cold bend/ cold impact test	VDE 0472		
		Hot deformation	VDE 0472		
		Shrinkage	VDE 0472		
	-Outer sheath	Loss of mass	VDE 0472		
		Aging in air ovens**	VDE 0472**		
		Tensile strength and elongation test before and after ageing**	VDE 0472**		
		Heat shock	VDE 0472**		
		Hot deformation	VDE 0472		
		Shrinkage	VDE 0472		
		Bleeding & blooming	IS-10810		
		Colour fastness to water	IS-5831		
		Cold bend/ cold impact test	VDE 0472		
		Oxygen index test	ASTMD-		
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – B SUB-SECTION-III-C&I-04 TYPE TEST REQUIREMENTS	Page 3 of 5

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			2863			
		Smoke Density Test	ASTMD-2843			
		Acid gas generation test	IEC-754-1			
	-fillers	Oxygen index test	ASTMD-2863			
		Acid gas generation test	IEC-754-1			
	-AL-MYLAR	Continuity test				
	shield	'Shied thickness				
		Overlap test				
	-Over all cable	Flammability	IEEE 383			
		Dimensional checks	IS 10810			
		Cross talk	VDE-0472			
		Mutual capacitance	VDE-0472			
		HV test	VDE-0815			
		Drain wire continuity				
11	Pressure gauge	Degree of protection test	IS-2147	No	No	
		Temp interference test	IS -3624	No	No	
12	Temperature gauge	Degree of protection test	IS-2147	No	No	
13	Pressure &	Degree of protection test	IS-2147	No	No	
	DP switch					
		As per standard (col 4)	BS 6134	No	No	
14	Level switch	Degree of protection	IS-2147	No	No	
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
		test				
15	Junction Box	Degree of protection test	IS-2147	No	Yes	
	NOTES:- Type tests are to be conducted only for the items which are being supplied as a part of this package. ** These tests shall be carried out as per VDE 0207, part6 & ASTM D-2116 for TEFLON insulated & outer sheath cables. as per VDE0207 for TEFLON insulated cables *** Applicable for armoured cables only. For instrumentation cables: 1.0 All cables to be supplied shall be of type tested quality. 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 from the date of bid opening. These reports should be for the tests 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. 2.0 In case the 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 case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.					
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PART- C

GENERAL TECHNICAL CONDITION

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	Clause No.	Description			
	1.00.00	General			
	2.00.00	Limit of contract			
	3.00.00	Justification of Proposed Design			
	4.00.00	Location and Layout Requirement			
	5.00.00	Equipment Performance Guarantee			
	6.00.00	Documents, Data and drawings to be furnished by Contractor			
	7.00.00	Engineering information Submission Schedule			
	8.00.00	Technical Coordination Meeting			
	9.00.00	Codes & Standards			
	10.00.00	Quality Assurance Programme			
	11.00.00	Manufacturing schedule			
	12.00.00	Design Improvements			
	13.00.00	Tests			
	14.00.00	Packaging and Transportation			
	15.00.00	Protection			
	16.00.00	Preservative Shop Coating			
	17.00.00	Protective guards			
	18.00.00	Design Co-ordination			
	19.00.00	Design Co-ordination Meeting			
	20.00.00	Tools, Tackles and Plants			
	21.00.00	Noise level			
	22.00.00	Taking over			
	23.00.00	Welding			
	24.00.00	Lubrication			
	25.00.00	Equipment Bases			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 			
	Clause No. Description 26.00.00 Rating Plates, Name Plates and Labels 27.00.00 Colour Code for all Equipments 28.00.00 Facilities by the Owner 29.00.00 Shaft Alignment 30.00.00 Dowelling 31.00.00 Equipment Delivery and Erection Annexures I to V- QA Formats Annexure VI CDROM/Documentation requirements			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 			
1.00.00	GENERAL			
1.01.00	The following provisions shall supplement all the detailed technical specifications and requirements brought out elsewhere in the specification, Erection Conditions of Contract (Part D) and Technical Data Requirements.			
1.02.00	The Contractor's proposal for Retrofitting of existing Electrostatic Precipitator shall fully comply with the requirements, specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment for replaced items based on the manufacturer's standard practice will also be considered, provided such offer is in line with Technical Specifications and such proposals meet the specified design standards and performance requirement are also acceptable to the owner. Sufficient amount of information for justifying such proposals shall be furnished to owner for the approval of proposals.			
2.00.00	LIMIT OF CONTRACT			
2.01.00	Equipment furnished by the Contractor shall be complete in every respect with all mountings, fixtures and standard accessories normally provided with such equipment and / or needed for erection completion, and safe operation of the equipments as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All similar standard components/ parts of similar standard equipments provided shall be interchangeable with one another.			
3.00.00	JUSTIFICATION OF PROPOSED DESIGN			
3.01.00	All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.			
3.02.00	The Bidder shall furnish the design basis for the equipments covered under the Scope of this specification. The Bidder shall also submit along with the offer a detailed write-up on the proposed design features and the details of similar designs, their operating experience and the recent modifications if any, and their specific advantages over the previous designs.			
4.00.00	LOCATION AND LAYOUT REQUIREMENT			
	The Bidder shall offer the best design to accommodate the renovated ESP and its accessories within the confines of the space available.			
5.00.00	EQUIPMENT PERFORMANCE GUARANTEE			
5.01.00	The performance guarantee for the equipments under the scope of the contract are detailed in the respective clauses of Part A, Sub-Section-VI. These guarantees shall supplement the general performance guarantee provisions covered under General Conditions of Contract in clause entitled, "Guarantee".			
5.02.00	Liquidated damages for shortfall in meeting performance guarantees during the Performance and Guarantee tests shall be assessed and recovered from the			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 			
6.00.00 6.01.00 6.02.00 6.03.00	contractor as detailed in Part A, Sub-Section-VI. Such liquidated damages shall be without any limitation whatsoever and shall be in addition to damages, if any, payable under any other clauses of Conditions of Contract. DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR Contractor may note that this is a Contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope. Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated. The Contractor shall furnish engineering data/drgs. in accordance with the schedule of information as specified in Technical Specification and Technical data sheet. The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in separate Annexure enclosed The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following: (a) Basic Engineering Documentation Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum: (i) System description of all the mechanical, electrical, control & instrumentation & civil systems. (ii) Technology scan for each system / sub-system & equipment. (iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options. (iv) Optimization studies including thermal cycle optimization. (v) Sizing criteria of all the systems, sub-systems including various piping systems/ equipment/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins. (vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.			
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	(vii) Operation Philosophy and the control philosophy of the equipment / system covered under the scope. (viii) General Layout plan of the ESP incorporating all facilities in Contractor's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in Contractor's scope. (ix) Basic layouts and cross sections of the ESP (various floor elevations), and other areas included in the scope of the Contractor. (x) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. (xi) The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer. (b) Detailed Engineering Documents i. General layout plan of ESP. ii. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the ESP. iii. Flow diagrams, Process & Instrumentation Diagrams along with write-up and system description. iv. Technical data sheets for all bought out and manufactured items. Contractor shall use the NTPC specifications as a base for placement of orders on their sub-vendors. v. Detailed design calculations for components, system/sub-system, piping etc., wherever applicable including sizing calculations for all auxiliaries as per criteria specified elsewhere in specification. vi. Comprehensive list of all terminal points which interface with Employer's facilities giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc. vii. Power supply single line diagram, block logics, control schematics, electrical schematics, etc. viii. Protection system diagrams and relay settings. ix. Interconnection diagrams. x. Cable routing plan. xi. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted			
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	instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xii. Alarm and annunciation list and alarms & trip set points. xiii. Sequence and protection interlock schemes. xiv. Type test reports and power system stability study report. xv. Control system configuration diagrams and card circuit diagrams and maintenance details. xvi. Detailed flow chart for digital control system. xvii. Man Machine Interface application engineering drawings & documents . xviii. Design basis, structural idealisation & GA, Foundation Load Data and other details of ESP supporting structure for design of foundation by employer. Foundation load data, Supporting structure documents, civil & Structural drawings and design for other structures in bidder's scope. xix. Model study reports wherever applicable. xx. Functional & guarantee test procedures and test reports. xxi. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. xxii. Documentation in respect of commissioning as listed out elsewhere in this specification. xxiii. Maintenance schedule for ESP clearly indicating interval, duration if shutdown required, man hours required and tools & tackles required for the maintenance.			
6.04.00	The Contractor while submitting the above documents / drawings for approval Reference as the case may be, shall mark on each copy of submission the reference letter along with the date vide which the submissions are made.			
6.05.00	Drawings (i) All documents/text information shall be in latest version of MS Office. (a) All the plant layouts shall be made in computerized 2D Format. (b) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I of Part-C. The soft copies to be supplied shall be uploaded by the vendor in c-folder, a web based			
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	system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC. Similarly the vendor can download the drawings/documents, approved/commented by NTPC, through above site. The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats. (c) Final copies of the approved drawings shall be submitted in vector form on CD-ROM along with the requisite number of hard copies as per Annexure-I. (ii) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. (iii) Each drawing submitted by the Contractor (including those of sub vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. (iv) The drawings submitted by the Contractor (or their sub vendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract. (v) The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". Each drawing/ document submitted by the Contractor shall clearly indicate on the drawing the scheduled date of submission of the drawing as agreed in the engineering information submission schedule. (vi) Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further space shall be identified on each drawing for approval stamp and electronic signature. (vii) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of			
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	these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipment provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer / Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. (viii) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. (ix) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/ system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. (x) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority / representative of Employer based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package. (xi) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability. (xii) As Built Drawings; After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit number of copies as per Annexure-I. (xiii) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The Contractor shall make a visit to site to see the existing facilities and			
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6.06.00	understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The Contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. (xiv) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule. (xv) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.			
	INSTRUCTION MANUALS The Contractor shall make First submission of Instruction Manuals for all the equipment/covered under the Contract by the end of nine months from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-I. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. (a) Erection Manuals The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. i) Erection strategy. ii) Sequence of erection. iii) Erection instructions. iv) Critical checks and permissible deviation/tolerances. v) List of tool, tackles, heavy equipment like cranes, dozers, etc. vi) Bill of Materials			
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	vii) Procedure for erection. viii) General safety procedures to be followed during erection/installation. ix) Procedure for initial checking after erection. x) Procedure for testing and acceptance norms. xi) Procedure / Check list for pre-commissioning activities. xii) Procedure / Check list for commissioning of the system. xiii) Safety precautions to be followed in electrical supply distribution during erection (b) Commissioning Manuals i. Commissioning Strategy ii. Sequence of commissioning iii. Commissioning Instructions iv. Critical checks list for all equipment v. Commissioning Procedures (c) Operation & Maintenance Manuals i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the Employer to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant / equipment including, operation, maintenance, dismantling and repair etc. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes of taking over until these manuals have been supplied to the Employer. ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the Employer for records. iii. A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings. iv. The manuals shall include the following :			
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	a) List of spare parts along with their drawing and catalogues and procedure for ordering spares. b) Lubrication Schedule and oil replacement including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation. c) Where applicable, fault location charts shall be included to facilitate finding the cause of mal operation or break down. v. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/ equipment/ assembly/sub-assembly - wise required for the complete plant. vi. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the Employer indicating lubrication method for each type/category of bearing.				
6.07.00	Plant Handbook The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of equipment and systems covering the complete ESP Package including - Design and performance data. - Process & Instrumentation diagrams. - Single line diagrams. - Sequence & Protection Interlock Schemes. - Alarm and trip values. - Performance Curves. - General layout plan - Important Do's & Don't's The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.				
6.08.00	Project Completion Report The Contractor shall submit a Project Completion Report at the time of handing over the plant.				
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7.00.00	ENGINEERING INFORMATION SUBMISSION SCHEDULE Prior to award to contract, a Detailed Engineering Information Submission Schedule/ master drawing list duly integrated with approved L2 schedule shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts. (a) Information that shall be submitted for the approval to the Employer before proceeding further, and (b) Information that would be submitted for Employer's information only. The Master Drawing List (MDL) shall be updated periodically and submitted to the Employer, highlighting the change made in the MDL. The schedule should allow adequate time for proper review and incorporation of changes/modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.				
7.01.00	ENGINEERING PROGRESS AND EXCEPTION REPORT				
7.01.01	The Contractor shall submit every month engineering progress and exception report giving the status of each engineering information including:- (a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission with reasons thereof. (b) Drawings which were not submitted as per agreed schedule.				
7.01.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.				
8.00.00	TECHNICAL CO-ORDINATION MEETING				
8.01.00	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.				
8.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as				
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	practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.																						
8.03.00	The Contractor shall ensure availability of the concerned experts / consultants/ personnel and representatives of his sub-vendors who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.																						
8.04.00	Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.																						
8.05.00	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.																						
9.00.00	CODES AND STANDARDS																						
9.01.00	LEGEND																						
	Abbreviations have been used for denoting international and National Standardization Organisation.																						
	<table><tr><th>Reference Abbreviation</th><th>Name & Address</th></tr><tr><td>ASME</td><td>American Society of Testing & Materials 1916, Race Street, Philadelphia Pennsylvania-19103,USA</td></tr><tr><td>BS</td><td>British Standards British Standards Institution 101, Pentonville Road London N 19 ND, UK</td></tr><tr><td>DIN</td><td>Deuthcer Normenausschuss Beuth Verlag GmbH, Auslieferung, Burggra Fenstrape, 4-7, 1000 Berline 30, Germany</td></tr><tr><td>IEC</td><td>International Electro technical Commission Burequ Central De la Commission Electrotechnique, Internationals, 1, rue, de Varembe Geneva, Switzerland.</td></tr><tr><td>ISO</td><td>International Organisation for Standardization Danish Road for Standardization DANSK TANDARDISERING SRAAT AUREHOEGVEJ-12 DK-2 900 HELLPRUP DENMARK</td></tr><tr><td>NFPA</td><td>National Fire Protection Association Battery March Park, Quincy MA 02269</td></tr><tr><td>EPA</td><td>Environmental Protection Agency, USA</td></tr><tr><td>VDE</td><td>German Standards VDE, Verlag GmbH, 1000 Berlin 12 Bisskarc-Ketrabe-33, West Germany</td></tr></table>					Reference Abbreviation	Name & Address	ASME	American Society of Testing & Materials 1916, Race Street, Philadelphia Pennsylvania-19103,USA	BS	British Standards British Standards Institution 101, Pentonville Road London N 19 ND, UK	DIN	Deuthcer Normenausschuss Beuth Verlag GmbH, Auslieferung, Burggra Fenstrape, 4-7, 1000 Berline 30, Germany	IEC	International Electro technical Commission Burequ Central De la Commission Electrotechnique, Internationals, 1, rue, de Varembe Geneva, Switzerland.	ISO	International Organisation for Standardization Danish Road for Standardization DANSK TANDARDISERING SRAAT AUREHOEGVEJ-12 DK-2 900 HELLPRUP DENMARK	NFPA	National Fire Protection Association Battery March Park, Quincy MA 02269	EPA	Environmental Protection Agency, USA	VDE	German Standards VDE, Verlag GmbH, 1000 Berlin 12 Bisskarc-Ketrabe-33, West Germany
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	IGCI International Gas Cleaning Institute IS Indian Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg. New Delhi-110001 IS-325-1970 Three phase induction motor IEC Document-2(Central Office) 432 VDE 0530 Part-1.66 IS:900 Code of practice of installation & Maintenance of induction motors single phase small AC and Universal electric motor. IS:996-1964 A58.1:1955(Issued BY ASA) IS:1026-1966 Flexible trailing cable for use in quarries and metallic ferrous mines BS:1116-1956 IS:1231 Dimensions of three phase foot mounted induction motor IEC-72-1 IS:1554-1964 PVC insulated heavy duty electric cables. IS:2147-1962 Degree of protection provided by enclosures for low voltage switchgear and control gear IEC Document 17B IS:2148 Flame proof enclosure for electric apparatus IEC Pub.-79-1 IS:2223 Dimensions of flange mounted AC induction motors IEC72-2 IS2253 Type of construction and mounting of motors IEC pub. 34-7 IS:2266-1970 Steel wire ropes for general engineering purposes BS302-1968 IS:3043-1966 Code of practice for earthing SAA wiring rules Part-I VDE 0100/11.58 VICE)131/2164 CW(ELCP) 9328 (BS) IS:3202 Code of practice for climate proofing of electrical equipments IS:3615-1969 Point hook with shank for general engineering purpose. BS482:1968 Revision of BS 2903. IS:3975-1967 Mild steel wires, strips and tapes for armouring cables IS4029 Guide for testing three phase induction motors. IS:4691-1968 Degree of protection provided by enclosures for rotating electrical machinery. IEC-34-5 (1968)Part-5 IS:4722-1968 Rotating electrical machines. IEC Doc.2 (Central Office),432,VDE 0530 Part I/1CC. IS:4728-1975 Terminal marking for rotating electrical machinery. IEC Pub.34-8 (1972)				
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	IS:5572(Part-I) Classification of hazardous Areas for electrical installations IS:5578-1970 Marking of insulated conductors guide IEC Doc.16(Central office) 20. IS:5749-1975 Forged ramshorn hooks Entwurf DIN 15402 Blatt1 Entwurf DIN 15402 Blatt2, BS 3017-1958 IS:5959-1975 Polyethylene insulated & PVC sheathed (heavy duty) electric cables. IEC Doc:20A (Central office) 30 IS:6362 Designation of method of cooling of rotating electrical machines. IEC Pub. 34-6 IS:6881 Construction and testing of electrical apparatus with type of protection 'e' IEC Pub. 79-9			
10.00.00	QUALITY ASSURANCE PROGRAMME			
10.01.00	To ensure that the equipments and services under the scope of this Contract whether manufactured or performed within the Contractor's Work's or at his sub-contractor's premises or at the Owner's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Engineer after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following: (a) His organization structure for the management and implementation of the proposed quality assurance programme; (b) Quality System Manual; (c) Design Control System; (d) Documentation Control System. (e) Qualification data for Bidder's key Personnel; (f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.; (g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls; (h) Control of non-conforming items and system for corrective actions. (i) Inspection and test procedure both for manufacture and field activities. (j) Control of calibration and testing of measuring testing equipment.			
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	(k) System for Quality Audits. (l) System for indication and appraisal of inspection status. (m) System for authorizing release of manufactured product to the Employer; (n) System for maintenance of records, and. (o) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as Annexure-I and Annexure-II respectively.				
10.02.00	GENERAL REQUIREMENT – QUALITY ASSURANCE				
10.02.01	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalization of such quality plans will be finalized before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports as per MQP/FQP submission/approval shall be furnished as per enclosed format no..QS-1-QAI-P-02/F1-R0.				
10.02.02	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organization , the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I).				
10.02.03	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organization", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).				
10.02.04	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold				
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	points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorized representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning. 10.02.05 The Contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. 10.02.06 The Contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities. 10.02.07 No material shall be dispatched from the manufacturer's works before the same is accepted, subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorized representative and duly authorized for dispatch by issuance of Material Dispatch Clearance Certificate (MDCC).. 10.02.08 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details. 10.02.09 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorized representative for approval prior to carrying out the welding/brazing. 10.02.10 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer. 10.02.11 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping shall be as per relevant code. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding. 10.02.12 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.				
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10.02.13	No welding shall be carried out on cast iron components for repair.				
10.02.14	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.				
10.02.15	All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 50mm shall be ultrasonically tested.				
10.02.16	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalized with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at Annexure-IV. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.				
10.02.17	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organization, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalized with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.				
10.02.18	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality				
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10.02.19	management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.				
10.02.20	The Contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.				
10.02.21	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.				
10.02.22	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.				
10.02.23	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorized representative.				
	Environmental Stress Screening				
	All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following.				
	1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.				
	Or				
	In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.				
	<u>Elevated Temperature Test Cycle</u>				
	During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to				
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	repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service. During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C. In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement. 2) <u>Burn in Test Cycle</u> The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test. The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time. During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable. During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.			
10.02.24	The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.			
10.03.00	QUALITY ASSURANCE DOCUMENTS			
10.03.01	The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓)mark. Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page			
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10.03.02	control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks. Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) MDCC			
10.03.03	Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.			
10.03.04	Before dispatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.			
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	(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release. (b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector. If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.				
10.03.05	TRANSMISSION OF QA DOCUMENTATION On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.				
10.04.00	Project Manager's Supervision				
10.04.01	To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.				
10.04.02	The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following: a) Interpretation of all the terms and conditions of these documents and specifications: b) Review and interpretation of all the Contractor's drawing, engineering data, etc: c) Witness or authorize his representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :				
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	d) Inspect, accept or reject any equipment, material and work under the contract: e) Issue certificate of acceptance and/or progressive payment and final payment certificates : f) Review and suggest modifications and improvement in completion schedules from time to time : and g) Supervise Quality Assurance Programme implementation at all stages of the works.			
10.05.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES			
10.05.01	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Owner to inspect and examine the materials and workmanship of the works during its manufacture or erection.			
10.05.02	The Project Manager, his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.			
10.05.03	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.			
10.05.04	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.			
10.05.05	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector.			
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10.05.06 10.05.07 10.05.08 10.05.09 10.05.10 10.05.01 10.05.02 10.05.03 10.05.04 11.00.00 11.01.00	Failure of Project Manager/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract. In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager/Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing. The inspection by Project Manager and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Program forming a part of the contract. To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 10.05.03, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month. All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager. Associated document for Quality Assurance programme Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at Annexure-I. Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II. List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III). Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV. MANUFACTURING SCHEDULE The Contractor shall submit a detailed PERT Network within the time frame agreed in the Letter of Award, Consisting of all the activities like design, manufacturing, purchase of bought out items, supply, receipt, erection dismantle, repair trial operation, PG test etc. within 15 days from the date of acceptance of letter of award.			
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	Based on the aforesaid approved PERT Network, the Contractor shall furnish the progress report, duly updated every monthly for review by the Owner.			
12.00.00	DESIGN IMPROVEMENTS			
12.01.00	The Engineer or the Contractor may propose changes in the specification of the equipments or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.			
12.02.00	If any such agreed upon change, is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and or schedule of completion before the Contractor proceeds with the change. Following such agreement the provisions thereof, shall be deemed to have been amended accordingly.			
13.00.00	TESTS			
13.01.00	Start-Up			
	(a) On completion of erection of the equipments and before start-up, each item of the equipment / system (whether supplied new as per this specification or as existing as per original supply) shall be thoroughly cleaned and then inspected jointly by the Engineer and the Contractor for correctness and completeness of installation and acceptability for start-up, leading to initial pre-commissioning activities / commissioning tests at site. The list of pre-commissioning activities / commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance program as well as those identified in the specifications. (b) The Contractor's commissioning / start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests. On completion of inspection, checking and after the pre-commissioning activities / commissioning tests are satisfactorily over, the complete equipment shall be placed on initial operation during which period the complete equipment shall be operated integral with sub-system and supporting equipments as a complete plant.			
13.02.00	Trial Operation			
	(a) The equipment shall be on Trial Operation, during which period all necessary adjustments shall be made while operating over the full load range enabling the plant to be made ready for Performance and Guarantee Tests. (b) The duration of Trial Operation of the complete equipment shall be fourteen (14) days out of which at least seventy two (72) hours shall be continuous operation on full load or any other duration as may be agreed to between the Engineer and the Contractor. The Trial Operation shall be considered successful, provided that each item of the equipment can operate continuously at the specified operating characteristics, for the period of Trial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment. (c) For the period of Trial Operation, the time of operation with any load shall be counted. Minor interruptions not exceeding four (4) hours at a time caused			
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13.03.00	during the 14 days trial operation period shall not effect the total duration of Trial Operation. If in the opinion of the Engineer the interruption is long, the Trial Operation shall be prolonged for the period of interruption. However, the seventy two (72) hours continuous operation at full load, as mentioned earlier shall be considered a mandatory requirement. (d) A Trial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Trial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during trial run shall also include the dates of start and finish of the Trial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Trial Operation. Based on the observations, necessary modifications / repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Engineer to enable the latter to accord permission to carry out performance and Guarantee tests on the Plant. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.			
	Performance and Guarantee Test (a) The final test as to the performance and guarantees shall be conducted at Site by the contractor in presence of the Owner. The Contractors Commissioning and start-up Engineers shall make the unit ready to conduct such tests. Such test will be commenced, within a period of 1000 hrs. after the successful completion of Trial Operations. Any extension of time beyond the above shall be mutually agreed upon. (b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the performance guarantee. (c) For performance / demonstration tests instrumentation, of accuracy class, to the approval of the Owner shall be used. The no. and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Owners Distributed Digital Control, Monitoring and Information System. Test will be conducted at specified load points. (d) Any special equipment, tools and tackles required for the successful completion of the Performance and Guarantee Tests shall be provided by the Contractor, free of cost. (e) The Performance test and specific tests to be conducted on equipments have been brought out in details in Part A, Sub-Section-VI.			
14.00.00	PACKAGING AND TRANSPORTATION			
14.01.00	All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of railway wagon sizes in India should be taken account of. The			
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15.00.00	Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. PROTECTION All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.			
16.00.00	PRESERVATIVE SHOP COATING			
16.01.00	All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable surface protection coatings. All surfaces which will not be easily accessible after the shop assembly, shall before hand be treated and protected for the life of the equipment. All surface shall be thoroughly cleaned of all mill scale, oxide and other coatings and prepared in the shop. The surfaces that are to be finish – painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Engineer at a later date.			
16.02.00	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 deg. C shall be selected by the Contractor, after obtaining specific approval of the engineer the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperatures higher than 95 deg. C and such primers shall also be subject to the approval of the Engineer.			
16.03.00	All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Engineer.			
17.00.00	PROTECTIVE GUARDS			
17.01.00	Suitable guards shall be provided for protection of personnel on all exposed rotating and / or moving machine – parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.			
18.00.00	DESIGN CO-ORDINATION			
18.01.00	The Contractor shall be responsible for the selection and appropriate design of the equipments furnished to provide the best coordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, sub-assemblies and assemblies shall be done so that it facilitates easy field assembly and maintenance. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical at or close to the operating range of the unit.			
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19.00.00 19.01.00	DESIGN CO-ORDINATION MEETING The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractors and the Consultants of the Owner during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.			
20.00.00 20.01.00	TOOLS, TACKLES AND PLANTS The Contractor shall supply with the equipment one complete set for each unit of all special tools and tackles for the erection, assembly, dismantling and maintenance of the equipment. However, these tools and tackles shall be separately packed and brought on to site. The bidder shall include the price of such T&P in the Lump sum total bid price set per unit or one set of form set.			
21.00.00 21.01.00	NOISE LEVEL The equivalent weighted sound level measured at a distance of 1.5 m above floor level in elevation and one meter horizontally from the base of replaced equipments furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 DBA. Noise level for motors shall be as specified in motor specification.			
22.00.00 22.01.00	TAKING OVER Upon successful completion of all the tests to be performed at Site on equipments furnished and erected by the Contractor, the Engineer shall issue to the Contractor a taking-over certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be with-held nor will the Engineer delay the issuance thereof on account of minor omissions or defects which do not affect the commercial operation/and/or cause any serious risk to the equipments. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.			
23.00.00 23.01.00	WELDING If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Engineer in advance of commencement of erection work.			
24.00.00 24.01.00	LUBRICATION Equipments supplied as per this specification shall be Lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.			
25.00.00 25.01.00	EQUIPMENT BASES Cast iron or welded steel base plates shall be provided for all rotating equipment which are to be installed on concrete base unless otherwise agreed to by the			
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	Engineer. Each base plate shall support the unit and its drive assembly shall be of a neat design with pads for anchoring the units, shall have a raised lip all round and shall have threaded drain connections. 26.00.00 RATING PLATES, NAME PLATES AND LABELS 26.01.00 Each replaced equipment is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, equipment, type or serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate and such diagram plates as may be required by the Engineer. 26.02.00 Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering or, alternatively, in the case of indoor circuit breaker starters, etc., of transparent plastic material with suitably colored lettering engraved on the back. 26.03.00 Items which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. 26.04.00 All such name plates, instruction plates lubrication charts, etc., shall be in bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided. 27.00.00 COLOUR CODE FOR ALL EQUIPMENTS 27.01.00 All exposed / external surfaces within ESP Package (originally installed as well as supplied new as per this specification) including all structure, equipments, platform, galleries, hand-railing etc. shall be painted at site by two coats of resin machinery enamel paint. The painting shall be to Owner's standard color scheme, which will be furnished to contractor during detailed engineering stage. The quantity and finish of paint shall be as per standards of ISI or approved equivalent. Before application of paint at least one coat of primer shall be applied on all surfaces. 28.00.00 FACILITIES BY THE OWNER 28.01.0 Facilities to be provided by the Owner listed out in Part D of this specification. 29.00.00 SHAFT ALIGNMENT 29.01.00 All the shafts of rotating equipments under the scope of supply shall be properly aligned to those of the matching equipments as perfect and accuracy as practicable. The equipments 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. The vibration level for the rotating equipments measured at the bearing housing shall not exceed 40 microns and shall conform to VDI 2056. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.			
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30.00.00	DOWELLING				
30.01.00	All the replaced drive motors and equipments shall be suitably dwelled after alignment of shafts with tapered machined dowels as per the direction of the Engineer.				
31.00.00	EQUIPMENT DELIVERY AND ERECTION				
31.01.00	General Requirements a) This section covers Contractors responsibilities for packing, shipping, warehousing and the installation of all equipment and materials furnished and installed under this specification. b) The Contractor shall submit for Owner's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, check-lists, documentation formats for all activities after equipment manufacture up to installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following: 1) Instructions for packing, shipping, receiving handling, warehousing and storage. 2) Instructions for location and installation of equipment furnished by this specification. 3) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification. 4) Instruction relating installation of piping / tubing, support and routing drawings of impulse pipes / signal tubes and tube cable trays. 5) Check lists and quality assurance hold points. 6) Format for all related documentation. c) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Owner approval during detailed engineering. d) The Contractor shall ensure that all work under this section shall be performed as per the requirements of this specification, owner approved EDE Manual and drawing / documents approved by the Owner during detailed engg.				
31.02.00	Crating / Packing a) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site till the time of erection.				
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	b) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted. c) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping. d) Review by the Owner of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified. e) All accessory items shall be shipped with the equipment; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior. f) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number. g) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number: 1) Export case markings 2) Case number 3) Gross weight and net weight in Kilograms 4) Dimensions in centimeters 5) Complete description of material h) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.				
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	i) Electrical equipments, control and instrumentation equipment shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. j) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. k) Coated surfaces shall be protected against impact, abrasion, discoloration and other damage. Surfaces which are damaged shall be repaired. l) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All piping, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit. m) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site. n) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.			
31.03.00	Factory Assembly a) Instrument enclosures which are replaced shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismantled from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels. b) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing. A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container. Equipment Installation a) General Requirements			
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	i) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification. ii) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Owners approval. Installation of all equipment / systems furnished by this specification shall be as per Owners approval. iii) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Owner. iv) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications. b) Installation Materials All materials required for installation, testing and commissioning of the equipment shall be furnished. c) Regulatory Requirements All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes. d) Cleaning All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown. e) Equipment Assembly Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications. f) Equipment Setting i) Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.			
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	ii) Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600mm from operating floor level. All free standing instrumentation cabinets and panels shall be located within the construction tolerances of +/- 3 mm of the location dimensions indicated on the Owner / Es plant arrangement drawings. g) Free-Standing Equipment Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer existing drawings and there Owner's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified. h) Non-free Standing Equipment i) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Owner existing Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner. ii) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this section. i) Equipment Location i) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Owner. ii) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated. iii) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed. j) Equipment Checkout 1) All equipment which are replaced / repaired shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage. 2) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial operated.			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – C GTR	Page 34 of 42

