



**RENOVATION & RETROFITTING OF ESP
NTPC KAHALGAON STAGE-I (4X210MW)**

BHEL-PEM-NOIDA

PEM-NOIDA

**TECHNICAL SPECIFICATION – MILL REJECT
SYSTEM**

REV. 00

**TECHNICAL SPECIFICATION
OF
MILL REJECT SYSTEM
(PE-TS-455-160-11000-A-A001)
NTPC Kahalgaon STAGE-I (4X210MW)**

January 2020



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1.00.00	PREAMBLE		
1.01.00	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.		
1.02.00	The Mill Reject System of Stage-I were originally designed, supplied & commissioned by M/s Marshall Sons & Co. (India) Ltd.		
1.03.00	The present mill reject system or 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.		
1.04.00	It is proposed to install new ESP pass of Unit # 1 after dismantling of the MRC-2. The Mill reject conveyor-2 (MRC-2) needs to be suitably dismantled and a new conveyor re-erected. The owner wishes to erect a new mill reject conveyor (MRC-2) and a new mill reject silo at a place as shown in the tender drawing 4210-104A(R&M)-2-POM-A-006. This requires, in addition to others, the extension and reversal of direction of movement of MRC-1.		
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2.00.00	INTENT OF SPECIFICATION		
2.01.00	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.		
2.02.00	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.		
2.03.00	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.		
2.04.00	The bid must include all the details called for in this specification.		
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2.05.00	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.		
2.06.00	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.		
2.07.00	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.		
2.08.00	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.		
2.09.00	This is R&M 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.		
2.10.00	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.		
2.11.00	All the material shall be jointly inspected by BHEL/BHEL TPI and NTPC as per approved QAP.		
2.12.00	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 par of standard drawing approval using previous projects reference drawings.		
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2.13.00	Technical review meeting shall be conducted at EOC, NTPC periodically for fast approval of the drawings. Bidder's designer shall attend the meeting to close the engineering related issue.		
2.14.00	Bidder's designer shall visit the site frequently and when ever 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's to resolve the issue whenever required.		
2.15.00	L-2 vendor list shall be finalized with NTPC with successful bidder's for mill reject system.		
2.16.00	All above ground hindrances for modified mill reject system shall be cleared by the bidder.		
2.17.00	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.		
2.18.00	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.		
2.19.00	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.		
2.20.00	Geotechnical Investigation is in BHEL scope. The geotechnical investigation report shall be provided to successful bidder for design of civil foundation. Foundation system requirements are appended at detailed specification civil. For details, refer Annexure-III.		
2.21.00	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. Construction of complete new MRC-2 with MRS Silo. Complete MRC-2 shall be constructed above ground. NTPC approved drawings as listed at Annexure-I are to be followed. 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 (as shown in the annexure-1 to tender drawing 4210-104A(R&M)-2-POM-A-006, 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 possible to bring the head pulley and discharge chute above ground so that MRC-2 shall be constructed completely above ground. NTPC approved drawings as listed at Annexure-I are to be followed.		
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. NTPC approved drawings as listed at Annexure-I are to be followed.		
3.06.00	Mill reject conveyor-2 (MRC-2) shall be above ground complete with conveyor gallery along with its supporting structures, short supports, stringers, deck plate, seal plate, conveyor structure, conveyor foundations, drive motors, drive units, pulleys, idlers, gravity take ups, take up structure, internal and external belt cleaners, pull cords switches, belt sway and zero speed switches, all electrical and accessories, including all structural work for conveyor gallery, supporting trestle, roofing, cladding, decking and their associated foundation bolts. etc. NTPC approved drawings as listed at Annexure-I are to be followed.		
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. NTPC approved drawings as listed at Annexure-I are to be followed.		
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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.		
	a) Engineering, supply, installation, testing and commissioning of LT MCC / Retrofitting (complete replacement of power & control components, wires, meters, relays, contactors, indication lamps, TB's etc.) panel for power supply to associate electrical equipment of Coal mill rejection system. b) Existing LT MCC panel for MRS drives is at Bunker conveyor floor generally at +28mtrs floor approximately 150 mtrs route length from tail end side of new MRC Unit#1 side. Control Panel is at Ground level at approximate 20-25 mtrs route length from Tail end side of new MRC Unit#1 side. c) Engineering, supply, installation, testing and commissioning of control system panels & associated electrical, C&I items, instruments, switches, cords, inter-connecting power, control, instrumentation cables, cables support system, lighting items, JB's, local boxes etc. for coal mill rejection system. New Control panel is to be suitably located near new Head pulley end. d) Engineering, supply and installation of Power, Control & Instrumentation cables including termination hardware for complete 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 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.		
	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 MRC-2, 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) (Refer Annexure- I to		
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	tender drawing "Layout of new fly ash conveying & transportation system 4210-104A(R&M)- 2-POM-A-006". 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 new MRS-2 is shown in the tender drawing "Layout of new fly ash conveying & transportation system".		
3.15.00	First fill of all consumables e.g.; oils and lubricants for 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, 2 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 (2W+2S) as per location indicated in NTPC approved drawings in Annexure-I, 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.		
3.21.00	NTPC approved drawings provided at Annexure-I are to be referred for scope clarity.		
3.22.00	Storage and Material Handling at Site		
	i) 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 when kept in open atmosphere shall be kept in closed store, with required protection and preservation.		
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- ii) 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.
- iii) 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.