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 			
	k) Defects i) All defects in erection shall be corrected to the satisfaction of the Owner and the Engineer. The dismantling and re-assembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications. ii) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications. l) Equipment Protection i) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit. ii) The equipment shall be protected during storage as described herein. iii) Equipment shall be protected from weld spatter during construction. iv) Protective Guards Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance. v) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor. vi) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non-drying, oily type, rust preventive compound.			
KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	PART – C GTR	Page 35 of 42

ANNEXURE-I

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

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

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

FORMAT NO.: QS-01-QAI-P-09/F1-R1

1/1

ENGG. DIV./QA&I

KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP SECTION – VI, PART-C	GENERAL TECHNICAL REQUIREMENT	PAGE 36 of 42

ANNEXURE-II

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

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

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

FORMAT NO.: QS-01-QAI-P-09/F2-R1

1/1

ENGG. DIV./QA&I

KAHALGAON SUPER THERMAL POWER STATION STAGE -I (4 x 210 MW)	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP SECTION – VI, PART-C BIDDING DOC. NO.: CS-4210-104A(R&M)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 37 OF42

ANNEXURE-III

	Project :	Stage ::	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL					DOC. NO.:		
	Package :							REV. NO.:		
	Supplier :		SUB-SYSTEM :					DATE :		
	Contractor No. :							PAGE : OF		
S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

LEGENDS

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

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

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

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

QP/INSPN CATEGORY:

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

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

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

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

FORMAT NO.: QS-01-QAI-P-1/F3-R0

1/1

Engg. Div. / QA&I

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ANNEXURE-IV

	Project :	Stage ::	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL						DOC. NO.:		
	Package :								REV. NO.:		
	Contractor :								DATE :		
	Contractor No. :								PAGE : OF		
S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
FORMAT						1/1	Engg. Div. / QA&I				

ANNEXURE-V

		Project :		Stage :		FIELD WELDING SCHEDULE							DOC. NO.:			
		Contractor :				(To be raised by the contractor)							REV. NO.:			
		Contractor No. :				Welding Code:							DATE :			
		System :											PAGE : OF			
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																
FORMAT						1/1						Engg. Div. / QA&I				

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC	
	ANNEXURE - VI				
	S.NO.	DESCRIPTION OF MANUALS	NO OF PRINTS	NO. OF CD-ROMs	
	1.	PLANT DEFINITION MANUAL- Drawings "FOR APPROVAL"	2 sets	4 CD-ROMs	
	2.	i) Layout drawings/P&IDs	6	2 CD-ROMs	
		ii) Other drawings	2	2 CD-ROMs	
	3.	Drawings "FOR INFORMATION"	2	2 FLOPPIES	
	4.	Drawings "FINAL DRAWING"	15	4 CD-ROMs	
	5.	Drawings "AS BUILT "	15	4 CD-ROMs	
	6.	Datasheets, Design Calculations, Purchase Specifications, etc. and Other type of documents			
		i) For Approval	2	2 CD-ROMs	
		ii) FINAL	15	4 CD-ROMs	
		iii) Analysis reports of equipments/ piping/ structures components/ systems employing software packages as detailed in the specifications	2	2 CD-ROMs	
	7.	Erection manual "DRAFT"	4 sets	2 CD-ROMs	
	8.	Erection manual "FINAL"	4 sets	4CD ROMS	
	9.	Operation & Maintenance manual "IST SUBMITTIOM"	4 sets	2 CD-ROMs	
	10.	Operation & Maintenance manual "FINAL"	4 sets	4CD ROMS	
	11.	Plant Hand Book "IST SUBMITTIOM"	4 sets	2 CD-ROMs	
	12.	Plant Hand Book "FINAL"	4 sets	4CD ROMS	
	13.	Commissioning and Performance "IST SUBMITTIOM"	4 sets	2 CD-ROMs	
	14.	Commissioning and Performance "FINAL"	4 sets	4 CD-ROMs	
15.	Performance and Functional guarantees test report	4 sets	4 CD ROMS		
16.	Project completion report	15	4CD ROMS		
17.	QA programme including Organization for implementation and QA system manual (with revision-servicing)	1	1 CD ROM		
18.	Vendor details in respect of proposed vendors including contractor's evaluation report.	1	1 CD ROM		
19.	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, PQR etc.				
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS				
	S.NO.	DESCRIPTION OF MANUALS	NO OF PRINTS	NO. OF CD-ROMs	
		i) For review/comment	2	2 CD ROM	
		ii) For final approval	2	2 CD ROM	
	20.	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals			
		i) 1 st submission	4 sets	2 CD ROM	
		ii) Final	4 sets	4 CD ROM	
	21.	QA Documentation Package for items / equipment manufactured and dispatched to site	2 sets	4CD ROMS	
	22.	QA Documentation Package for field activities on equipment / systems at site	2 sets	4 CD ROMS	
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PART- D

ERECTION CONDITIONS OF CONTRACT

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			एनटीपीसी NTPC	
	TABLE OF CONTENTS				
	Clause No.	Description			
	1.00.00	General			
	2.00.00	Regulation of local authorities and statutes			
	3.00.00	Welding requirements			
	4.00.00	Owner’s lien on equipment			
	5.00.00	Inspection, testing and inspection certificates			
	6.00.00	Access to site and works on site			
	7.00.00	Contractor’s site office establishment			
	8.00.00	Co-operation with other contractors			
	9.00.00	Discipline of workmen			
	10.00.00	Contractor’s field Operation			
	11.00.00	Photographs and Progress Report			
	12.00.00	Manpower Report			
	13.00.00	Protection of work			
	14.00.00	Employment of labour			
	15.00.00	Facilities to be provided by the Owner			
	16.00.00	Facilities to be provided by the Contractor			
	17.00.00	Lines and Grades			
	18.00.00	Fire protection			
	19.00.00	Security			
	20.00.00	Contractor’s area limits			
	21.00.00	Contractor’s co-operation with the owner			
	22.00.00	Pre-commissioning trials and initial operations			
	23.00.00	Material handling and storage			
	24.00.00	Construction Management			
25.00.00	Field office records				
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CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT				एनटीपीसी NTPC
	Clause No.	Description			
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26.00.00	Contractor's materials brought on to site
27.00.00	Protection of property and contractor's liability
28.00.00	Painting
29.00.00	Insurance
30.00.00	Unfavorable working conditions
31.00.00	Protection of monuments and reference points
32.00.00	Work and safety regulations
33.00.00	Foreign personnel
34.00.00	Code requirements
35.00.00	Foundation dressing and grouting
36.00.00	Shaft alignments
37.00.00	Dowelling
38.00.00	Check out of control systems
39.00.00	Commissioning spares
40.00.00	Cabling
41.00.00	Equipment Delivery and Erection
42.00.00	WELDING - Special Requirements
43.00.00	Deviation Dispositioning
44.00.00	NON-DESTRUCTIVE TESTING (NDT)
45.00.00	Testing Equipment & Facilities
Annexure-I	Safety Plan
Annexure-II	List of Suggestive safety Equipment/PPEs to be included in List of Minimum T&P

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 			
1.00.00	GENERAL			
1.01.00	The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.			
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project Co-coordinator, 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	In addition to the local laws and regulations, the Contractor shall also comply with the Minimum Wages Act. 1948 and the Payment of Wages Act both of Government of India and the rules made there under in respect of its labour and the labour of its sub-Contractors currently employed on or connected with the contract.			
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 Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Owner, shall be to the account of the Owner. 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	WELDING REQUIREMENTS			
	The welding of various area including high pressure parts shall be in accordance with the following requirements :			
3.01.00	Qualification of Weld Procedures			
	Only qualified welding procedures as per ASME Section IX shall be used by Contractor at site. Procedure qualification records along with WPS shall be submitted to NTPC for review. Welding procedure shall indicate all essential and non-essential parameters as per ASME Section IX. Makes of welding consumables shall be subject to employer's approval.			
3.02.00	Welder's Qualification			
	Only welders who are qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts and its attachment welding. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory pre-production qualification test to be conducted by the Contractor at site as per ASME Sec IX in presence of employer's representative(s), prior to performing work under			
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CLAUSE NO.		ERECTION CONDITIONS OF CONTRACT			
		these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders. All the welders carrying out welding at site shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested and authorized to carry out welding.			
3.03.00		Records All records of the welding procedures, the welder's qualification tests and the welder's performance details for the work performed under these specifications shall be maintained by the Contractor in a manner acceptable to the Employer. The names of all the welders who made each weld on the boiler pressure parts other equipment, wherever applicable, covered under this package and piping within the jurisdiction of the India Boiler Regulations shall be maintained by the Contractor. The certified copies of any or all the above documents shall be submitted to the Employer on request.			
3.04.00		Marking On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.			
3.05.00		HEAT TREATMENT			
3.05.01		Pre-heating, post-heating and post-weld stress relief operations of all welds, shall be performed in accordance with the requirements of applicable code. Local post weld stress relieving heat treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils. In case of P-91, X-20, X-22 and other material of P5B group and above, the PWHT shall be by induction heating method only. Oxy-acetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures throughout the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of a potentiometric recorder. Recorders other than those of potentiometric type shall not be used for such temperature recording during stress relieving operations.			
3.05.02		The Contractor & Employer's representative, at start and at the end of HT Cycle shall sign the time and temperature charts for heat-treatment. After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (as specified at clause no 7.00.00- of this chapter) etc.			
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3.06.00	WELD EDGE PREPARATION Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.			
3.07.00	FIELD WELDING SCHEDULE The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field-welding schedule to be issued by the Contractor shall contain the following: (a) Drawing No (s) (b) Location of the weld (c) Size of the weld (outside diameter and thickness) (d) Type of joints (e) Material specifications (f) Size of fillet on backing ring, when the type of joint is with backing ring (g) Electrode/ filler metal specifications (h) Number of welds per unit (i) Quantity of filler metal per weld (j) Indication of required Non-destructive Examination (NDE) for each weld (k) Pre-heat temperatures for welding (l) Process of welding (m) Post-welding heat treatment temperature ranges, duration, under as specified at clause no 4.00.00 of this chapter entitled "Heat Treatment". (n) Qualification details of weld procedures to be adopted as specified at clause no 3.01.00 of this chapter entitled 'Qualification of Weld Procedures'.			
4.00.00	OWNER'S LIEN ON EQUIPMENT The Owner 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 Owner 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 Engineer.			
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5.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES The Provisions of the Clause entitled Inspection, Testing and Inspection Certificates under Technical Specification, Part C shall also be applicable to the erection portion of the Works. The Engineer 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 Engineer 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 Engineer. 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 replacement or re-work done to the Contractor's work.				
6.00.00	ACCESS TO SITE WORKS ON SITE				
6.01.00	Suitable access to and possession of the Site shall be afforded to the Contractor by the Owner in reasonable time. The Owner shall provide access roads as per the agreed schedule.				
6.02.00	The Contractor is required to dismantle the existing foundation and cast new foundation if necessary for the new equipment supplied.				
6.03.00	The works so far as it is carried out on the Owner's premises, shall be carried out at such time as the Owner may approve and the Owner shall give the Contractor reasonable facilities for carrying out the works.				
6.04.00	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 Engineer or his representative.				
7.00.00	CONTRACTOR'S SITE OFFICE ESTABLISHMENT The Contractor shall establish an Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Engineer 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.				
8.00.00	CO-OPERATION WITH OTHER CONTRACTORS				
8.01.00	The Contractor shall co-operate with all other contractors or tradesmen of the Owner, who may be performing other works on behalf of the Owner and the workmen who may be employed by the Owner and doing work in the vicinity of the Works under the Contract. The Contractor shall also arrange to perform his work so as to minimise, to the maximum extent possible, interference with the work of other contractors and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Owner, due to the Contractor's work shall promptly be made good at his own expense. The Owner shall determine the resolution of any difference or conflict that may arise between the Contractor and the workmen of the Owner in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the Contractor				
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	shall have no claim against the Owner on that account other than an extension of time for completing his works. Owner shall have full access to visit the Contractor's site at any time for inspection and surveillance checks.				
8.02.00	The Owner shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Owner shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Owner shall be binding on the Contractor.				
9.00.00	DISCIPLINE OF WORKMEN The Contractor shall adhere to the disciplinary procedure set by the Engineer in respect of his employees and workmen at Site. The Owner shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Engineer such employee has mis-conducted himself or is incompetent or is negligent or otherwise undesirable and then the Contractor shall remove such a person objected to and provide in his place a competent replacement.				
10.00.00	CONTRACTOR'S FIELD OPERATION				
10.01.00	The Contractor shall keep the Owner 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 Owner shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Owner 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 safety, adequacy and efficiency of plant and equipment and his erection methods.				
10.02.00	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-contractor and all the properties under his custody during the performance of the work. The requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Owner is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.				
11.00.00	PHOTOGRAPHS AND PROGRESS REPORT				
11.01.00	The Contractor shall furnish three (3) prints each to the Owner of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Owner 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.				
11.02.00	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				
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	actual progress and the action proposed for corrective measures, wherever necessary.				
12.00.00	MAN-POWER REPORT				
12.01.00	The Contractor shall submit to the Owner, 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.				
12.02.00	The Contractor shall also submit to the Owner 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.				
13.00.00	PROTECTION OF WORK The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Engineer. No claim will be entertained by the Owner or the representative of the Owner 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 of 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 dispute.				
14.00.00	EMPLOYMENT OF LABOUR				
14.01.00	The Contractor will be expected to employ on the work only his regular skilled employee with experience of his particular work. No female laborer shall be employed after darkness. No person below the age of eighteen years shall be employed.				
14.02.00	All travelling expenses including provisions of all necessary transport to and from Site. Lodging allowance and other payments to the Contractor's employees shall be sole responsibility of the Contractor.				
14.03.00	The hours of work on the Site shall be decided by the Owner and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day – Monday through Saturday.				
14.04.00	Contractor's employees shall wear identification badges while on work at Site.				
14.05.00	In case the Owner becomes liable to pay any wages or dues to the Contractor's laborers or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labor Regulation Abolition Act or				
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	any other law due to act of omission of the Contractor, the Owner may make such payments and shall recover the same from the Contractor's Bills.			
15.00.00	FACILITIES TO BE PROVIDED BY THE OWNER			
1501.00	Space The Contractor shall advise the Owner within thirty (30) days from the date of letter of award about his exact requirement of space for his office, storage area, pre-assembly and fabrication areas, etc. The above requirements shall be reviewed by the Owner and the space as decided by Owner will be allotted to the Contractors for construction of his temporary structures/ facilities like offices, storage sheds, pre-assembly and fabrication areas etc. for Contractor's as well as his Sub-Contractor's use. Land for staff and labour colony shall not be provided by the Owner and Contractor has to make his own arrangement for the same at his own cost.			
15.02.00	Electricity The Contractor shall submit the Owner within thirty (30) days from the date of letter of award about his electrical power requirement, if any, to allow the planning of the same by the Owner. The Contractor shall be provided with free supply of electricity for the purpose of execution of the contract at one point only at work site at 415V voltage level. The Contractor shall make his own further distribution arrangement and shall maintain a minimum drawal power factor of 0.8, and all such devices for maintaining power factor of 0.8 or better shall be under the scope of Contractor. All temporary wiring must comply with local regulations and will be subject to Employer's inspection and approval before connection to supply. Electricity for all other facilities if required by the Contractor shall be on chargeable as per NTPC norms. The free supply of power will not be provided for the use in the labour and staff colony. Power supply for labour and staff colony shall be provided at one point and Contractor shall be charged at rates prevalent at the site.			
15.03.00	Water Free supply of service water will be made available for construction and drinking purposes at a single point at works site to be decided by the NTPC.			
15.04.00	Communication The Owner will extend the telephone facilities, if available at Site, for purposes of Contract. The Contractor shall be charged at actuals for such facilities.			
15.05.00	Instrument and service air shall be provided at one point for each ESP near boiler area.			
15.06.00	All tools & tackles including cranes and any other special tools and tackles shall be arranged by the Contractor at his own cost. However, as a backup service, crane may be provided by the Owner at his discretion depending upon the availability on chargeable basis. The contractor shall have no claims, whatsoever in case of non-availability of the construction equipment being provided by NTPC as back up service and the work shall be carried out by the Contractor as per Schedule.			
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15.07.00	Area lighting shall be provided by Owner as per his own scheme. However, any additional lighting required for the safe execution of the work shall be arranged by the Contractor. Any damage caused due to inadequate lighting shall be made good by the Contractor at his own cost.				
16.00.00	FACILITIES TO BE PROVIDED BY THE CONTRACTOR				
16.01.00	Contractor's site office Establishment The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC.				
16.02.00	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 requirements covered under the Contractor. He shall submit a list of all such materials to the Engineer 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 Owner. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, etc. for the purpose of fabrication, erection and commissioning.				
16.03.00	Testing Equipment and Facilities The Contractor shall provide the necessary testing, equipment and facilities.				
16.04.00	Site laboratory for civil works: Contractor shall provide and maintain a site laboratory for the testing of construction material under the direction and general supervision of employer. Alternatively, bidder shall make arrangement for testing of material/workmanship of work in his scope at employer's lab (if available) or any other approved external laboratory.				
16.05.00	First-aid				
16.05.01	The Contractor shall provide necessary first-aid for all his employees, representatives and workmen working at the Site. Sufficient number of Contractor's personnel shall be trained in administering first-aid.				
16.05.02	The Owner will provide the Contractor, in case of any emergency, the services of an ambulance for transportation to the nearest hospital.				
16.06.00	Cleanliness				
16.03.01	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 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 Owner. 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				
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16.03.02	flame resistant, oil proof sheet shall be provided to protect the floor from such damage. 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 Engineer. Proper sanitary arrangement shall be provided by the Contractor, in work-areas, office and residential areas of the Contractor.				
17.00.00	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 layout the Works. Basic horizontal and vertical control points will be established and marked by the Engineer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Engineer 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 marked by the Engineer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Engineer 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 Engineer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Engineer at Contractor's expense.				
18.00.00	FIRE PROTECTION				
18.01.00	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 site 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.				
18.02.00	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.				
18.03.00	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.				
18.04.00	The Contractor shall provide enough fire protection equipment of the types and number for the ware-houses, office, temporary structures, labor colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time.				
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19.00.00	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 Engineer in the prescribed manner.			
20.00.00	CONTRACTOR'S AREA LIMITS The Engineer 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 Engineer.			
21.00.00	CONTRACTOR'S CO-OPERATION WITH THE OWNER In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Owner, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Owner and the same shall be acceptable at all times to the Contractor. The Owner 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 Owner and the Contractor shall strictly adhere to such restrictions and co-operate with the Engineer. 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.			
22.00.00	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
22.01.00	General			
22.01.01	The Contractor upon completion of installation of equipment and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. All pre-commissioning/ commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.			
22.01.02	The pre-commissioning and commissioning activities including Guarantee tests, checks and trial operations of the equipment/systems furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant			
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22.01.03	clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices etc. and labour required for successful performance of these operations. 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 operations. The following activities shall be carried out by the Contractor, 18 month prior to schedule date of commissioning of the equipment/systems installed by him. (a) The Contractor shall furnish the organization chart of his operation and commissioning engineers for the acceptance of employer. Adequate number of operation and commissioning engineers shall be deployed by the Contractor to effectively meet the requirement of round the clock operation in shifts also, till the plant is taken over by the Owner. (b) The Contractor shall submit the bio-data containing the details of experience of his operation and commissioning engineers for the acceptance of Owner. (c) The Contractor shall furnish the deployment schedule of his operation and commissioning engineers for the acceptance of the Owner. (d) Apart from above, Contractor shall ensure deployment of sufficient skilled/semi-skilled/unskilled manpower during pre-commissioning and commissioning activities.				
22.01.04	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment/systems which are installed by him.				
22.01.05	The Contractor shall also be responsible for flushing and initial filling of all oils and lubricants required for the equipment furnished and installed 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 these specifications and documents.				
22.02.00	Commissioning Documentation				
22.02.01	The Contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various equipment/systems covered under the contract.				
22.02.02	Standard checklist, as the name suggests, shall be a fairly general document, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking,				
22.02.03	The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system. Commissioning schedule is a document envisaged for commissioning of a system. The testing/ commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting.				
22.02.04	The Contractor shall submit the list of commissioning documentation to be submitted by him, along with their submission schedule for various equipment/systems covered				
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	under the contract, within 6 (six) months from the date of award of contract, for the acceptance of Owner.				
22.02.05	The contractor shall submit the commissioning documentation for various equipment covered under the contract for the approval of employer, at least 18 months before the schedule date of commissioning of the equipment/systems.				
22.03.00	Commissioning Activities				
22.03.01	Upon completion of pre-commissioning activities/tests, the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities.				
22.03.02	Contractor shall carry out the checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.				
22.03.03	Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.				
22.03.04	The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment of prior to that as the case may be.				
22.03.05	Other tests shall be conducted, if required by the Employer, to establish that the plant equipment are in accordance with requirements of the specifications.				
22.03.06	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipment including all electrical and C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.				
22.04.00	Initial Operation Upon completion of system checking/Tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation as stipulated in General Technical Requirements				
23.00.00	MATERIALS HANDLING AND STORAGE				
23.01.00	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.				
23.02.00	Contractor shall be responsible for examining all the shipment and notify the Engineer immediately of any damage, shortage, discrepancy etc. for the purpose of Owner's information only. The Contractor shall submit to the Owner 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				
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	and erection of the equipment at Site. Any demurrage, warfare and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.				
23.03.00	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 Owner.				
23.04.00	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 Owner. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are store. 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.				
23.05.00	All electrical panels, control gears, motors and such other devices supplied under the scope of this specification shall be properly dried by heating 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.				
23.06.00	All the electrical equipment supplied new 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 Owner.				
23.07.00	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.				
23.08.00	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.				
23.09.00	All the materials stored in the open or dusty location must be covered with suitable weatherproof and flameproof covering material wherever applicable.				
23.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Owner will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.				
23.11.00	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, and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Owner, 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.				
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24.00.00	CONSTRUCTION MANAGEMENT				
24.01.00	The field activities of the Contractors working at Site, will be coordinated by the Owner and the Owner's decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Owner regarding scheduling and coordination of work. Such decision by the Owner shall not be a cause for extra compensation or extension of time for the Contractor.				
24.02.00	The Owner shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Owner. The contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Owner and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Owner may call for any other meeting either with individual contractors or with selected number of contractor and in such a case the Contractor if called, will also attend such meetings.				
24.03.00	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 accelerate the progress of the work comply with the schedule and shall communicate such actions in writing to the Owner, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.				
24.04.00	The Owner shall however not be responsible for provision of additional labor and/or materials or supply or any other service to the Contractor except for the co-ordination work between various Contractors as set out earlier.				
25.00.00	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. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and engineering data shall be submitted to the Owner in required number of copies.				
26.00.00	CONTRACTOR'S MATERIALS BROUGHT ON TO SITE				
26.01.00	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 Owner. All such goods shall, from the time of their being brought vest in the Owner, 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 Owner. The Contractors shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.				
26.02.00	The Owner 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				
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	the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Owner 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. 26.03.00 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Owner the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Owner. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Owner to do so then the Owner shall have the liberty to dispose off such materials as detailed under clause 25.02.00 above and credit the proceeds thereto the account of the Contractor. 27.00.00 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY 27.01.00 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 Owner and the employees of other Contractors and Sub-contractor and all public and private property including structure, building, other plants and equipments and utilities either above or below the ground. 27.02.00 The Contractor will ensure provision of necessary safety equipment such as barriers, signboards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Owner and the owners of public or private property and utilities when such property and utilities are likely to get damaged or injured during the execution of his Works and shall make all necessary arrangements with such owners, related to removal and/or replacement or protection of such property and utilities. 28.00.00 PAINTING For painting refer Sub-Section-III, Part-A, Section-VI of Technical Specification. Painting for structures shall conform to the painting specification specified in Part-'B' under "Civil". Painting for other Mechanical, Electrical, C&I equipment/ systems shall conform to the painting specification given in various subsections of Part-A and Part-B of Technical Specifications. 29.00.00 INSURANCE 29.01.00 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 works to be done beyond the Contractor's own or his Sub-contractor's manufacturing Works. 29.02.00 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 the following :			
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32.00.00 32.01.00	Owner. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Owner or by his representative 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 Owner. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc. WORK & SAFETY REGULATIONS General i) The Contractor shall comply with all the requirements of “<i>The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act,</i>” 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, <i>Health and Environment (SHE)</i> 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 Owner 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 Annexure-I. v) The Contractor shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Owner 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 Owner in this regard. vii) The Contractor will make available minimum quantity of all Safety equipment & Safety Personal Protective Equipment (PPEs) of required specifications as per suggestive list as per Annexure-II, as part of list of minimum T&Ps. Further, Contractor will ensure availability of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion. The Contractors shall provide suitable latest PPEs of prescribed standard to all their employees and workmen according to the need. The Engineer I/c			
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	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 Owner 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 Of 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 Owner (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.			
32.01.01	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.			
32.01.02	Flood Monitoring (Hydro Projects) The Contractor shall take necessary measures for monitoring of flood / water levels and develop a forewarning system to evacuate people to safer places well before the flood occurs. For this purpose he may maintain liaison with meteorological department and NTPC. The Contractor shall make suitable communication and			
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32.01.03 32.01.04 32.01.05 31.02.00 32.03.00	transporting system to rescue the workers to safer places. The Contractor shall provide suitable shelters, food, drinking water and other requisite facilities till they are brought back to their colonies and normalcy is restored.			
	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 its 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.			
	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.			
	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 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.			
	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 Owner (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. 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.			
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32.04.00	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.				
32.05.00	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 Owner (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.				
32.06.00	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.				
32.07.00	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				
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32.08.00	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. 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 Contractor 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 radio-active 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, storage and handling of such material, will be taken by the contractor. 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. 32.09.00 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.			
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32.10.00 32.11.00 32.12.00 32.13.00 32.14.00	 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. 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. Vehicular Traffic The Contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988. 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. 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.			
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32.15.00 32.15.01	Electrical Installations 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 (i) Satisfy the Engineer I/C that the appliance is in good working condition; (ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances; (iii) 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. (iv) 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 / equipment whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the Contractor to electricians / workmen / Officers. (v) 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.			
32.16.00 32.16.01	Safety Organization 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 sub-contractor, the employees / workmen of the sub Contractor shall also be considered as the Contractor's employees/workmen for the above purpose.			
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32.06.02	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 2 days safety training from any reputed organization or from NTPC before resuming the work. If already trained in past the declaration along with training 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 Engineer IC 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.			
32.17.00	Reporting of Accident and Investigation 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.			
32.18.00	Right to stop Work			
32.18.01	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.			
32.18.02	The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause 31.18.01} 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 work and will not be the ground for waiver of levy of liquidated damages.			
32.19.00	Fire Protection 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.			
32.20.00	Penalties (i) 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.			
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	(ii) 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. (b) Major injuries or accident causing 25% or more permanent disablement to workmen or employees: Penalty @2.5% of contract value or Rs. 1,00,000/- per person which ever is less 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. (iii) 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. (iv) 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			
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	एनटीपीसी NTPC 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 evaluation of tender documents. If the information given by the Contractor is found incorrect, his contract will be liable to be terminated. 32.21.00 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 Owner. 33.00.00 FOREIGN PERSONNEL 33.01.00 The Contractor shall submit to the Owner 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. 33.02.00 Any person unsuitable and unacceptable to the Owner shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Owner, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel. 33.03.00 No person brought to India for the purpose of the works shall be repatriated without the consent of the Owner in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Engineer. The Owner may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation. 33.04.00 The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Owner 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 Owner for that purpose. 33.05.00 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 Owner and the Engineer may establish from time to time on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordinate with their co-workers and the community and shall not engage themselves in any other employment neither part-time nor full-time nor shall they take part in any local politics. 33.06.00 The Owner 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.			
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34.00.00	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 engineering practice, the Engineer's Drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.			
35.00.00	FOUNDATION DRESSING AND GROUTING FOR EQUIPMENT/ EQUIPMENT BASES			
34.01.00	The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.			
35.02.00	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.			
35.03.00	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.			
35.04.00	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 and the 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 flow able and the mix shall not show excess water on top when it is being puddle in place. For thicker grout beds upto 65mm, 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. Ann acceptable plasticizer may be added to the grout mixture in a proportion recommended by the plasticizers manufacturer. All such grouts shall be thoroughly, mixed for not less than five minutes in an approved mechanical mixer and shall be used immediately after mixing.			
35.05.00	Placing of Grout			
35.05.01	After the base has been prepared, its alignment and level has been checked and 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 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.			
35.05.02	The grout shall be poured either through grout holes if 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			
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	continued until the entire space below the base is thoroughly filled and the grout stands at least 25mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.			
35.06.00	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.			
35.07.00	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 Owner.			
36.00.00	SHAFT ALIGNMENTS All the shafts of rotating equipment under the scope of supply 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.			
37.00.00	DOWELLING All the replaced motors and equipments shall be suitable dowelled after alignment of shafts with tapered machined dowels as per the direction of the Owner.			
38.00.00	CHECK OUT OF CONTROL SYSTEMS After completion of erection and commissioning of items covered under the specification the Contractor shall check out the operation of all control systems for the equipment furnished and installed under this specifications.			
39.00.00	COMMISSIONING SPARES			
39.01.00	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 Owner as having satisfactorily completed the Trial Operation. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Letter of Award and such list shall be reviewed by the Owner and mutually agreed to.			
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39.02.00	However, such review and agreement will not absolve the Contractor of his 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 Contractor at no extra cost to the Owner. These spares will 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 utilized as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of performance and guarantee test shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Owner.				
40.00.00	CABLING				
40.01.00	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 symmetrical 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 Owner .				
40.02.00	Each cable, whether power or control, shall be provided 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.				
40.03.00	Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100V 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 gas lines, special care should be taken for the protection of the cables in designing the cable channels.				
40.04.00	In each cable run, some extra length shall be kept at a suitable point to enable one or two straight through joint to be made, should the cable develop fault at a later date.				
40.05.00	Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to Engineer's approval. Multicore control 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 un bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly out.				
40.06.00	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.				
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41.00.00	EQUIPMENT DELIVERY AND ERECTION			
41.01.00	General Requirements (a) This part covers Contractor's responsibilities for packing, shipping, warehousing and the installation of all equipment and materials furnished and installed under this specification. (b) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following : (1) Instructions for packing, shipping, receiving handling, warehousing and storage. (2) Instructions for location and installation of equipment furnished by this specification. (3) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification. (4) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays. (5) Check lists and quality assurance hold points. (6) Format for all related documentation. (c) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering. (d) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg.			
41.02.00	Crating (a) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.			
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	(b) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted. (c) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping. (d) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified. (e) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior. (f) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number. (g) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number : a) Export case markings b) Case number c) Gross weight and net weight in Kilograms d) Dimensions in centimeters e) Complete description of material (h) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.			
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CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 			
41.03.00	(i) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. (j) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. (k) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired. (l) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All piping, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit. (m) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site. (n) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense. (o) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.			
	Factory Assembly (a) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels. (b) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing. A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.			
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CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 			
40.04.00	Equipment Installation (a) General Requirements (1) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification. (2) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Owner's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval. (3) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer. (4) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications. (b) Installation Materials All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor. (c) Regulatory Requirements All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes. (d) Cleaning All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown. (e) Equipment Assembly Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications. (f) Equipment Setting Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets,			
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	stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it. Indicating type field mounted instruments shall be installed in such a way that center of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level. All free standing instrumentation cabinets and panels shall be located within the construction tolerances of +/- 3 mm of the location dimensions indicated on the Employer's plant arrangement drawings. (g) Free-Standing Equipment Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified. (h) Non-free Standing Equipment (1) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner. (2) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part. (i) Equipment Location (1) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer. (2) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated. (3) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.			
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	(4) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading. (5) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion. (6) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections. For location of C&I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred. (j) Installation of Field Mounted Instruments and Devices The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage. In addition to above relevant Portion as specified elsewhere in technical specification may be referred. (k) Piping Connections (1) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping. (2) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature. (l) Equipment Checkout (1) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage. (2) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.			
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	(m) Defects (1) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications. (2) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications. (n) Equipment Protection (1) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit. (2) The equipment shall be protected during storage as described herein. (3) Equipment shall be protected from weld spatter during construction. (4) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance. (5) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor. (6) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound. 42.00.00 WELDING - SPECIAL REQUIREMENTS If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work. 43.00.00 DEVIATIONS DISPOSITIONING: Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NTPC. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning.			
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44.00.00	NON-DESTRUCTIVE TESTING (NDT): The Contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job & acceptance norms agreed.				
45.00.00	TESTING EQUIPMENT & FACILITIES: Contractor shall provide the testing equipment and facilities necessary to carry out tests & inspections.				
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	ANNEXURE-I 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 adopted 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.			
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	ANNEXURE-II				
	List of suggestive Safety Equipments/PPEs To be included in List of minimum T&P :				
Sl. No.	Description	Quantity			
1.	Safety Net (conforming IS 11057:1984) Net Size : 10m x 5m, Mesh Size : 25mm, Mesh Rope : 2mm double cord, Border/Tie Cord: 12 mm diameter polypropylene rope (tested as per IS : 5175). Two metres length shall be provided at all four corners.	25 Nos.			
2.	Fall Arrestor : Rope grab fall arrestor & anchorage line Anchorage Line : 14 mm – 16mm diameter, three strand twisted Polyamide rope. Rope Grab fall arrestor : Openable & Guided type Fall Arrestor (one flexible line) conforming EN 353-2 & works on 14-16 mm diameter Polyamide rope, material: Nickel Chrome plated Steel. Connector : Karbiner conforming to EN 362 (Minimum Strength 22 kN), material : Steel	30 Nos. of Rope Grab Fall arrestor and Karbiner each. 10 nos of anchorage line, each 30 metre long.			
3.	Horizontal life line Stainless Steel Wire rope of 8 mm diameter. Minimum six nos. of steel U-bolt clips are required for clamping each wire rope to a rigid support (03 nos. of U-bolt clips at both end).	20 nos. of wire rope, each 40 metre long.			
4.	Ladders on column The minimum design live load on metallic ladder shall be a single concentrated load of 100 kilo grams. All rungs shall have a minimum diameter of 1.90 centimetres, and minimum clear length of rungs shall be 40.6 centimetres. The distance between rungs shall not exceed 30.5 centimetres. Each ladder shall have maximum height of 9.0 metre. The ladder shall have proper fastenings for attaching it to a column using positive means such as bolt, weld or other type of fasteners.	Cumulative length of ladders is 200 metres.			
5	Safety PPEs (Industrial Safety Helmet & Industrial safety / Electrical shoes) Industrial Safety Helment (IS: 2995 p 1984 marked). Industrial Safety / Electrical Shoes (IS:15298-2002 marked) Full Body Safety Harness (conforming IS:3521)	Safety Helment & Safety Shoes : 100 nos. each. Full Body Safety Harness : 30 Nos.			
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SUB-SECTION-V-Q