4.00.00 DETAILED SPECIFICATION OF THE SYSTEM

MILL REJECT CONVEYORS AND SILO

1. **The key parameters of the mill reject system shall be as follows.**

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)

2. **The specific codes/standards followed for the design of the system are as below**

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
IS:8531-1986	Specification for pulleys for Belt conveyors

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IS:8598-1987	Specification for idlers and idlers set for belt conveyors
IS: 9295-1983	Steel tubes for idlers for belt conveyors
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 3832 : 2005	Manual hoist /CPB
IS 3938 : 1983	Electric hoist
IS 7155 (PART 5):1990	Code of Recommended Practice for Conveyor safety

3. Other important design considerations

a	Maximum slope of the conveyor	16 degree
b	Maximum sag between idlers	2 %
c	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
d	Factor of safety for belt conveyor	10 (MINIMUM)
e	Normal working tension at design capacity	Less than 80 % of max. allowable working tension
f	Take up travel	To suit all operating condition or for N-N belting-2.5 % of conveyor centre to centre distance, which ever 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

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		vulcanizing joints without adding any external belt.

- 3.1 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. A value for idler shall be considered 2.81b (min.) for the purpose of conveyor design calculation only.

4. Pulleys – The diameters of the pulleys shall be as follows

a	Head pulley	400 mm diameter
b	Tail and take up pulley	315 mm diameter
c	Snub/bend pulley	315 mm 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/em (minimum).

5. Belt protection equipment

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- 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.

6. Idlers- The idlers shall be as per the following details

a	Carrying idler	35 degree, 3 roll, 114.3 mm diameter@ 1.2m pitching
b	Return idlers	Single roll, 114.3 mm diameter, @ 3 m pitching
c	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
d	Self aligning carrying idler	35 degree, 3 roll, 114.3 mm diameter@10m from head and tail pulley with intermediate spacing 15m
e	Self aligning return idler	Single roll, 114.3 mm diameter@10 m from head and tail pulley with intermediate spacing 20 m
f	Self cleaning return idler	88.9 mm diameter & 163 mm over rubber disc at head end
g	Transition idler	20 degree, 3 roll, 114.3 mm diameter near head pulley.
h	Brg size for all above	Brg 6204, sealed and lubricated for life
i	Thickness of all idlers	4.0 mm (without any negative tolerance)

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

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waterproof, 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.

- 7. 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 TISCRAAL and the top cover shall be 6 mm thick MS.
- 8. 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 TISCRAAL 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.
- 9. Gear Box-** 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.
- 10. 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

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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 down stream equipment/conveyor.

11. 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.

12. Belt cleaner

12.1 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.

12.2 Internal Belt Cleaner

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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.

13. 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 / 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.

14. 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.

15. 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 / 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.

16. 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.

S:3938

Specification for Electric Wire Rope Hoist

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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- Specification
IS:210 Cast Iron Castings

For the Hoists with more than 2.0 tonne lifting capacity or more than 10.0 M lift, with the exception of hoists for gtu 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 3 meter 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.

17. Sump Pumps

sump pumps alongwith 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)

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- (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

18. Civil Specification for Overhead Conveyor Trestles

18.01.00

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. Refer NTPC approved drawings listed at Annexure-I

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 8 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).

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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_s) obtained from modal combination is less than the base shear (V_o) computed using the approximate fundamental period (T_a) given in IS:1893:Part I and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacement storey forces, storey shears and base reaction shall be

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enhanced in the ratio of V_o / V_o . However, no reduction is permitted if V_o is less than V_o .

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.

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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

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acceleration 'g') for design of equipment and structures :0.14
where inelastic action is not relevant or not permitted

Notes:

1. g = Acceleration due to gravity

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

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In units of 'g' for KAHALGAON STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	150%	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

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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

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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

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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

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<u>TERMINAL POINTS & EXCLUSIONS</u>			
1.00.0	TERMINAL POINTS		
1.01.0	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. i) Pyrite hoppers outlet ii) Discharge of new Mill Reject Silo		
2.00.00	EXCLUSIONS		
	i) Complete civil work pertaining to RCC work and equipment foundation. However, bidder has to prepare & get approval from BHEL/ NTPC of related foundation drawings.		
3.00.00	FACILITIES BY OWNER		
3.01.00	Space The contractor shall advise the owner within 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 NTPC Engineer and the space as decided by NTPC 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-contractors 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.		
3.02.00	Electricity The Contractor shall submit to the owner within 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. For further distribution, contractor shall make his own arrangements. 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.		
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3.03.00	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.		
3.04.00	Service Air		
3.04.01	Service air shall be provided at one point for each ESP near boiler area.		
3.04.02	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 back up 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.		
3.04.03	Accommodation for the contractor's personnel may be provided by Owner on chargeable basis as per availability.		
3.04.04	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.		
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ANNEXURE-I

INPUT DRAWINGS

S. No.	Title	Drawing No.
A	Drawings of Existing System	
1.	GA of Conveyor MRC-1 (Unit#1) with Pyrite Hopper Discharge Chutes	0-9002-3 (Sheet 1 of 2)
2.	General Arrangement of Conveyor MRC1 (Unit # I to IV)	0-9002-3 (Sheet 2 of 2)
3.	GA of MRC-2 with Reject Bin	0-9002-4
4.	Foundation Plan & Load Data for Conv. MRC-1	0-9002-6
5.	Foundation Plan & Load Data for Conv. MRC-2	0-9002-7
6.	General Layout (Key Plan)	1-9002-2
B.	Drawings for New System for Layout and Foulings	
1.	Layout of New Fly Ash Conveying & Transportation System	4210-104A(R&M)-2-POM-A-006, REV-B
2.	General Layout Plan	4230/4231-999-POC-F-001, REV-0
3.	Sketch of MRC New/Old (Layout of New Fly Ash Conveying & Transportation System)	4210-104A(R&M)-2-POM-A-006
4.	Proposed Layout for Modified Mil Reject System (above ground facilities)	RMSG-LAYOUT-TENDER-RMS-001
C.	NTPC approved drawings	
1.	BELT CLEANER OF MRS (PRIMARY SCRAPER) - GA	
2.	BELT SWAY SWITCH - GA	
3.	CARRYING IDLER - GA AND DATASHEET	
4.	CONVEYOR BELT - QAP	
5.	DRIVE PULLEY - GA AND DATASHEET	
6.	FQP for Electrical, Control & Instrumentation (MRS)	
7.	FQP-Mech (Material Receipt, Storage) for MRS	
8.	GEOTECHNICAL INVESTIGATION LAYOUT	
9.	GEOTECHNICAL INVESTIGATION REPORT	
10.	MRC-1 AND MRC-2 FOR MRS - POWER CALCULATION	
11.	MRC-1 AND MRC-2 OF MRS - GA	