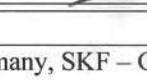
QUALITY ASSURANCE

SUB-SECTION-V-QM

MECHANICAL

		ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): CONVEYOR IDLERS	STANDARD QUALITY PLAN CONFORMING TO CODE: AS PER NTPC APPRD DRG/DS/TECH SPEC				QP NO.: 0000-999-QOM- S - 063 REV. NO: 01 DATE : 08/07/2015 PAGE 1 OF 3 VALID UPTO :07/07/2018		REVIEWED BY: ANKUSH BIRLA U SUDEEP RAJEEV KUMAR JAIN		APPROVED BY:  K.M. JAIN Dt..... Approved			
			SI NO		COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M C/N		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY M C N
1		2	3	4	5	6		7	8	9	D*	** 10	11	
1.0 Raw Materials														
1.1	Tube for Roller	Surface Defects OD, Thickness, Nominal Mass, Ovality, Eccentricity & Straightness Chemical Properties Physical Properties (Tensile, Yield Stress, % Elongation, Flattening & Drift Expansion Test)	Major Major Major Major	Visual Measure Chemical Analysis Mechanical Test	100% IS 9295 IS 9295	100% IS 9295 IS 9295	IS 9295 IS 9295 / NTPC Tech Spec		IR Manufacturer TC	√ √	P P	V V V	- V V	See Note 1
1.2	Bar for Shaft/Spindle	Chemical & Physical Properties	Major	Chemical & Mechanical Test	1 /Heat	1/Heat	Relevant Material Standard as per Approved Drg/Datasheet /NTPC Tech Spec		TC	√	P	V	V	
1.3	Bearing Housing, and Sections & Flats for Idler Frames	Chemical & Physical Properties	Major	Chemical & Mechanical Test	1 Sample/ Procurement Batch	1 Sample/ Procurement Batch	Relevant Material Standard as per Approved Drg/Datasheet /Tech Spec		TC	√	P	V	V	
1.4	Rubber Disc for Impact Idler & Self Cleaning Idler	Tensile & Elongation, Hardness, Specific Gravity, Abrasion Loss, Ash Content	Major	Mechanical Test	1% Samples /procurement Batch	1% Samples /procurement Batch	Relevant Material Standard as per NTPC Approved Drg/Datasheet /Tech Spec	NTPC Approved Drg/Datasheet /Tech Spec	IR	√	P	V	V	
1.5	Bearings	Type/Size/Dimension/ Make	Major	Verification	100%	100%	Approved Drg/Datasheet /Tech Spec		IR	√	P	V	V	See Note 2
1.6	Labyrinth, Dust seal	Dimension, Condition	Major	Verification	100%	100%	Approved Drg/Datasheet /Tech Spec/Mfg Standard		IR	√	P	V	V	

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
 ** M: MANUFACTURER / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION.
 AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS 'W'.

	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): CONVEYOR IDLERS	STANDARD QUALITY PLAN CONFORMING TO CODE: AS PER NTPC APPRD DRG/DS/TECH SPEC	QP NO.: 0000-999-QOM- S - 063 REV. NO: 01 DATE : 08/07/2015 PAGE 3 OF 3 VALID UPTO :07/07/2018	REVIEWED BY: ANKUSH BIRLA U SUDEEP RAJEEV KUMAR JAIN	APPROVED BY:    

Note 1: Tubes for Rollers shall conform to IS : 9295 and shall be procured from BIS approved sources with valid license

Note 2: Type of bearings as per NTPC Approved drg/DS/Tech Spec. Acceptable makes for Bearings are ABL – Hosur/NEI (NBC) – Jaipur, FAG – Germany, SKF – Germany, NSK – Japan, FAG(INDIA) – Vadodara, SKF (INDIA) - Pune

Note 3: NTPC /Lloyds/BVQI approved WPS, PQR & WPQ are acceptable. Only Qualified welders to be deployed.

Note 4: Lot means 1000 Nos or Part thereof offered per Visit

Note 5: Test procedure specific to the manufacturer shall be finalized with the manufacturer, prior to start of manufacturing of Idlers. However, following procedures are being given as guidelines, which are inline with the procedure followed by Major Manufacturers , for easy reference

a) **Dust Ingress Test:** The selected Roller is mounted horizontally on a suitable fixture in a test rig located in a closed dust chamber and made to rotate at the operating speed range of the roller.

A continuous dust cloud is maintained in the dust chamber throughout the test period. Test is carried out for duration of 180 minutes. There after roller is dismantled

Acceptance Norm for Dust Ingress Test: No Dust particle to be found beyond inner labyrinth ring zone. If Dust particle are physically visible following procedure may be followed to ascertain the percentage of dust presence in the grease. Approximate 2 gms of “Grease” from the bearing of this dismantled roller is taken and dissolved in a solvent and residue content weighed. Similarly same weight of fresh unused grease is dissolved in the solvent and residue content weighed. The difference in the weights of the two residue content shall be within 5%.

b) **Water Ingress Test:** The selected Roller is mounted horizontally on a suitable fixture in a test rig and made to rotate at the operating speed range of the roller for a duration of 180 minutes.

During running of roller, water is sprayed from both sides at an angle of approx 35 degree at a min. pressure of 1 kg per cm square directly on the roller face near end cap. After testing roller is dismantled and check for water particles at the bearing area.

Acceptance Norm for Water Ingress Test: Roller is accepted if there is no ingress of water on bearing and there is no emulsification of grease. Presence of water after outer labyrinth seals shall be considered as improper sealing. In case of improper sealing observed on the selected sample then two more random sample from the lot shall be tested as per the above procedure and if both samples are accepted then lot shall be considered as accepted.

c) **Friction Test:** The selected Roller is mounted horizontally on a suitable fixtures and made to rotate at the operating speed range of the roller for determining the friction factor.

Testing Methodology 1: Test idler is driven to rotating speed above the operating speed after that Drive disconnected. Idler allowed to decelerate freely after disengaging the drive, rotating speed recorded. Dying time (ie time to decelerate from operating speed to zero speed) is noted.

Friction Factor = $K^2 \times 2 \times 3.1416 \times N / 60 \times t \times 9.81 \times R1$ where

K = Radius of Gyration i.e. as $\sqrt{(D_1^2 + D_2^2) / 4}$

D1 = Roller outside diameter in mtr

D2 = Roller inner diameter in mtr

N = Actual operating speed in rpm

R1 = Outside radius of roller in mtr

t = Deceleration time in sec

Testing Methodology 2: The test roller is rotated under a known load on a test rig (keeping the load on the shaft while the rollers are running). The resisting force in measured using a spring balance (connected through a lever arm). Taking moments of the above two forces (ie load applied on the roller & the resisting force) at the roller center the Frictional Factor is calculated

Acceptance Norm for Friction Test: Friction factor shall be within 0.02

Note 6: Care to be taken to reduce metal to metal contact & relative motion between Rollers

LEGEND: * RECORDS, IDENTIFIED WITH “TICK” (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: MANUFACTURER / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION.

AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN “N” AS ‘W’.

	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.):	STANDARD QUALITY PLAN		QP NO.: 0000-999-QOM- S - 088		REVIEWED BY: M KHALIQUZZAMA		APPROVED BY:	
	CONVEYOR PULLEYS	CONFORMING TO CODE: AS PER NTPC APPRD DRG/DS/TECH SPEC		REV. NO: 00 DATE : 27/11/2017		K J RAO		K K OJHA	
				PAGE 1 OF 5		R K JHA			
				VALID UPTO :26/11/2020					

SI NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
					M	C/N				M	C	N		
1	2	3	4	5	6	7	8	9	D*	** 10			11	
1.0	Raw Materials													
1.1	Plate for shell & end disc	Chemical Physical Lamination	Major Major Major	Chemical Analysis Tensile, yield, % elongation Ultrasonic	1 per heat 1 per heat 100%	1 per heat 1 per heat 100%	Approved Drawing/ Datasheet/Technical Specification ASTM A 435	Approved Drawing/ Datasheet/Technical Specification ASTM A 435	MTC MTC UT Report	✓	P	V	V	UT for plate thickness > 25 mm
1.2	Plate for shell & end disc for nonmagnetic pulley	Chemical Physical	Major Major	Chemical Analysis Tensile, yield, % elongation	1 per heat 1 per heat	1 per heat 1 per heat	Approved Drawing/ Datasheet/Technical Specification	Approved Drawing/ Datasheet/Technical Specification	MTC MTC	✓ ✓	P P	V V	V V	Refer Note 5
1.3	Forged rounds for shaft	Chemical Heat treatment Physical Micro structure Internal defect	Major Major Major Major Major	Chemical Analysis HT. Chart Tensile, yield % elongation & hardness Grain size Ultrasonic test	1 per Heat 100% 1 per heat 1/ HT batch 100%	1 per Heat 100% 1 per heat 1/HT batch 100%	Approved Drawing/ Datasheet/Technical Specification ASTM E 112 ASTM A388	Approved Drawing/ Datasheet/Technical Specification Minimum grain size 5 Note-1	MTC HT Chart Lab report UT report	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	UT for shaft dia > 40 mm
1.4	Forged rounds for Hub	Chemical Heat treatment Physical Micro structure Internal defect	Major Major Major Major Major	Chemical Analysis HT. chart Tensile, yield, % elongation & hardness Grain size Ultrasonic test	1 per Heat 100% 1 per heat 1/ HT batch 100%	1 per Heat 100% 1 per heat 1/ HT batch 100%	Approved Drawing/ Datasheet/Technical Specification ASTM E 112 ASTM A388	Approved Drawing/ Datasheet/Technical Specification Minimum grain size 5 Note-1	MTC HT Chart Lab report UT report	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	UT for hub dia > 40 mm

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
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एनटीपीसी NTPC		ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.):		STANDARD QUALITY PLAN			QP NO.: 0000-999-QOM- S - 088		REVIEWED BY: M KHALIQUZZAMA		APPROVED BY:				
		CONVEYOR PULLEYS		CONFORMING TO CODE: AS PER NTPC APPRD DRG/DS/TECH SPEC			REV. NO: 00 DATE : 27/11/2017		K J RAO		K K OJHA				
							PAGE 2 OF 5		R K JHA						
							VALID UPTO :26/11/2020								
1.5	Cast steel Hub	Chemical Heat treatment Physical	Major Major Major	Ch. Analysis HT. Chart Tensile Yield % elongation bend test impact test Ultrasonic	1 per heat 100% 1 per heat	1 per heat 100% 1 per heat	Approved Drawing/ Datasheet/ Technical Specification	Approved Drawing/ Datasheet/ Technical Specification ASTM A-609 (Level II for rim zone and Level III for core zone)	MTC MTC HT. Chart	√ √ √	P P P	V V V	V V V		
		Internal Defect	Major		100%	100%	ASTM A-609		UT Report	√	P	V	V		
1.6	Cast steel hub for nonmagnetic pulley	Chemistry	Major	Ch. Analysis	1 per heat	1 per heat	Approved Drawing/ Datasheet/ Technical Specification	Approved Drawing/ Datasheet/ Technical Specification	MTC	√	P	V	V	Refer Note 5	
		Physical	Major	Tensile Yield % elongation	1 per heat	1 per heat			MTC	√	P	V	V		
		Heat treatment	Major	HT Chart	100%	100%			HT. Chart	√	P	V	V		
		Internal defect	Major	Radiography	100%	100%			EN12681	EN12681(Level III) RT film & RT report	√	P	V		V
		Surface Defect	Major	DPT	100%	100%			EN 1371 Level 2	EN 1371 Level 2 DPT Report	√	P	V		V
2.0	IN PROCESS														
2.1	Welding procedure & welder qualification	Welding procedure & welder qualification	Major	Verification	100%	100%	ASME Sec. IX	ASME Sec. IX	Records	√	P	V	V	Refer Note 2	
2.2	Long seam welding of shell	NDT	Major	Ultrasonic	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 Appendix 12	UT Report	√	P	W	W	RT film review by NTPC	
		NDT(for SS shell)	Major	Radiography	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 UW51/52	RT film & Report	√	P	W	V		
		NDT	Major	DPT	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 Appendix 8	DP test Report	√	P	W	V		
2.3	Welding of shell with end plate	NDT	Major	Ultrasonic	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 Appendix 12	IR	√	P	W	W		

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 AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS 'W'.

		ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): CONVEYOR PULLEYS		STANDARD QUALITY PLAN CONFORMING TO CODE: AS PER NTPC APPRD DRG/DS/TECH SPEC				QP NO.: 0000-999-QOM- S - 088				REVIEWED BY: M KHALIOUZZAMA				APPROVED BY:			
								REV. NO: 00 DATE : 27/11/2017				K J RAO				K K OJHA			
								PAGE 3 OF 5				R K JHA							
								VALID UPTO :26/11/2020											
		NDT	Major	DPT	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 Appendix 8	DP test Report	√	P	W	V						
2.4	Welding of hub and end disc	NDT	Major	DPT	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 Appendix 8	DP test Report	√	P	W	V						
2.5	Welding of cast steel hub to shell	NDT	Major	Ultrasonic	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 Appendix 12	UT Report	√	P	W	W	RT film review by NTPC					
		NDT(for SS shell and hub)	Major	Radiography	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 UW51/52	RT film & Report	√	P	W	V						
		NDT	Major	DPT	100%	10%	ASME Sec V	ASME Sec VIII, Div 1 Appendix 8	DP test Report	√	P	W	V						
2.6	Shaft after machining	NDT(on machined surface)	Major	DPT	100%	10%	ASTM E 165	No linear indication	DP test Report	√	P	V	V						
3.0	FINAL INSPECTION																		
3.1	Assembly of pulley before Lagging	Dimension	Major	Measurement	100%	10%	Approved Drawing	Approved Drawing	IR	√	P	W	V						
		Run out	Major	Measurement	100%	10%	Approved Drawing	IS:8531	IR	√	P	W	V						
		Static Balancing	Major	Balancing	100%	10%	Approved Drawing	Approved Procedure	IR	√	P	W	V						
3.2	Pulley after rubber Lagging	Visual & Dimension	Major	Visual/ measurement	100%	10%	Approved Drawing	Approved Drawing	IR	√	P	W	W						

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		ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.):		STANDARD QUALITY PLAN			QP NO.: 0000-999-QOM- S - 088		REVIEWED BY: M KHALIQUZZAMA		APPROVED BY:		
		CONVEYOR PULLEYS		CONFORMING TO CODE: AS PER NTPC APPRD DRG/DS/TECH SPEC			REV. NO: 00 DATE : 27/11/2017		K J RAO		K K OJHA		
							PAGE 4 OF 5		R K JHA				
							VALID UPTO :26/11/2020						
3.3	Rubber lagging (Hot Vulcanizing)	Surface finish	Major	Visual	100%	10% from the offered lot	Approved Drg. / Mfr Drg.	Approved Drg. / Mfr Drg.	TR	√	P	W	W
		Thickness	Major	Measurement	100%		Approved Drg.	Approved Drg.	TR	√	P	W	W
		Shore Hardness	Major	Measurement	100%		Approved Drg. / IS:3400	Approved Drg.	TR	√	P	W	W
		Abrasion Loss	Major	Measurement	100%		Approved Drg. / DIN 53516	Approved Drg.	TR	√	P	W	W
		Peel off test	Major	Measurement	100%		Approved Drg. / IS 3400	Approved Drg.	TR	√	P	W	W
		Ash Content	Major	Measurement	100%		Manufacturer Std Practice	12% Max.	TR	√	P	W	W
		Tensile strength & % elongation	Major	Physical Test	100%		Approved Drg./ IS:3400	Approved Drg.	TR	√	P	W	W
		Spark test	Major	Physical Test	100%		Approved Drg. / IS: 4682	IS: 4682	TR	√	P	W	W
		Specific gravity	Major	Physical test	100%		Approved Drg. / IS:3400	Approved Drg.	TR	√	P	W	W
3.3	Static Balancing after lagging	Measurement	Major	Measurement	100%	100%	Approved Drawing/ Datasheet/Technical Specification/Approved procedure		IR	√	P	W	W
4.0	Cleaning & Painting	Paint shade & DFT	Major	Visual & Measurement	100%	100%	Approved painting schedule/Technical Specification		IR	√	P	V	

Note:

- When Back Wall Echo (BWE) set to 100% Full Screen Height (FSH) in sound area of the material, a defect echo > 20% FSH is not acceptable. Also loss of BWE > 20% is not acceptable.
- Welding procedures and welders qualified in presence of NTPC/Lloyds/BVQI/TUV shall be deployed for welding
- Rubber lagging checks on integral samples, procedure: Additional plate on the hub portion shall be tack welded and rubber lagging shall be done on the tack welded plate along with the pulley lagging. Tests shall be done on the integral test piece. Also specific gravity & ash content shall be checked on actual job also & the variation in the corresponding values shall not be more than 5% of the integral sample test result. Integral samples shall be removed in the presence of NTPC. These tests are done at rubber lagging manufacturer's premises.
- In case of any doubt, NTPC inspector may take sample from the actual job for tensile, elongation and hardness test. Manufacturer shall repair the same before dispatch to site.
- Random 1% grade verification for stainless steel material shall be carried out by NTPC during inspection.

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 AS APPROPRIATE, **CHP:** NTPC SHALL IDENTIFY IN COLUMN "N" AS 'W'.

	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): CONVEYOR PULLEYS	STANDARD QUALITY PLAN CONFORMING TO CODE: AS PER NTPC APPRD DRG/DS/TECH SPEC	QP NO.: 0000-999-QOM- S - 088 REV. NO: 00 DATE : 27/11/2017 PAGE 5 OF 5 VALID UPTO : 26/11/2020	REVIEWED BY: M KHALIOUZZAMA K J RAO R K JHA	APPROVED BY:  K K OJHA

PROCEDURE FOR PULLEY STATIC BALANCING

1. The pulley is put on stand fitted with Anti-Friction Ball Bearing.
2. Rotate the pulley in one direction.
3. Let the pulley come to rest on its own. The pulley comes to rest at a place where its mass is highest due to gravity. Mark this position.
4. Rotate the pulley again in the same direction and allow it come to rest on its own and see, whether the pulley stops at the same marked area.
5. This ensures that imbalance is present at the marked portion.
6. To counteract this imbalance keep the 'weights' 'clamped' to top of the pulley shell opposite to the marked portion and add 'weights'.
7. Repeat stage 2 to 5 by addition or removal of weights to ensure that the pulley comes to rest at different position when rotated every time.
8. Repeat the above by rotating the pulley in opposite direction also.
9. Note the added weight and mark its position.
10. Tack weld equivalent weight on shell inner periphery.
11. Repeat procedure and ensure pulley comes to rest at different position after every rotation.
12. Run weld the added weight and recheck balancing.
13. Total weight added should not be more than that allowed as per approved drawing.

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ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.):		STANDARD QUALITY PLAN					QP NO.: 0000-999-QOM- S -071		REVIEWED BY:		APPROVED BY:		
Gear Box (Helical/ Bevel Helical) (Case Hardened)		CONFORMING TO CODE:					REV. NO: 00 DATE 18.02.2014		M KHALIQUEZZAMA		Approved		
		SUB SYSTEM – COAL HANDLING PLANT					PAGE 1 OF 4		RAJEEV GARG		L GOWRISHANKAR		
							VALID UPTO :17.02.2017		A K JHA		Dt.....		
Sl. No	Component & Operations	Characteristics	Class	Type of Check	Quantum of Check		Reference Document	Acceptance Norms	Format of Record	Agency			Remarks
					M	C/ N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.
1.0 RAW MATERIAL													
1.1	GEAR BOX CASING (CAST)	Mechanical & Chemical	Major	Mech. & Chem.	1 per Heat	1 per Heat	Relevant Material Specs. as per Approved Drg. / Data Sheet	T.C.	√	P	V	V	Refer Note - 1
		Dimensional	Major	Measurement	100%	-	Mfr Drg	I.R.		P	-	-	
		Surface Condition	Minor	Visual	100%	-	MSS SP-55	I.R.		P	-	-	
	GEAR BOX CASING (FABRICATED FROM MS PLATES)	Mechanical & Chemical	Major	Mech. & Chem.	1/Heat	1/Heat	Relevant Material Specs. as per Approved Drg. / Data Sheet	T.C.	√	P	V	V	
		Internal Defect	Major	Ultrasonic Testing	100%	100%	ASTM - A 435	T.C.	√	P	V	V	For Thk ≥ 20 mm
1.2	PINION AND GEAR	Chemical	Major	Chemical	1 /Heat	1 /Heat	Relevant Material Specs. as per Approved Drg. / Data Sheet	T.C.	√	P	V	V	
		Mechanical properties	Major	Mech.	1/Heat/HT Batch	1/Heat/HT Batch	Relevant Material Specs. as per Approved Drg. / Data Sheet	T.C.	√	P	V	V	
		Grain Size	Major	Microstructure	1/Heat/HT Batch	1/Heat/HT Batch	ASTM E-112 Grain Size – 5 minimum	T.C.	√	P	V	V	
		Internal Defect	Major	Ultrasonic testing	100%	100%	ASTM A 388 See note -2	T.C.	√	P	V	V	For Dia./Thk ≥ 40mm
1.3	INPUT AND OUTPUT SHAFT	Chemical	Major	Chemical	1 /Heat	1 /Heat	Relevant Material Specs. as per Approved Drg. / Data Sheet	T.C.	√	P	V	V	
		Mechanical properties	Major	Mech.	1/Heat/HT Batch	1/Heat/HT Batch	Relevant Material Specs. as per Approved Drg. / Data Sheet	T.C.	√	P	V	V	
		Grain Size	Major	Microstructure	1/Heat/HT Batch	1/Heat/HT Batch	ASTM E-112 Grain Size – 5 minimum	T.C.	√	P	V	V	
		Internal Defect	Major	Ultrasonic testing	100%	100%	ASTM A 388 See note -2	T.C.	√	P	V	V	For Dia./Thk ≥ 40mm

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FORMAT NO.: QS-01-QAI-P-10/F3-R1

1/4

ENGG. DIV./QA&I

ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): Gear Box (Helical/ Bevel Helical) (Case Hardened)		STANDARD QUALITY PLAN CONFORMING TO CODE: SUB SYSTEM – COAL HANDLING PLANT					QP NO.: 0000-999-QOM– S -071 REV. NO: 00 DATE 18.02.2014 PAGE 2 OF 4 VALID UPTO :17.02.2017		REVIEWED BY: M KHALIQUZZAMAN RAJEEV GARG A K JHA		APPROVED BY: I. GOWRISHANKAR			
Sl. No	Component & Operations	Characteristics	Class	Type of Check	Quantum of Check		Reference Document	Acceptance Norms	Format of Record	Agency			Remarks	
					M	C/ N				M	C	N		
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.	
2.0 IN PROCESS INSPECTION & FINAL MACHINING														
2.1	GEAR CASING (FABRICATED)	WPS, PQR & WPQ	Major	Verification	100%	100%	ASME Sec.IX		WPS, PQR, WPQ	√	P	V	V	Refer Note - 3
		Stress Relieving	Major	Visual	100%	100%	Mfr S.R.Procedure		H. T. Chart	√	P	V	V	
		Surface defect (Welding)	Major	DP Test on weld	100%	100%	ASTM E-165	No linear indication	I.R.	√	P	V	V	
2.2	GEAR CASING	Leakage Test	Major	Leak Test	100%	100%	With Deterision P13 or kerosene	No Leakage	T.C.	√	P	V	V	For min. 04 hrs. duration.
		Visual	Major	Visual	100%	-	Mfr Std.		I.R.		P	-	-	
		Dimensional	Major	Measurement	100%	-	Mfr Drg.		I.R.		P	-	-	
2.3	PINION AND GEAR (AFTER MACHINING AND CASE HARDENING)	Case Depth	Major	Measurement	1/ HT Batch	1/ HT Batch	Mfr Std		I.R.	√	P	V	V	
		Hardness	Major	Measurement	1/ HT Batch	1/ HT Batch	NTPC Approved Drg. / Data Sheet		I.R.	√	P	V	V	
		Surface defect	Major	DP Test	100%	100%	ASTM E - 165	No linear indication	I.R.	√	P	V	V	
		Dimension	Major	Measurement	100%	-	Mfr Drg		I.R.		P	-	-	
2.4	INPUT AND OUTPUT SHAFT AFTER MACHINING	Dimension	Major	Measurement	100%	-	Mfr Drg		I.R.		P	-	-	
		Surface defect	Major	DP Test	100%	100%	ASTM E-165	No linear indication	I.R.	√	P	V	V	
		Hardness	Major	Measurement	100%	100%	NTPC Approved Drg. / Data Sheet		I.R.	√	P	V	V	

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 CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

FORMAT NO.: QS-01-QAI-P-10/F3-R1

2/4

ENGG. DIV./QA&I

ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.):		STANDARD QUALITY PLAN					QP NO.: 0000-999-QOM- S -071		REVIEWED BY:		APPROVED BY:			
Gear Box (Helical/ Bevel Helical) (Case Hardened)		CONFORMING TO CODE:					REV. NO: 00 DATE 18.02.2014		M KHALIQUZZAMAN		Approved			
		SUB SYSTEM – COAL HANDLING PLANT					PAGE 3 OF 4		RAJEEV GARG		GOWRISHANKAR			
							VALID UPTO :17.02.2017		A K JHA					
Sl. No	Component & Operations	Characteristics	Class	Type of Check	Quantum of Check		Reference Document	Acceptance Norms	Format of Record	Agency			Remarks	
					M	C/ N				M	C	N		
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.	
2.5	GEARS ASSEMBLY INSPECTION	Backlash	Critical	Measurement	100%	Random 10%	Mfr Std. /NTPC Approved Drg	I.R.	√	P	W	W	Refer Note - 4	
		Contact Pattern	Critical	Blue Matching	100%	Random 10%	Mfr Std. /NTPC Approved Drg	I.R.	√	P	W	W		
3.0 FINAL INSPECTION OF ASSEMBLED GEAR BOX														
3.1	ASSEMBLED GEAR BOX	Overall Dimensions and completeness	Critical	Measurement	100%	Random 10%	NTPC Approved Drg	I.R.	√	P	W	W	Refer Note - 5	
3.2	NO-LOAD RUNNING TRIAL TEST FOR MIN. 04 HRS OR TILL TEMPERATURE STABILISATION	Reduction Ratio	Critical	Measurement	100%	Random 10%	NTPC approved Drg. / Data Sheet	I.R.	√	P	W	W	Refer Note – 5 & 6	
		Oil Leakage	Critical	Visual	100%	Random 10%	No Leakage	I.R.	√	P	W	W		
		Temp. Rise of Oil	Critical	Measurement	100%	Random 10%	NTPC approved Drg. / Data Sheet	Max. 30°C above ambient Tempr.	I.R.	√	P	W		W
		Noise Level	Critical	Measurement	100%	Random 10%	NTPC approved Drg. / Data Sheet	Max. 85 dBA at 1m in horizontal direction and 1.5 m in elevation	I.R.	√	P	W		W
		Vibration	Critical	Measurement	100%	Random 10%	NTPC approved Drg. / Data Sheet	50 Microns (Max.) at Shaft Bearing in all 3 Directions	I.R.	√	P	W		W

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FORMAT NO.: QS-01-QAI-P-10/F3-R1

3/4

ENGG. DIV./QA&I

	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): Gear Box (Helical/ Bevel Helical) (Case Hardened)		STANDARD QUALITY PLAN CONFORMING TO CODE: SUB SYSTEM – COAL HANDLING PLANT				QP NO.: 0000-999-QOM- S -071 REV. NO: 00 DATE 18.02.2014 PAGE 4 OF 4 VALID UPTO : 17.02.2017		REVIEWED BY: M KHALIQUZZAMA RAJEEV GARG A K JHA		APPROVED BY: Approved 1. GOWRISHANKAR Dt.....		
	Sl. No	Component & Operations	Characteristics	Class	Type of Check	Quantum of Check		Reference Document	Acceptance Norms	Format of Record	Agency		Remarks
						M	C/ N				M	C	N
1.	2.	3.	4.	5.	6.		7.	8.	9.	D	** 10.		11.
3.3	PAINTING, PACKING & IDENTIFICATION	Uniformity of paint Coating & Finishing	Major	Visual	100%	100%	Approved Drg/Datasheet	I.R.	√	P	V	V	
		DFT Measurement	Major	Visual	100%	100%	Approved Drg/Datasheet	I.R.	√	P	V	V	

NOTE: -

1. In case of Cast Iron Castings, Chemical Composition test shall be applicable only if specified by Approved Drawing / Data Sheet.
2. **ULTRASONIC TEST**
 - (a) Ultrasonic test shall be carried out by UT- level II personnel.
 - (b) Defect echo max 20% of FSH &/or BWE min. 80% of FSH when BWE set to 100% of FSH in defect free area.
3. NTPC/BHEL/Lloyd / BVQI / DNV/TUV approved WPS, PQR & WPQ to be followed. Only Qualified Welders shall be engaged for the job.
4. Random 10% per Gearbox / Model, subject to minimum one number per Gearbox / Model to be witnessed by NTPC. Tooth contact and backlash can be verified from inspection record if it is not feasible to measure it on the assembled gear box.
5. Random 10% per Gearbox / Model subject to minimum one number per Gearbox / Model to be witnessed by NTPC.
6. Noise and vibration at shop is for reference purpose only.
7. Supplier is required to maintain internal correlation relating raw material heat nos. to the final product.
8. Latest edition of all the standards mentioned in the quality plan is to be used.

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: MANUFACTURER / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

FORMAT NO.: QS-01-QAI-P-10/F3-R1

4/4

ENGG. DIV./QA&I

CLAUSE NO.	QUALITY ASSURANCE			
1.01.00	ACI FITTINGS AND BASALT LINED PIPES & FITTINGS			
1.01.01	ACI Fittings shall be tested for Mechanical properties.			
1.01.02	Basalt liners shall be tested for chemical and mechanical properties. Basalt liners shall be examined visually for detection of cracks and defects. Level difference between two basalt liner shall be minimum. No loose piece is allowed.			
1.01.03	DPT of welds shall be carried out on root and finished welds of fabricated fittings.			
1.01.04	Fittings shall be hydraulically tested at twice the operating pressure or 1.5 times the design pressure whichever is higher for 30 min duration.			
1.02.00	FLUSHING BOXES & TROUGH TYPE EXPANSION JOINTS			
1.02.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. MPI/DP tests shall be done on welds to ensure freedom from defects. Water fill test on assembly shall be carried out.			
1.03.00	GEAR BOX			
1.03.01	In addition to checks for physical, chemical, hardness, microstructure as per relevant standard, the shaft and gear/pinion forgings shall be subjected to ultrasonic testing.			
1.03.02	MPI to be carried out on Gears/Pinions after machining. Case depth, hardness and MPI after hard-facing shall be checked to ensure freedom from defects.			
1.03.03	Gear boxes shall be checked for reduction ratio, backlash and contact pattern. No load shop trial run to be conducted on gear boxes to check for oil leakage, temperature rise, noise level and vibration.			
1.04.00	METALLIC EXPANSION JOINTS			
1.04.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. Leak test shall be carried out 1.1 times design pressure in case of vacuum application.			
1.04.02	DPT shall be carried out on welds before and after forming to check cracks. Spring rate shall also be measured.			
1.04.03	Proof of design test shall be carried out on one of the expansion joint as per (EJMA) relevant standards. In case the bidder have already carried out the same on the expansion joint of the type and rating being offered, the test certificate shall be submitted for review.			
1.05.00	FLY ASH BRANCH SEGREGATION VALVES , FLY ASH FEED VALVES, VACUUM BRAKER, AIR INTAKE VALVE AND KNIFE GATE VALVE FOR HOPPER ISOLATION			
1.05.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. Functional checks of the valves for smooth opening and closing shall also be done. Valves shall also be tested for allowable leakage rate, as applicable. Actuator operated valves shall be tested along with actuators			
1.06.00	AIR LOCK/PUMP TANK			
1.06.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. Air lock/pump tanks shall be tested hydraulically for 1.5 times the design pressure or 2 times working pressure, whichever is higher, for 30 min duration at manufacturer's works. NDT on welds shall be as per requirement of design code/standard.			
1.07.00	BAG FILTERS			
1.07.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. Leakage test shall be carried out for casing and other pressure parts. Pulsing and sequential test on bag filter shall be done.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	SECTION-VI, PART - B SUB-SECTION-V-QM-02 AHP	Page 1 of 5

CLAUSE NO.	QUALITY ASSURANCE	
1.08.00	~~DRY FLY ASH STORAGE SILO, BUFFER HOPPER~~	
1.08.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. MPI/DP test on welding shall be carried out. Fit up assembly checks shall be carried out at shop for all despatchable segments.	
~~1.09.00~~	~~ASH SLURRY SUMP ISOLATION PLUG VALVES, SUMP/TRENCH LINERS AND TRENCH JETTING/AGITATING NOZZLES~~	
1.09.01	All material shall be tested for chemical and mechanical properties as per relevant standard. Sump/Trench Liners and Nozzle Tip shall be checked for hardness.	
1.09.02	Sump isolation Plug valves shall be water-fill tested.	
1.10.00	FLUID COUPLING:	
1.10.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. Static and dynamic balancing shall be carried out for all rotating parts. Check for leak tightness of the coupling shall be carried out	
1.10.02	Functional test on fusible plug for each type of coupling shall be conducted at shop. All couplings to be run tested at shop.	
1.10.03	Check for temperature rise, torque speed, torque slip characteristics and over speed test on one coupling of each size and type during load test (preferably at Full load) at shop.	
1.11.00	ELECTRIC HOIST & OVERHEAD TRAVELLING CRANE:	
1.11.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. UT at proof machined condition (for dia/thickness ≥ 50 mm) and MPI/DPT after machining shall be done on gear blanks, shafts, pinions and axles	
1.11.02	Proof load test on hook as per relevant standard shall be carried out. UT shall be carried out on shank portion of the hook. DPT shall be carried out after proof load test. Wire ropes shall be tested as per relevant standard. Gear box shall be checked for ratio, backlash, Temp. rise, noise and no leakage of oil.	
1.11.03	All butt welds of rope drum shall be subjected to 100% RT. DP test shall be carried out after stress relieving of rope drums.	
1.11.04	100% radiography of weld under tension and 10% radiography of compression butt weld shall be done for girder etc. 100% DP of all butt welds and 10% DPT on fillet shall be carried out.	
1.11.05	All tests of completed assembly shall be carried out as per IS-3177 for Overhead Travelling Crane and as per IS 3938 for Electric Hoist. Chain Pulley Blocks shall be tested as per IS -3832.	
~~1.12.00~~	~~PACKAGE AIR CONDITIONER:~~	
1.12.01	Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard. Performance test of PAC shall be carried out as per relevant standard on one unit of each type and rating at site.	
1.13.00	~~For items/components like pipes, valves, pumps, compressors, specialties etc refer table below~~	
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP
SECTION-VI, PART - B SUB-SECTION-V-QM-02 AHP		Page 2 of 5

CLAUSE NO.		QUALITY ASSURANCE															
S N	Tests/Checks																
	Items / Components	Material Test	WPS/ WQS/PQR	DPT/MPI	Ultrasonic Test	Radiographic Test	PWHT	Assembly / Fit up	Dimensions	Hydraulic	Pneumatic Test	Balancing	Functional/operational Test	Performance Test	Other Tests	All Tests as per relevant Std	
1	Pipes & Fittings	Y ^a							Y	Y ²⁰						Y	
2	Diaphragm Valves	Y ^a							Y	Y ⁵			Y		Y ⁶	Y	
3a	Cast Butterfly Valves (Low Pressure)	Y ^a		Y ³	Y ^b			Y	Y	Y ⁵			Y		Y ⁷	Y	
3b	Fabricated Butterfly Valves (Low Pressure)	Y ^a	Y	Y ³	Y ^{12a}	Y ^{12b}	Y ^{12c}	Y	Y	Y ⁵			Y		Y ⁷	Y	
4	Gate/ Globe/ Check Valves	Y ^a		Y ³	Y ^b			Y	Y	Y ⁵	Y		Y		Y ⁸	Y	
5	Dual Plate Check Valves	Y ^a		Y ³	Y ^b			Y	Y	Y ⁵	Y		Y		Y ⁴	Y	
6	Plug / Ball Valves	Y ^a		Y ³	Y ^b			Y	Y	Y ⁵	Y		Y			Y	
7	Rolled & Welded Pipes / Mitre fittings	Y ^a	Y	Y ³		Y ¹			Y	Y ²⁰							
8	Coating & Wrapping of Pipes	Y ^a							Y							Y ²	
9	Strainers	Y ^a		Y ³					Y	Y ²⁰					Y ⁹		
10	Rubber Expansion Joints	Y ^a						Y	Y	Y ¹⁰					Y ¹¹		
11	Site Welding		Y	Y ³		Y ¹				Y ²⁰							
12	Submersible Pump	Y ^a							Y	Y ¹⁷		Y		Y		Y	
13	Horizontal Centrifugal Pumps/ Sump Pumps	Y ^a		Y ³	Y ^b			Y	Y	Y ¹⁷		Y		Y ¹⁶	Y ¹⁵	Y	
14	Compressors/ Blowers / vacuum Pumps	Y ^a		Y ³	Y ^b			Y	Y	Y ²⁰		Y		Y ¹⁸	Y ¹⁹	Y	
15	Atmospheric Storage Tanks/Mixing Tanks	Y ^a	Y	Y ³				Y	Y	Y ²⁰					Y ¹³	Y	
16	Pressure vessels & Heat exchangers	Y ^a	Y	Y ³		Y ²¹	Y ²²	Y	Y	Y ²⁰					Y ²³	Y	
17	Air Drying Plant	Y ^a	Y	Y ³		Y ²¹	Y ²²	Y	Y	Y ²⁰	Y		Y		Y ²⁴		
18	Mixers	Y ^a		Y ³	Y ^b			Y	Y				Y		Y ²⁵		
19	Fans	Y ^a		Y ³	Y ^b			Y	Y			Y		Y	Y ¹⁴	Y	
	NOTES																
a	One per heat/heat treatment batch/lot.																
b	For shaft/spindles/forgings diameter □ 50 mm																
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2		TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP				SECTION-VI, PART - B SUB-SECTION-V-QM-02 AHP				Page 3 of 5					

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC		
1	Weld Joints not subjected to hydraulic test shall be subjected to 100% RT.			
2	Tests for primer and enamel / Coal Tar Tapes as per AWWA-C-203 / IS 15557			
3	On machined surfaces of castings/shaft/spindles/forgings. DPT/MPI on root run (after back gouging/chipping – as applicable) for 100% and on finish butt & fillet welds for 10%.			
4	Dry Cycle Test on Dual Plate Check valve spring for one lakh (10 ⁵) Cycles shall be carried out as a type test.			
5	Valves shall be tested for Body, seat & back seat leakage as applicable. Hydraulic test pressure shall be as per relevant standard. & shall be done as per relevant standard. Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator. Valves shall be offered for hydro test in unpainted condition			
6	Tests on rubber diaphragm such as hardness, bleed resistance test, rubber to fabric bond, flex test & type test for 50,000 cycles shall be carried out.			
7	In addition to Body & seat hydrotest, disc-strength shall be carried out as per relevant standard			
8	Blue matching for metal-seated valves, Wear travel for gate valves, pneumatic seat leakage test & reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg absolute for valves to be tested for vacuum operation for internal pressure 25 mm of Hg absolute for a period of 15 minutes			
9	Pressure drop across the strainer for each type and size as a special test shall be carried out			
10	During hydraulic and vacuum tests in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.			
11	Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149, ageing test and adhesion strength of rubber to fabric & rubber to metal shall be carried out.			
12	a) For fabricated butterfly valves: UT as per ASTM A-435 on plates for body and disc shall be carried out. b) 100% RT as per ASTM, Section-VIII, Division-I, on butt joins of body and disc c) Post Weld Heat Treatment (PWHT) as per ASME, Section-VIII, Division-I on butt joints of body and disc of thickness above 30mm shall be carried out.			
13	Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted.			
14	All fans shall be subjected to run test and Vibration, noise, temperature rise, and current drawn shall be measured during the run test. Performance test of one fan of each type and size shall be carried out as per applicable standard for air flow, static pressure, speed, Efficiency, power consumption.			
15	In case of diaphragm/plunger, only proven material shall be used and certificate in this regard shall be submitted for review.			
16	All pumps to be performance tested as per Hydraulic Institute Standard/Relevant standard. Performance test to include check for noise, vibration level and bearing temperature rise. NPSH test shall be carried out for pumps, if applicable.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210(R&M)- 104A-2	TECHNICAL SPECIFICATION FOR UPGRADATION & RENOVATION OF ESP	SECTION-VI, PART - B SUB-SECTION-V-Q-02 AHP
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CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC		
17	Pumps shall be tested at 200% of pump rated head or at 150% of pump shut-off head whichever is higher for 30 min duration.			
18	Performance testing of each compressor/ Blower / Vacuum Pump shall be carried out at shop as per BS-1571/ IS: 5456 /ISO 1217/ Pneurop 6612/ equivalent as applicable. Noise & vibration shall also be measured during performance testing.			
19	For Compressors capacity control and operation of safety valves shall be checked during inspection at shop			
20	Pressure retaining parts shall be hydraulic tested. Hydraulic test pressure shall be as per applicable std / 1.5 x design pressure or 2 x working pressure whichever is higher for 30 minutes duration. Atmospheric tanks shall be water fill tested			
21	RT on weld joints shall be as per respective code requirements. Heat Treatment of the Tank/Vessel shall be done as per fabrication code requirement.			
22	Dished ends shall be stress relieved as per relevant code. However, dished ends welds (if manufactured by using welded plates) shall be subjected to 100% RT and stress relieved.			
23	Tube to tube sheet joints of heat exchanger shall be subject to mock up test. Coolers/heat exchanger shall be hydro tested on tube side and shell side			
24	Refrigerant compressors shall be tested as per relevant std and certification from manufacturer for the same shall be submitted. Due point measurement & function of auto drain trap shall also be carried out.			
25	Concentricity/ centering & Axial Run out Shall also be measured			

SUB-SECTION-V-QE

ELECTRICAL

Table for Transformer Rectifier Set for ESP

ATTRIBUTES / CHARACTERISTICS <i>ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY</i>	Visual	Dimensional & Physical	Make/Type/Rating	Mech. / Chem. Properties	Electrical	Electronics	Welding	NDT	Pretreatment 7 tank	Painting,	All tests as per relevant std	All tests as per IEC-146
Thyristor	Y	Y	Y			Y						Y
Contactors	Y	Y	Y		Y							
Switch Fuse Unit	Y	Y	Y		Y							
HRC Fuse	Y	Y	Y		Y							
Current Transformer	Y	Y	Y		Y							
Over Voltage Protector	Y	Y	Y		Y							
Measuring Instruments	Y	Y	Y		Y							
Control Transformer	Y	Y	Y		Y							
Bushings	Y	Y	Y		Y							
Dial Thermometer	Y	Y	Y		Y							
Resistor wire wound	Y	Y	Y		Y							
Sudden Pressure Relay	Y	Y	Y		Y							
PVC Insulated Copper wire (ISI Marked)	Y	Y	Y		Y							
Terminal Block	Y	Y	Y		Y							
Gasket	Y	Y	Y	Y								
Electrolytic Copper	Y	Y	Y	Y								
Capacitor, Resistor	Y	Y	Y	Y	Y	Y						
PCB	Y	Y	Y		Y							
Insulated Conductor	Y	Y	Y	Y	Y							
Laminations	Y	Y	Y	Y	Y							
Press Board, Paper	Y		Y	Y	Y							
Insulating Oil (Silicon)	Y	Y	Y	Y	Y							
Radiator	Y	Y	Y	Y				Y				
Transformer Tank	Y	Y	Y	Y			Y	Y				
Panel Fabrication	Y	Y	Y	Y			Y		Y	Y		
Electronic Cards	Y	Y	Y		Y	Y						
Linear Reactor, Choke	Y	Y	Y	Y	Y							
Transformer Assembly	Y	Y		Y	Y						Y	
Control Panel	Y	Y	Y	Y	Y	Y				Y		
HV, TR Set	Y	Y	Y		Y	Y				Y	Y	
EPC Controller (Separate QAP	Y	Y			Y	Y						
Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalisation. 2) All major Bought Out Items will be subject to NTPC approval.												

Annunciation, Control ,PLC Panel

ATTRIBUTES / CHARACTERISTICS

ITEMS/COMPONENTS , SUB SYSTEM ASSEMBLY

	Visual	GA, BOM , Lay Out of components	Dimensions	Paint Shade/ Thickness/ Adhesion	Component Rating/ Make / Type	Wiring	IR & HV	Review of TC for instruments	Accessibility of TBS/ Devices	Illumination	Functional Check for Control Element , Annunciation	Test as per IEC 1131 *	Routine & acceptance Tests as per relevant std
Annunciation, Control, PLC Panel	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions
2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents.

- *Applicable for PLC

SUB-SECTION-V-QE-02

LT POWER CABLE

QUALITY ASSURANCE

LT Power Cables

Item / Components / Sub System Assembly	Attributes / Characteristics																
	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on wooden	Constructional requirements feature as per NTPC specification	Routine & Acceptance Tests as per relevant standard & NTPC specification	FRLS Tests	
Aluminum (IS-8130)	Y	Y	Y	Y		Y											
XLPE Compound (IS-7098)	Y		Y			Y	Y				Y						
PVC insulation Compound (IS: 5831)	Y		Y			Y					Y	Y					
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1)	Y		Y								Y	Y				Y	
Extrusion & curing /Manufacturing of Core (PVC / XLPE)		Y			Y		Y					Y					
Core Laying								Y									
Armour wire/strip	Y	Y	Y														
Inner sheath	Y	Y															
Armouring		Y							Y								
Outer Sheathing		Y								Y							
Power Cable (Finished) (IS-5831, ASTM- D2843, IS10810(Part 58), IEC-60754 Part-1, IEC 60332 part III cat B)								Y	Y	Y	Y	Y		Y	Y	Y	
Wooden drum(IS-10418) /Steel Drum		Y											Y	Y			

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to NTPC approval.

QUALITY ASSURANCE

ROUTINE TESTS	Following routine tests shall be carried out on each drum of finished cables for all types (PVC / XLPE insulated) & sizes.	
1)	Conductor Resistance test	
2)	High voltage test	
ACCEPTANCE TESTS	Following Acceptance tests shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in the offered lot.	
A) For Conductor (as per sampling plan mentioned in IS: 1554 / 7098)		
	1)	Annealing test (Copper)
	2)	Tensile Test (Aluminum)
	3)	Wrapping Test (Aluminum)
	4)	Resistance test
B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IS: 1554 / 7098)		
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects
C) For PVC / XLPE insulation & PVC Sheath (as per sampling plan mentioned in IS: 1554 / 7098)		
	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing (for tests after ageing see “D”)
	3)	Hot set test (For XLPE insulation)

QUALITY ASSURANCE

D) Ageing test:

	Criteria	Condition	Test Requirements	Remarks
PVC insulation & outer sheath:	Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). Tensile & elongation testing shall preferably be done with a computerized machine. The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).	All sizes which meet the criteria	The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C+/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test then all sizes (which had met the criteria) will be put on ageing test as per IS.
		Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----
XLPE insulation	Samples as per relevant IS, from each size of cables in the offered lot,will be put on ageing test as per IS.			
E) Following tests will be carried out on completed cables as per IS on each size of each type (PVC / XLPE insulated)				
	1)	Insulation resistance test (Volume resistivity method)		
	2)	High voltage test		

QUALITY ASSURANCE

F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)

	1)	Thermal stability test on PVC insulation and outer sheath
	2)	Oxygen index test on outer sheath
	3)	Smoke density rating test on outer sheath
	4)	Acid gas generation test on outer sheath

G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cables as per following sampling plan:

		This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured PVC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched together, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall be covered. For one particular type, cables with OD less than or equal to 30 mm shall be clubbed together in touching formation while cables with OD greater than 30 mm shall be clubbed together leaving a gap equal to OD of cable having least diameter. Cable OD shall be taken as nominal overall diameter as per NTPC approved datasheet.