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12.	PAINTING SCHEDULE
13.	SECTOR GATE - MQP
14.	SECTOR GATE FOR MRS SILO - GA
15.	SILO - GA
16.	SILO - SIZING CALCULATION
17.	SKIRT BOARD SINLGE FEEDING CONV NO. - MRC-2 AT MRS - GA
18.	SQP FOR IDLERS
19.	SQP FOR PULLEYS
20.	STRUCTURAL STEEL FABRICATION - MQP
21.	SUB VENDOR LIST
22.	TECHNOLOGICAL STRUCTURE - MQP
23.	TT1 AND TT2 FOR MRS - GA
24.	ZERO SPEED SWITCH - GA

NOTE: Feasibility/ accuracy of dimensions in NTPC approved drawings are to be checked by bidder. In case any change is required pertaining to design/ equipment specific requirement, same may be taken up with end customer during detailed engineering after placement of order to successful bidder.

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<u>GENERAL TECHNICAL CONDITIONS</u>			
1.00.0	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, Technical data sheet and Technical Data Requirements. These conditions are to be read specifically applicable for the mill reject system under scope in this specifications.		
1.02.00	Deleted		
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		
4.01.00	Drawing of plant layout around ESP area showing the space availability adjacent to existing ESP and plant for extension of MRC-1 and construction of new MRC-2 is attached as tender drawing.		
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 Specification.		
5.02.0	Liquidated damages for shortfall in meeting performance guarantees during the Performance and Guarantee tests shall be assessed and recovered from the contractor as detailed in the tender specification.		
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6.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR		
6.01.00	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.		
6.02.0	The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in separate Annexure enclosed		
6.03.0	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. (vii) Operation Philosophy and the control philosophy of the equipment / system covered under the scope.		
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- (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) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- (x) 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. Deleted
- 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 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 .

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- 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.

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.

6.05.0 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 general technical requirement. The soft copies to be supplied shall be uploaded by the vendor in c-folder, a web based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

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

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

- (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.

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- (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 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.

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- (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 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.

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- (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.

6.06.00 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
- vii) Procedure for erection.
- viii) General safety procedures to be followed during erection/installation.
- ix) Procedure for initial checking after erection.

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- 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 for 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 :
 - 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.

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6.07.00	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.		
	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 1. Design and performance data. 2. Process & Instrumentation diagrams. 3. Single line diagrams. 4. Sequence & Protection Interlock Schemes. 5. Alarm and trip values. 6. Performance Curves. 7. General layout plan 8. 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.		
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.		
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	(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. 7.02.02 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. 8.00.0 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 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.		
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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
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 IS:1026-1966	A58.1:1955(Issued BY ASA) Flexible trailing cable for use in quarries and metallicferrous 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

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	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) 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 electricalparatus with type of protection'e' IEC Pub. 79-9		
10.00.00	QUALITY ASSURANCE PROGRAMME		
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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 subcontractor'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. (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		
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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 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.		
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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.		
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 correlation of the test report with the job.		
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	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 subcontractor 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 subcontractors 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 management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.		
10.02.19	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		
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During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

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

2) Burn in Test Cycle

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

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

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

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

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 control on each document.