H) Following tests shall be carried on one length of each size of each type (PVC / XLPE insulated) of offered lot:

	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch)number marking on sheath
	2)	Measurement of Eccentricity & Ovality

SUB-SECTION-V-QE-03

LT CONTROL CABLE

QUALITY ASSURANCE

Control Cables

Attributes / Characteristics Item / Components / Sub System Assembly	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on wooden	Constructional requirements feature as per NTPC specification	Routine & Acceptance Tests as per relevant standard & NTPC specification	FRLS Tests
Copper (IS-8130)	Y	Y	Y	Y		Y									
PVC insulation Compound (IS: 5831)	Y		Y			Y				Y	Y				
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1)	Y		Y							Y	Y				Y
Extrusion & curing /Manufacturing of Core		Y			Y						Y				
Core Laying							Y								
Armour wire/strip	Y	Y	Y												
Inner sheath	Y	Y													
Armouring		Y					Y								
Outer Sheathing		Y							Y						
Finished Cable (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1, IEC 60332 part III cat B)							Y	Y	Y	Y	Y		Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y										Y	Y		

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to NTPC approval.

QUALITY ASSURANCE

ROUTINE TESTS	Following routine tests shall be carried out on each drum of finished cables for all sizes.	
1)	Conductor Resistance test	
2)	High voltage test	
ACCEPTANCE TESTS	Following Acceptance tests shall be carried out on each size of cables, in the offered lot.	
A) For Conductor (as per sampling plan mentioned in IS: 1554)		
	1)	Annealing test (Copper)
	2)	Resistance test
B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IS: 1554)		
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects
c) For PVC insulation & PVC Sheath (as per sampling plan mentioned in IS: 1554)		
	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing (for tests after ageing see “D”)

QUALITY ASSURANCE

D) Ageing test:

	Criteria	Condition	Test Requirements	Remarks
PVC insulation & outer sheath:	Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). Tensile & elongation testing shall preferably be done with a computerized machine. The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).	All sizes which meet the criteria	The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test then all sizes (which had met the criteria) will be put on ageing test as per IS.
		Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----

E) Following tests will be carried out on completed cables as per IS on each size:

	1)	Insulation resistance test (Volume resistivity method)
	2)	High voltage test

F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes):

	1)	Thermal stability test on PVC insulation and outer sheath
	2)	Oxygen index test on outer sheath
	3)	Smoke density rating test on outer sheath
	4)	Acid gas generation test on outer sheath

G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable will be carried out as per following sampling plan:

		This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured, unarmoured) will be bunched together, as per calculations in line with the IEC. All sizes of armoured & unarmoured cables shall be covered.

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H) Following tests shall be carried on one length of each size (armoured & unarmoured) of offered lot:

	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / outer sheath extrusion's batch number marking
	2)	Measurement of Eccentricity & Ovality

SUB-SECTION-V-QE-04

CABLING, EARTHING & LIGHTNING

CABLING, EARTHING, LIGHTNING PROTECTION

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

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

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

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

SUB-SECTION-V-QE-09

MOTOR

QUALITY ASSURANCE

MOTOR

TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-I/ IS-12615	vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y										
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y									
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y										
Stator copper	Y	Y	Y	Y			Y		Y										
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y			Y					Y							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y										
Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												

KAHALGAON SUPER THERMAL POWER
STATION STAGE-I (4x210 MW)

BID DOC. NO.:
CS-4210-104A(R&M)-2

TECHNICAL SPECIFICATION FOR
RENOVATION & RETROFITTING OF ESP

SECTION-VI, PART - B
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MOTOR

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Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant

supporting documents during QP finalization. However, No QP for LT motor upto 50KW.

2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard

3. Makes of major bought out items for HT motors will be subject to NTPC approval.

4. Y1 = for HT Motor / Machines only.

SUB-SECTION-V-QE-10

VFD MODULE

**ITEMS/COMPONENTS,
SUB SYSTEM
ASSEMBLY**

Final
Inspection
as ISS
/ IEC

Remarks

HT Breaker (IEC 56)	Y	Y	Y	
DC Reactor	Y	Y		For details refer table for DC Reactor
Transformer	Y	Y		For details refer table for Transformer
Motor	Y	Y		For details refer separate table for Motor
VFD Panel	Y	Y		For details refer table for VFD

Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalization.

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

DC REACTOR

ATTRIBUTES /
CHARACTERISTICSITEMS/COMPONENTS,
SUB SYSTEM
ASSEMBLY

Visual

Dimensional

Mech. & Chem. Property

Electrical Characteristics

Pretreatment by Seven Tank

Painting by Stove Enameling

Final Inspection as per IS-2026

Welding/NDT

Winding Material (Aluminium)

Y

Y

Y

Y

Insulation Material

Y

Y

Y

Sheet Steel

Y

Y

Y

Winding

Y

Y

Y

Fabrication of Enclosures

Y

Y

Y

Y

Y

Assembly

Y

Y

Routine Tests

Y

Y

Y

Note : 1) This is an indicative list of tests/checks. The manufacturer to furnish a detailed Quality Plan indicating their practice & procedure along with relevant supporting documents during QP finalisation for all items.

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

QUALITY ASSURANCE

TRANSFORMER (OIL FILLED)													
Attributes / Characteristics Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	WPS & PQR	Routine Test as per relevant test	Routine Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y						
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y							
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y		Y	
Gasket	Y				Y	Y		Y				Y	
Transformer Oil (IS:335 / IEC296)												Y	
Off-Circuit Tap Changer	Y									Y			
Core Coil Assembly & Pre-tanking	Y								Y				
Marshalling Box	Y	Y					Y					Y	
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve,	Y									Y			
Welding (ASME Sect-IX)	Y										Y		
Complete Transformer (IS:2026/ IEC-60076)	Y												Y
Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2) All major Bought Out Items will be subject to NTPC approval.													

DRY TYPE TRANSFORMER

Attributes / Characteristics Items/Components Sub Systems	Visual & Dimensional check	Mechanical properties	Electrical strength	Thermal Properties	Chemical Properties	NDT / DP / MPI	Voltage Ratio, Vector Group & Polarity	Make / Type / Rating / Model / TC / General Physical Inspection	WPS & PQR	Routine Test as per relevant	Measurement of capacitance & tan delta between winding	Routine Test
Enclosure door, H.V. & L.V. Cable Box / Flange Throat	Y	Y						Y				
Copper Conductor	Y	Y	Y		Y							
Insulating Material	Y			Y	Y							
CRGO Lamination & Built Core	Y											
Bushing /Insulator (IS:2544 / 5621)	Y							Y		Y		
Gasket	Y							Y		Y		
Off-Circuit Tap Changer	Y							Y				
Core Coil Assembly	Y						Y					
Marshalling Box	Y									Y		
WTI, Thermister, Terminal Connector	Y							Y				
Welding									Y			
Complete Transformer (IS:11171 / IEC 60076)	Y										Y	Y
Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item. 2) All major Bought out Items will be subject to NTPC approval.												

VFD PANEL

Attributes Characteristics																		
Item Components Sub System Assembly	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	IS:6005 ,Seven tank process	Paint finish/ shade/thickness	Mountings / BOM/ Make, Completeness	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Final testing as per Relevant IS/IEC				
Sheet Steel (IS-513)		Y	Y	Y														
Aluminum / Copper Bus-bar (IS-5082/IS-613/IS-1987)	Y	Y	Y	Y														
Support Insulator (BS-2782/IEC-660/IS-10912)	Y	Y	Y	Y														
Control / Selector Switch (IS-6875)					Y	Y	Y											
Contactors/ MCB (IS-13947)					Y	Y	Y											
O/L Protection relays (IS-3231)					Y		Y											
C.T / V.T/ Indicating Meter (IS-2705/3156/1248)					Y	Y	Y											
Fuse/ Fuse carrier (IS-13703)					Y	Y	Y											
Terminals/lugs/pvc wires (IS-13947/IS-694)	Y			Y	Y	Y	Y											
Timers (IS-3231)					Y	Y	Y											
Push Button/ Lamp/ (IS-6875)					Y	Y	Y											
Control Transformer (IS-12021)					Y	Y	Y											
Mimic, Annunciater					Y		Y											
GASKET (IS-11149)		Y	Y	Y	Y		Y											
Fabrication								Y										
Pretreatment & Painting									Y	Y								
VFD panel										Y	Y	Y	Y	Y				

NOTE:

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

SUB-SECTION-V-QI

CONTROL & INSTRUMENTATION

SUB-SECTION-V-QI-01

MEASURING INSTRUMENTS
(PRIMARY & SECONDARY)

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

TESTS ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

: Note: 1) Detailed procedure of Environmental Stress Screening shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

ITEMS	TESTS											
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **			Y	Y **	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y *	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Flue Gas analyser	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												
R-Routine Test A- Acceptance Test Y – Test applicable												
Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.												

SUB-SECTION-V-QI-02

INSTRUMENTATION CABLE

INSTRUMENTATION CABLE													
ITEMS	TESTS												
	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheath/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++
1. Instrument cable twisted and shielded													
Conductor(IS-8130)	Y			Y			Y						
Insulation(VDE-207)				Y	Y	Y	Y					Y	Y
Pairing/Twisting				Y	Y		Y						
Shielding				Y			Y			Y			
Drain wire	Y			Y			Y		Y	Y			
Inner Sheath				Y	Y	Y	Y					Y	Y
Outer Sheath				Y	Y	Y	Y					Y	Y
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y		Y
Cable Drums(IS-10418)				Y			Y						
Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784. Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items. Note : ® - Routine Test A - Acceptance Test Y - Test Applicable Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable) * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1) ** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk (As applicable) + Sample size will be One No. of each size/type per lot. ++ Sample size will be One No. sample for complete lot offered irrespective of size/type.													

SUB-SECTION-V-QC

CIVIL

SUB-SECTION-V-QC-01

CIVIL WORKS

CLAUSE NO.	QUALITY ASSURANCE				एनटीपीसी NTPC
	SAMPLING, TESTING AND QUALITY ASSURANCE FOR CIVIL WORKS				
1.0.0	INTRODUCTION				
1.1.0	This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification including excavation and filling, cast in situ concrete and allied works, fabrication and erection of structural steel works, masonry / sheeting and allied works, finishing items,etc.				
1.2.0	This part of the technical specification shall be read in conjunction with other Parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.				
1.3.0	All tests required for all materials (bought by Contractor) and workmanship shall be done / got done by the contractor at his own cost. The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part.				
1.4.0	The Contractor shall provide the facilities whatsoever required and also bear the cost for all sampling, testing and quality assurance in the field and in the laboratory. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian standards and / or international standards and this technical specification. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All sampling shall be done in the presence of the Engineer or his authorised representative. The Contractor shall establish the QA&QC laboratory at site and all field tests shall be done in the presence of the Engineer and / or his authorised representative. The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute such as CSMRS, NCBM, IITs, National Test House, Kolkata etc. as agreed by the Engineer. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by FQA representative of the engineer. The cost of transportation and other associative cost including the test charges shall be borne by the contractor. These cost shall deemed to be included in the respective item of work in the contract. If the Engineer desires to witness such tests at laboratory, Contractor shall arrange to conduct the test in his presence.				
1.5.0	The recommendations and suitability of material for concreting and other building materials like brick, cement, aggregates etc., shall be ascertained by contractor prior to start of work. Preliminary evaluation of aggregate and its evaluation for potential alkali-aggregate reactivity as per following scope of work shall be done:- A. <u>Evaluation of Aggregates:</u>				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)		BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	SECTION-VI, PART - B SUB-SECTION-V-QC-01 CIVIL	Page 1 of 17

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC		
	I. To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386. II. To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis soundness, deleterious material, silt content, clay content and organic impurities as per IS: 2386. III. To prepare evaluation report based on test results of I) and ii) above and to advise regarding suitability of fine and coarse aggregates B. <u>Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:</u> Evaluation for Potential Alkali-Aggregate reactivity as per following scope of work: I. To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test. II. To prepare a report based on test results of I) above and to advise regarding suitability of aggregates and further testing required if any. The Contractor shall initiate the action with regard to the above mentioned evaluation of aggregates and other building material, so as to ensure timely completion of these tests thereby not affecting any project work. All records shall be submitted, unless specified otherwise, as per the format developed by the Contractor and approved by the Engineer. 1.6.0 The Contractor shall enclose a comprehensive list of bought out items (BOIs) envisaged in the contract for carrying out fabrication/ manufacturing/ erection/ construction/ commissioning activities, procurement of forged, cast, semi-finished and finished components/equipment etc and shall indicate the names of reputed manufacturers for each of them in their bid proposal. The items envisaged by the Contractor to be procured from these manufacturers shall meet the specification requirement. An indicative list of major bought out items (not exhaustive) for civil works is enclosed at Annexure-I, for which the contractor shall submit the requisite details / lists of manufacturer's in their bid proposal. 1.7.0 The list of manufacturers / sub-vendors of each of the BOIs identified / indicated by the Contractor shall be discussed / reviewed by the NTPC during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOI shall be agreed/ approved. The list of manufacturers for all the BOIs envisaged in contract shall be included in the bid proposal and the same shall be discussed for finalization during the post bid discussions before placement of award. Where the manufacturers are placed in "DR" (Details required) category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the NTPC for approval within the period agreed at the time of post bid discussions. The Contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-Contractor detail submission / approval shall be furnished on format no. QS-01-QAI-P-02/F1. NTPC shall furnish other			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	SECTION-VI, PART - B SUB-SECTION-V-QC-01 CIVIL	Page 2 of 17

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC		
	relevant formats for information/ clarification for manufacturers / sub-vendors approval to the Contractor at the time of post bid discussions (Main supplier's evaluation report Format No: QA-01-QAI-P-04/F1-R0 and Sub supplier questionnaire Format no: QA-01-QAI-P-04/F2-R0). Such manufacturers / sub-vendors approval shall not relieve the Contractor from any obligation, duty or responsibility under the contract. 1.8.0 Structural / Reinforcement steel supply if in the scope of the contractor shall be procured from Main Steel Producers like SAIL, TISCO, RINL, Essar Steel Ltd, Ispat Industries Ltd, JSW Steel Ltd, Indian Iron & Steel Co. Ltd, Jai Balaji Industries Ltd at Durgapur (for 8 to 40mm reinforcement steel only), Uttam Value Steels Ltd, Jindal Steel & Power. 1.9.0 The Field Quality Plans shall detail out all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site. The contractor shall furnish complete QA & QC programme (QAP) for the work envisaged which may include the following:- • The organisation structure for the management and implementation of the proposed Quality Assurance Programme. • Documentation Control System • The procedure for procurement of materials and source inspection. • System for site controls including process controls. • Control of non-conforming items and systems for corrective action • Inspection and test procedures for site activities • System for indication and appraisal of inspection status • System for maintenance of records • System for handling, storage and delivery. • Quality Plan detailing out quality practices and procedures, relevant standards and acceptance levels for all types of work under the scope of this contract. The Contractor shall appoint a dedicated, experienced and competent quality management representative on site, preferably directly reporting to the Project Manager, supported by experienced personnel, to ensure the effective implementation of the approved quality assurance programme. The onsite quality management representative shall have the organisational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints. The QA & QC setup of the contractor shall consist of qualified and experienced engineers, with their supporting staff. The QA&QC set up in addition to requisite mechanical & electrical engineers shall consist sufficient graduate civil engineers & supervisors to take care of quality assurance activities of both site & laboratory. The deployment of man power for QA & QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the Engineer-in-charge for acceptance.			
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	SECTION-VI, PART - B SUB-SECTION-V-QC-01 CIVIL	Page 3 of 17