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The QA Documentation file shall be progressively completed by the Supplier's subsupplier 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.			
10.03.02	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.' (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.		
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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 :
- 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.

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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. 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.		
10.05.06	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		
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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.			
10.05.07	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.		
10.05.08	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.		
10.05.09	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.		
10.05.10	Associated document for Quality Assurance programme		
10.05.01	Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at Annexure-I .		
10.05.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II .		
10.05.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).		
10.05.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV .		
11.00.00	MANUFACTURING SCHEDULE		
10.01.00	The Contractor shall submit a detailed PERT Network within the time frame agreed in the Letter of Award/Activity Scheudle/contract, 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. Based on the aforesaid approved PERT Network, the Contractor shall furnish the progress report, duly updated every monthly for review by the Owner.		
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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		
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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 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.

13.03.00 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.

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(e)	The Performance test and specific tests to be conducted on equipments have been brought out in details in section “ Functional Guarantee, Performance Testing and Liquidated Damage”.		
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 Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.		
15.00.00	PROTECTION		
	All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either 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.		
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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.		
19.00.00	DESIGN CO-ORDINATION MEETING		
19.01.00	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	TOOLS, TACKLES AND PLANTS		
20.01.00	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	NOISE LEVEL		
21.01.00	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	TAKING OVER		
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22.01.00	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	WELDING		
23.01.00	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	LUBRICATION		
24.01.00	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	EQUIPMENT BASES		
25.01.00	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 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.		
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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 Mill Reject System (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		
28.01.00	Facilities to be provided by the Owner listed out in 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.		
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		
30.01.00	General Requirements - This section covers Contractors responsibilities for packing, shipping, warehousing and the installation of all equipment and materials furnished and installed under this specification. - The Contractor shall submit for Owner's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, check-lists,		
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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, ware-housing 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 engineering.

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.
- 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

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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.
- 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

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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.

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31.04.00	Equipment Installation a) General Requirements 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		
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- 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.

- 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.

j) 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.

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- 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.
- k) 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.
- l) 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

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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.

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ANNEXURE-I

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

SL N O.	COMPO NENT & OPERA TIONS	CHARA CTERIS TICS	CLASS	TYPE OF CHECK	QUANT AM OF CHECK		REFER ENCE DOCUM EN	ACCEP TANCE NORMS	FORMA TE OF RECOR D		AGENCY			REMAR K
					M	C/ N					M	C	N	
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'					DOC. NO. REV....CAT....						
MANUFACTU RER/SUB- SUPPLIER MAIN SUPPLIER		MAIN SUPPLI ER												
SIGNARURE								FOR NTPC USE	REVI EWED BY	APPRO VED BY	APPRO VAL SEAL			

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ANNEXURE-II

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

SL N O.	ACTIVI TY & OPERA TIONS	CHARACTE RISTICS/IN STRUMENT S	CLAS S OF CHEC KS #	TYPE OF CHECK	QUANT AM OF CHECK	REFERENC E DOCUMEN	ACCE PTAN CE NOR MS	FORMATE OF RECORD		REMARK
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.
			LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED						DOC. NO. REV....CAT....	
MANUFACTU RER/SUB- SUPPLIER		MAIN SUPPLIER								
SIGNARURE			BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)				FOR NTPC USE	REVI EWE D BY	APPR OVED BY	APPR OVAL SEAL

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ANNEXURE-IV

PROJECT : STAGE: PACKAGE : SUPPLIER : CONTRACT NO.:				STATUS OF ITEM REQUIRING QP & SUB-SUPPLIER APPROVAL				DOC. NO.:			
								REV. NO.:			
								DATE:			
								PAGE: OF			
S.N.	ITEM/SE RVICE	QP/Ins p. Cat.	QP SUB. SCH EDU LE APP ROV AL SCH EDU LE.	DATE OF SUB- SUBMI SSION	DATE OF COM MT. APPL.	STAT US CODE C/II/I	PROPO SED SUB- SUPPLI ERS	PLACE OF MANUFA CTURING WORKS	APROVA L STATUS	SUB- SUPPLI ER DETAIL S SUBMIS SION SCHED ULE	REMARK

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ANNEXURE-V

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S. No.	DESCRIPTION OF MANUAL	NO OF PRINTOUTS	NO. OF CD-ROMs
1.	PLANT DEFINITION MANUAL-Drawings "FOR APPROVAL"	2 sets	4 CD-ROMs
2.	i) Layout drawings/P&IDS ii) Other drawings	6 2	2 CD-ROMs 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 ii) FINAL iii) Analysis reports of equipments/ piping/ structures components/ systems employing software packages as detailed in the specifications	2 15 2	2 CD-ROMs 4 CD-ROMs 2 CD-ROMs
7.	Erection manual "DRAFT"	4 Sets	2 CD-ROMs
8.	Erection manual "FINAL"	4 Sets	4 CD-ROMs
9.	Operation & Maintenance manual "IST SUBMITTIOM"	4 Sets	2 CD-ROMs
10.	Operation & Maintenance manual "FINAL"	4 Sets	4 CD-ROMs
11.	Plant Hand Book "IST SUBMITTIOM"	4 Sets	2 CD-ROMs
12.	Plant Hand Book "FINAL"	4 Sets	4 CD-ROMs
13.	Commissioning and Performance "IST SUBMITTIOM"	4 Sets	2 CD-ROMs

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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	4 CD-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.	2	1 CD-ROM
19.	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, PQR etc. i) For review/comment ii) For final approval	2 2	2 CD-ROMs 2 CD-ROMs
20.	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) 1st submission ii) Final	4 Sets 4 Sets	2 CD-ROMs 4 CD-ROMs
21.	QA Documentation Package for items / equipment manufactured and dispatched to site	2 Sets	4 CD-ROMs
22.	QA Documentation Package for field activities on equipment / systems at site	2 Sets	4 CD-ROMs

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<u>ERECTION CONDITIONS OF CONTRACT</u>			
1.00.0	GENERAL		
1.01.0	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. These conditions are to be read specifically applicable for the mill reject system under scope in this specifications.		
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project 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 Subcontractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.		
1.00.00	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		
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3.02.00	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. 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 preproduction 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 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		
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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.

The Contractor & Employer's representative, at start and at the end of HT Cycle shall sign the time and temperature charts for heat-treatment.

3.05.02 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 reference clause of this chapter) etc.

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

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	(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 clause of this chapter entitled "Heat Treatment". (n) Qualification details of weld procedures to be adopted as specified at clause 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.		
5.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES The Provisions of the Clause entitled Inspection, Testing and Inspection Certificates under Technical Specification 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.		
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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 a Site Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the 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 Engineer 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 shall have no claim against the Owner on that account other than an extension of time for completing his Works.		
8.02.00	Owner shall have full access to visit the Contractor's site at any time for inspection and surveillance checks. 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 Engineer 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		
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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 Engineer 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 Engineer 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 Engineer or 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 Engineer 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 Engineer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Engineer 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 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 Engineer, 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 Engineer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have		
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13.00.00	been employed and actually employed, skill-wise and the areas of employment of such labor. 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 Engineer 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 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 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		
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15.01.00	Space The contractor shall advise the owner within 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 NTPC Engineer and the space as decided by NTPC 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-contractors 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 & telex facilities, if available at Site, for purposes of Contract. The Contractor shall be charged at actual 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-		
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	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.		
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	Deleted		
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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		
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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.		
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 Engineer and the same shall be acceptable at all times to the Contractor. The Engineer 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		
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22.00.00 22.01.00 22.01.01 22.01.02 22.01.03	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. PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES General 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. 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 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.		
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	(d) Apart from above, Contractor shall ensure deployment of sufficient skilled/semiskilled/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 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.		
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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 equipments 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 Engineer's information only. The Contractor shall submit to the Engineer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, warfare and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.		
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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 Engineer, 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		
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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 Engineer. 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 Engineer. 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 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 this tender specification 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		
	Painting for Mechanical, Electrical, C&I equipment/ systems, Civil and Structure shall conform to the painting specification given in various subsections of Technical Specifications.		
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29.00.00	INSURANCE		
29.01.00	In addition to the conditions covered under the entitled “Insurance” in Section Clause 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 : Workmen’s Compensation As per statutory Provisions Employee’s liability As per statutory Provisions		
29.03.00	Comprehensive Automobile Insurance This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Owner’s men and damage to the property of others arising from the use of motor vehicles during on or off the Site operations, irrespective of the ownership of such vehicles. The liability covered shall be as herein indicated. Fatal Injury		