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	Based on the schedule of work agreed with the Engineer-in-charge and the approved FQP, the Contractor shall prepare a schedule of tests and submit them to the Engineer-in-charge and organize to carry out the tests as scheduled/ agreed. The QA&QC laboratory shall have all necessary equipment, instruments and shall be managed by a qualified / experienced person. An indicative list of test equipment is attached at Annexure-II. All these testing equipment shall be provided by the contractor at his own cost. The contractor shall maintain the equipment in good working condition along with valid calibration certificates, for the duration of the contract. Any other equipment though required for testing but not listed in the equipment list shall be provided / arranged by the contractor at his own cost. QA&QC laboratory building shall be constructed by the Contractor at their own cost. The laboratory building shall be constructed and installed with the appropriate facilities. Temperature and humidity controls shall be available wherever necessary during testing of samples 1.10.0 The Contractor shall prepare and obtain approval of the Owner of the Field Quality Plan (FQP) well before the start of the work. This FQP shall cover for all the items / activities covered in the contract/schedule of items and required for completion of the work. 1.11.0 All materials / components and equipment covered under the scope of work which are to be manufactured at shop/ factory of the vendor/subvendor shall be covered under a comprehensive quality assurance programme. The detailed quality plan for manufacturing shall be drawn up by the contractor and will be submitted to the owner for approval in the prescribed format for manufacturing quality plan. Manufacturing Quality Plan (MQP) shall detail out all the components and equipment, various test/inspection, to be carried out as per the requirements of this specification and standards mentioned therein. The quality practices and procedures followed by Bidder's/Sub-Bidder's/ sub-supplier's Quality Control Organization shall include , the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of material procurement, manufacture, assembly and final testing / performance testing . The quality plan shall be submitted in electronic media e.g. CD or E-mail in addition to hard copy, for review and approval. After approval the same shall be finally submitted in compiled form on CD. 1.12.0 The Contractor shall store and handle the materials as per the requirements of the relevant standards at his own cost. 1.13.0 All the equipment shall be duly calibrated by NABL/ NPL accredited laboratories/accreditation agencies. 1.14.0 The Contractor shall submit to the NTPC Field Welding Schedule for field welding activities in the format No.: QS-01-CQA-W11/F1, this format shall be furnished to the Contractor at pre-award stage. The field-welding schedule shall be submitted to the NTPC along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. The Contractor shall submit Welding Procedure Specification (WPS) in the format No: QS-01-QAI-W-06/F1 for NTPC approval/			
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1.15.0	acceptance, this format shall be furnished to the Contractor during post bid discussion stage. All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC. All welding/brazing procedures shall be submitted to the NTPC or its authorized representative for approval prior to carrying out the welding/brazing. All brazers, welders and welding operators employed on any part of the contract either in the Contractor's/ sub-Contractor's works or at site or elsewhere shall be qualified as per AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC. Welding procedure qualification and Welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, tests shall be conducted in presence of NTPC/authorized representative. No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes. All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification; The NDT operator shall be qualified as per SNT-TC-1A (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC. The Contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (Man-In-Charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the Contractor. The Contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the Technical Specification requirements in association with the specialized blasting agency. The Contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services/ work awarded to them by Contractor. The services of such specialized blasting agency shall be available throughout the period in which the blasting work is undertaken at site			
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1.16.0	ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME: i. Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 ii. Indicative list of major bought out items for civil works (Annexure-I) iii. Indicative list of Field Quality Laboratory and Survey equipment list (Annexure-II) iv. Indicative QA&QC Manpower requirements (Annexure-III) v. Indicative Field Quality Plan for Civil Works (Annexure-IV) vi. Indicative Field Quality Plan for Structural Steel Works (Annexure-V) (Note: The field quality plan attached is indicative and the contractor shall prepare the field Quality plan covering the entire scope of work in the contract and submit the same to corporate QA for acceptance/approval. However any addition or deletion in the scope of work, during detailed engineering shall be accordingly added/ deducted from the Field Quality Plan)			
2.0.0	GENERAL QA REQUIREMENTS			
2.1.0	STORAGE AND HANDLING OF COMMON BUILDING MATERIALS All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in NTPC Technical Specification.			
2.2.0	EXCAVATION AND FILLING WORKS The contractor shall submit a work methodology covering various items of works for all stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading , compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance. For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available throughout the period in which the blasting work is undertaken at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor. Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the engineer. However, these tolerances shall be applicable for localized areas only.			
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	All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference. i. Testing data / report of aggregates including petrographic examination & potential reactivity of aggregate and repeated temperature cycle tests wherever specified ii. Mix design details and record of trial mixes carried out at site iii. Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports. iv. Approved scheme for concreting v. Hourly records of concreting including pour card vi. Protocol indicating the dimensional tolerance and details of inserts vii. Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used viii. Bar bending schedule ix. Location and details of mechanical anchoring used for reinforcement x. Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings xi. Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification xii. Temperature control record of concrete at the time of placement if applicable. xiii. Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations xiv. Batching Plant shall be calibrated regularly at least once in a 3 months. Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used. Production and supply of concrete from batching plant shall conform to the provisions of IS 4926 xv. Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per NTPC Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 1% up to 1000 nos., @0.5% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456 and relevant IS code.																											
<table><tr><th colspan="4">TOLERANCES</th></tr><tr><th colspan="2">Description of Item/ Structural Element</th><th>Max (mm)</th><th>Min (mm)</th></tr><tr><td colspan="2">Cast In Situ Concrete</td><td></td><td></td></tr><tr><td>1.</td><td>Faces of concrete in foundations and structural members against which back fill is placed</td><td>+25</td><td>-10</td></tr><tr><td>2.</td><td>Eccentricity of footing as percentage of footing width in the direction of placement</td><td colspan="2">2% but limited to 50mm</td></tr><tr><td>3.</td><td>Top surfaces of slabs and of concrete to receive base</td><td>+5</td><td>-5</td></tr></table>					TOLERANCES				Description of Item/ Structural Element		Max (mm)	Min (mm)	Cast In Situ Concrete				1.	Faces of concrete in foundations and structural members against which back fill is placed	+25	-10	2.	Eccentricity of footing as percentage of footing width in the direction of placement	2% but limited to 50mm		3.	Top surfaces of slabs and of concrete to receive base	+5	-5
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2.5.0	TOLERANCES					
	Description of Item/ Structural Element			Max (mm)	Min (mm)	
		plates to be grouted				
	4.	Alignment of beams, lintels, columns, walls, slabs and similar structural elements			+5	-5
	5.	Cross sectional dimensions of walls, slabs and similar structural elements			+5	-5
	6.	Deviation from specified dimensions of cross-section of columns and beams			+12	-6
	7.	Alignment of holding down bolts without sleeves			+1.5	-1.5
	8.	Alignment of holding down bolts with sleeves			+5	-5
	9.	Level of holding down bolt assemblies			+10	-10
	10.	Embedded Parts (in any direction).			+5	-5
	11.	Level of embedment for equipment support			+1.5	0
	12.	Level of embedment for other embedded parts			+5	-5
	13.	Centers of pockets or holes with greatest lateral dimension not exceeding 150mm			+10	-10
	14.	Variation in steps - Riser - Tread			+1.5 +3.0	-1.5 -3.0
	Pre- Cast Concrete					
	15.	Length:	+/- 0.1 percent	+/- 5	+ 10	
	16.	Straightness or Bow	1/750 of the length	+/- 5	+/- 10	
	17.	Cross-sectional dimensions	+/- 3 mm or +/- 0.1 percent whichever is greater			
	18.	Squareness:	When considering the squareness of the corner the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm.			
	19.	Flatness:	The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm.			
	Placing of reinforcement and for cover (Cover blocks shall be of same grade of concrete in which these would be embedded)			Clause 12.3.1 and 12.3.2 of IS 456		
	Formwork			Clause 9.6 of IS 14687 and 11.1 of IS 456		
	Batching			Clause 10.2.2 of IS 456		
	STRUCTURAL STEEL WORK					
	For structural steel works provisions of technical specifications and IS: 800 shall apply. A detailed methodology for structural steel works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.					
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	The contractor shall submit the welding procedures specification (WPS), heat treatment procedures, NDT procedures etc. at least ninety days before scheduled start of erection work at site. All welding and brazing shall be submitted to the NTPC and carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC. All brazers, welders and welding operators employed on any part of the contract either in the contractor's / sub-contractor's works or at site or elsewhere shall be qualified as per AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC. The records of welding procedure qualification and welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, the tests shall be conducted in presence of NTPC / authorized representative. No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes. All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC. Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specification / approved WPS. The requirements of pre-heating shall be <table><tr><td>Thickness of thickest part at the area of welding / heat affected zone</td><td>Welding using other than low hydrogen welding electrodes IS 2062</td><td>Welding using low hydrogen welding electrodes or submerged arc welding IS 2062</td></tr><tr><td>Up to 20 mm (including)</td><td>None</td><td>None</td></tr><tr><td>Over 20 mm to 40 mm (including)</td><td>Not allowed</td><td>200 C</td></tr><tr><td>Over 40 mm to 63 mm (including)</td><td>Not allowed</td><td>660 C</td></tr><tr><td>Over 63 mm</td><td>Not allowed</td><td>1100 C</td></tr></table>					Thickness of thickest part at the area of welding / heat affected zone	Welding using other than low hydrogen welding electrodes IS 2062	Welding using low hydrogen welding electrodes or submerged arc welding IS 2062	Up to 20 mm (including)	None	None	Over 20 mm to 40 mm (including)	Not allowed	200 C	Over 40 mm to 63 mm (including)	Not allowed	660 C	Over 63 mm	Not allowed	1100 C
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	The following tests / checks shall be carried out for structural steel works				
	SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD		
		Physical and chemical properties of material if supply in the scope of contractor	As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC		
		Ultrasonic test on plates above 40mm	As per ASTM A435		
		Welding procedure & welders qualification test	AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards		
	Fillet Weld				
		Macro-etch examination on production test coupons for main fillet welds	Minimum one joint per built up beams, columns and crane girder etc.		
		Tension member of crane girder	Dye penetration test on 25% weld length		
		All other fillet welds	DPT on 5% of weld length with minimum 300mm at each location		
	Butt Weld				
		DPT	100% after back gouging on all butt welds		
		Mechanical testing of production test coupons	Minimum one joint per built up beam, column and crane girder.		
		Radiography test on butt welds (In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the engineer)	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds,		
		Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints		
		Control assembly check in shop before erection	1st and further every 10th set of identical structure		
		Dimensional tolerances during fabrication and erection	as per IS-7215 and IS-12843		
		Surface Preparation and Paint thickness	SA 2 1/2 , By elcometer random after each coat, each member		
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2.6.0	PAINTING WORKS Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted. The methodology for painting works shall broadly contain the source of approved brand of paints, shot / sand blasting as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance.			
2.7.0	SHEETING WORKS All bought out items shall be procured from the manufacturer's approved by engineer and tested as per relevant IS Codes/ Specification. Raw material of colour coated sheets shall meet the chemical & physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for colour match, bare metal thickness, weight of Z/AZ coating, thickness of painting system, reverse impact, T-Bend adhesion, scratch resistance, salt spray test for 1000 Hrs and any other test / properties as specified in the technical specifications. Colour coated sheets shall be marked with video jet printing at the interval not more than 2m bearing manufacturer's name, date and time of manufacturing. Fasteners shall also be tested for 1000 hrs salt spray test as per the requirement of technical specifications. Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183. For sheet installation no gas cut opening shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion.			
2.8.0	TILE WORKS The Contractor shall submit the work methodology which shall include the type, grade and make of materials along with their technical data sheets, details, etc, clearance from E-I-C regarding leak proofness and damp proofness of parent concrete surface, surface preparation, the procedure of application, curing, testing and acceptance. The agencies having adequate experience to execute the acid / alkali resistant lining works shall be engaged for executing the acid / alkali resistant lining works after obtaining the approval from the E-I-C. The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the NTPC approved brand / source. Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable. The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other			
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2.12.0	ARCHITECTURAL & MISC. WORKS Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in NTPC technical specification. Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm. Materials used in glass and glazing shall be procured from source approved by NTPC and shall conform to the requirements of the Technical Specification and IS Codes. False ceiling panels shall be best quality material in thickness and properties called for in the specification / schedule of items. Material Test Certificate to be submitted before bulk supply. All bought items covered in the scope of contract shall be procured from sources approved by NTPC and shall conform to the requirements of the technical specifications and referred standards /codes.			
2.13.0	PRE CAST CONCRETE WORKS 1. All the materials used in Pre cast Concrete work shall be tested and conform to the requirements of IS codes and NTPC Tech. Specification. 2. Concrete mix for Pre cast members shall conform to IS-456-2000. 3. All relevant QA requirements pertaining to cast insitu concrete shall be applicable. 4. Load test on Pre cast members shall be carried out for the type of members as decided by NTPC Engineer as per IS-456-2000. 5. Pre Cast Concrete member shall be checked for dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances shall be as per NTPC Technical Specification.			
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	Annexure – II			
	INDICATIVE FIELD QA&QC LABORATORY SET-UP			
	S.No	Equipment	Nos.	
	1	Vicat Apparatus with deskpot	2	
	2	Le Chatelier flask	2	
	3	Le Chatelier Mould	2	
	4	Cube Moulds for cement testing	12	
	5	Vibration Machine	1	
	6	Length comparator	2	
	7	Shrinkage Bar mould	2	
	8	Sieve shaker	1	
	9	Sieves for sand, coarse & fine aggregate	1 set for each	
	10	Sieves for coarse aggregate for Road	1 set	
	11	Proctor testing equipment	2 sets + 18 cores	
	12	Slump testing equipment	6 sets	
	13	Oven	2	
	14	Physical balance	1	
	15	Rapid moisture meter	2	
	16	Thermometer	4	
	17	Burret	2	
	18	Measuring cylinders	9	
	19	Measuring flasks	3	
	20	Compression testing machine	2 sets	
	21	Cube moulds	30	
	22	Electronic balance	2 (12 kg capacity), 2 (200 mg capacity)	
	23	pH balance	As per requirement	
	24	Radiographic facilities	As per requirement, Party should deploy BARC approved agency for carrying out RT	
	25	Mechanical weighing machine	1 (100 kg capacity)	
	26	Ultrasonic testing machine	As per requirement	
	27	D.P. Test kit	10	
	28	Vernier 300 mm, 600 mm	2	
	29	Micrometer (0.25 mm) out side (25.00)	2	
	30	Radiography film viewer	2	
	31	Inside Micrometer 25-750 dia	2	
	32	Digital elcometer for paint thickness	2	
	33	Baking oven for electrode	3	
	34	Portable ovens	2	
	35	Rebar detector to locate the reinforcement before core cutting operation	1	
	36	Concrete coring machine (55mm, 60mm up to 150 mm dia core bit)	1	
	37	Rebound hammer	1	
38	Ultrasonic pulse velocity tester	May be arranged from specialist laboratory.		
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	SECTION-VI, PART - B SUB-SECTION-V-QC-01 CIVIL	Page 16 of 17

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	Note: 1. The equipment listed above are indicative and required to be mobilized as minimum requirement. Additional equipment if any, required for successful completion of work shall be provided /arranged by the contractor. 2. All test reports/ inspection reports have to be computerized and maintained on LAN with an access to the owner 3. Computers - 2 Nos shall be deployed with Windows operating system and connected to the NTPC server 4. Based on the schedule (L2/L3 Network), Quality control & Quality Assurance work plan shall be finalized by the contractor and the same shall be submitted to the engineer-in-charge for acceptance/approval. The Finalized work plan shall be maintained on the computer to be accessed by the owner for database and day to day monitoring. QA&QC ORGANISATION SET UP Project Manager Manager (Quality) Civil Engineer For All Types of Civil Works (1no.) Lab Assistant & sufficient Skilled Manpower (Min. 2 Nos) NOTE: 1. The above organization setup is minimum, however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval. 2. The Contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work. 3. The Contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.				
KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)	BIDDING DOC. NO.: CS-4210-104A(R&M)-2	TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP	SECTION-VI, PART - B SUB-SECTION-V-QC-01 CIVIL	Page 17 of 17	



TITLE
NTPC KAHALGAON STAGE-I(4X210MW)
MILL REJECT SYSTEM MODIFICATION
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-455-160-A001

SECTION - I

REV 00

Sub Section -IA

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Master Drawing List (To be submitted by bidder after placement of order)

Sl. No	NTPC Drawing / Document No.	BHEL Drawing No.	Drawing Title
1	4210-104-PVM-B-111	PE-V2-455-160-A001	G.A. OF BUCKET ELEVATOR FOR MRS
2		PE-V2-455-160-A001A	QUALITY PLAN OF BUCKET ELEVATOR FOR MRS
3	4210-104-PVM-B-104	PE-V2-455-160-A002	SIZING CALCULATION OF MRS SILO
4	4210-104-PVM-B-106	PE-V2-455-160-A003	G.A. OF SILO FOR MRS
5	4210-104-PVC-G-056	PE-V2-455-160-A005	GA AND DESIGN DOCUMENTS OF SILO AND ITS STRUCTURE
6	4210-104-PVM-B-068	PE-V2-455-160-A006	GA of MODIFIED MRC-1 for MRS
7	4210-104-PVM-B-069	PE-V2-455-160-A007	Power calculation of MRC-1 & Bucket Elevator for MRS
9	4210-104-PVC-G-058	PE-V2-455-160-A009	GA AND DESIGN DOCUMENT OF CONVEYOR MRC-1 (EXTENDED PORTION ONLY)
11	4210-104-QVM-W-027	PE-V2-455-160-A011	QAP of Conveyor Belt for MRS
12	4210-104-PVM-B-105	PE-V2-455-160-A012	DATA SHEET OF CONVEYOR BELT
13	4210-104-PVM-B-073	PE-V2-455-160-A013	GA of Belt cleaner for MRS
14	4210-104-PVM-B-103	PE-V2-455-160-A014	GA & DATA SHEET OF IDLERS
15	4210-104-QVM-W-028	PE-V2-455-160-A015	QAP of Idler for MRS
16	4210-104-PVM-B-070	PE-V2-455-160-A016	GA and DS of pulley of MRC-1 & Bucket Elevator for MRS
17	4210-104-QVM-W-029	PE-V2-455-160-A017	QAP of Pulley for MRS
18	4210-104-PVM-B-107	PE-V2-455-160-A018	G.A. OF COUPLING FOR MRS
19	4210-104-PVE-B-106	PE-V2-455-160-A019	G.A. AND DATA SHEET OF MOTOR FOR MRS CONVEYOR
20	4210-104-PVM-B-071	PE-V2-455-160-A020	GA and DS of Gear box of MRC-1 & Bucket Elevator for MRS
21	4210-104-QVM-W-030	PE-V2-455-160-A021	QAP of Gear Box for MRS
22	4210-104-PVM-B-112	PE-V2-455-160-A022	PAINTING SCHEDULE
23	4210-104-PVM-B-108	PE-V2-455-160-A023	G.A. OF SECTOR GATE FOR MRS UNDER SILO
24	4210-104-QVM-W-031	PE-V2-455-160-A024	QAP of Sector Gate for MRS
25	4210-104-PVM-B-109	PE-V2-455-160-A025	G.A. OF DISCHARGE CHUTE FOR MRS
26	4210-104-PVM-B-110	PE-V2-455-160-A026	G.A. OF SKIRT BOARD FOR MRS
27	4210-104-PVE-B-107	PE-V2-455-160-A027	G.A. OF ZERO SPEED SWITCH FOR MRS
28	4210-104-PVE-B-108	PE-V2-455-160-A028	G.A. OF BELT SWAY SWITCH FOR MRS
29	4210-104-PVE-B-109	PE-V2-455-160-A029	G.A. OF PULL CORD SWITCH FOR MRS
30	4210-104-QVM-W-025	PE-V2-455-160-A030	FQP-Mech (Material Receipt, Storage) for MRS
31	4210-104-QVM-W-026	PE-V2-455-160-A031	FQP Mechanical Erection of MRS
32	4210-104-QVE-G-002	PE-V2-455-160-A032	FQP for Electrical, Control & Instrumentation (MRS)
33	4210-104-QVM-W-034	PE-V2-455-160-A033	QAP of Misc. Fabricated Items (Technological Structure) of MRS



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34	4210-104-QVM-W-035	PE-V2-455-160-A034	QAP of Shop Fabricated Conveyor Structure and Silo of MRS
35	4210-104-PVE-B-104	PE-V2-455-160-A035	GA, DATA SHEET AND WIRING DIAGRAM OF MRS POWER CUM CONTROL PANEL
36	4210-104-PVE-B-105	PE-V2-455-160-A036	GA, DATA SHEET AND WIRING DIAGRAM OF CONTROL PANEL OF MRS
37	4210-104-PVE-B-110	PE-V2-455-160-A037	DATA SHEET OF POWER CABLE
38	4210-104-PVE-B-111	PE-V2-455-160-A038	DATA SHEET OF CONTROL CABLE
39	4210-104-PVE-B-112	PE-V2-455-160-A039	DATA SHEET OF INSTRUMENT CABLE
40	4210-104-PVE-B-113	PE-V2-455-160-A040	DATA SHEET OF CABLE AND CABLE TRAY SUPPORT
41	4210-104-PVE-B-114	PE-V2-455-160-A041	CABLE SCHEDULE
42	4210-104-PVI-W-030	PE-V2-455-160-A042	DATA SHEET OF LEVEL SWITCH FOR MRS SILO
43	4210-104-PVM-B-074	PE-V2-455-160-A043	GA and DS of hoist and Monorail for MRS
44	4210-104-QVM-W-033	PE-V2-455-160-A044	QAP of Chain Pulley Block for MRS
45	4210-104-PVM-B-097	PE-V2-455-160-A045	Sump drain pump GA and DS
46	4210-104-PVI-W-031	PE-V2-455-160-A046	DATA SHEET OF LEVEL SWITCH FOR SUMP PUMP (MRS)
47	4210-104-QVM-W-032	PE-V2-455-160-A047	QAP of Sump Pump for MRS
48	4210-104-PVM-B-113	PE-V2-455-160-A048	O & M MANUAL OF MRS
			SUB-VENDOR LIST OF ITEMS (NTPC APPROVAL)
NOTE:	VENDOR SCHEDULED SUBMISSION DATES SHALL AS PER DISCUSSION DURING KICK-OFF MEETING/SUBSEQUENT MEETINGS.		
	VENDOR RE-SUBMISSION PERIOD IS 10 DAYS.		
	BHEL/NTPC REVIEW PERIOD IS 18 DAYS.		

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work. All other docs as deemed necessary by customer to comprehend the system and equipment considered shall be under scope of work.

2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.

4. Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.

5. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

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d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

f) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with DIN or equivalent International Standard No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

g) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

h) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

i) Bidder to follow the following the drawing submission schedule:

- BHEL shall furnish comments/approval on each submission within 18 days from receipt.
- Every revised submission incorporating comments – within 10 days.

j) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

k) The first revision shall be indexed by the letter "A" followed up by the respective letter in alphabetical order.

l) Once the drawing or document is approved for construction by the Employer or its representative the document shall be indexed with the number "0" followed up by the respective number in chronological order. Hence, the sequence of the revision index of a design document shall be as follows: A - B - C - [...] - 0 - 1 - 2 - [...]. Each revision is to be listed in the revision history with the respective date and a short description of the modification(s). In addition, all modification(s) shall be highlighted and/or marked up as specific and detailed as possible."

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