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29.04.02	The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-contractors, his agents and his employees have to perform work pursuant to the Contract.		
29.04.03	The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.		
30.00.00	UNFAVOURABLE WORKING CODITIONS		
	The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavorable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Owner. Such unfavorable construction condition will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.		
31.00.00	PROTECTION OF MONUMENTS AND REFERENCE POINTS		
	The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the 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.		
32.00.00	WORK & SAFETY REGULATIONS		
32.01.00	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.		
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- iii) The Contractor shall have the approved Safety, *Health and Environment (SHE)* Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Owner in charge.
- iv) The Contractor shall prepare 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 and submit to Engineer I/C for approval as per the format of Safety plan as annexed with this tender specification.
- 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 attached Annexure, 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 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.

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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 Engineer (I/c).

xi) *First Aid boxes* equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.

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 transporting system to rescue the workers to safer places. The Contractor shall provide suitable shelters, food,

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drinking water and other requisite facilities till they are brought back to their colonies and normalcy is restored.			
32.01.03	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.	
32.01.04	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.	
32.01.05	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.	
32.02.00	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	
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	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.		
32.03.00	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.	
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	
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from such hazards. The Contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.

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

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

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

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

32.08.00 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

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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.

32.10.00 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.

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32.11.00	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.		
32.12.00	Vehicular Traffic The Contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.		
32.13.00	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.		
32.14.00	Excessive Noise, Vibration		
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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.			
32.15.00	Electrical Installations		
32.15.01	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 armor / sheath 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 / equipments 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 shall be provided with suitable ELCBs and RCCBs wherever required.		
32.16.00	Safety Organisation		
32.16.01	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		
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	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.		
32.16.02	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 atleast 2days safety training from any reputed organization or from NTPC before resuming the work. If already trained in past the declaration along with trg. certificate to be furnished to NTPC safety officer. The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the 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, 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		
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- (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 specification 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 respective Sub-Clause shall also apply in addition to the penalties mentioned in this sub-clause.
- (ii) If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Owner 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 his 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

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(4) been issued warning notice/s by NTPC head of the project on non observance of safety norms (5) not provided safety training to all his workmen, the Contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident. The safety performance will also be one of the overriding criteria for evaluation of overall performance of the Contractors by NTPC. The Contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for 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		
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	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 or 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.		
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 BASIS		
35.01.00	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 plasticiser may be added to the grout mixture in a proportion recommended by the plasticisers manufacturer. All such grouts shall be		
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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 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.		
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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. 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.		
39.02.00	These spare 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 utilised 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		
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	recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.		
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.		
41.00.00	EQUIPMENT DELIVERY AND ERECTION		
41.01.00	General Requirements - This part covers Contractor's responsibilities for packing, shipping, warehousing and the installation of all equipment and materials furnished and installed under this specification. - 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 : - Instructions for packing, shipping, receiving handling, warehousing and storage. - Instructions for location and installation of equipment furnished by this specification. - Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification. - Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays. - Check lists and quality assurance hold points. - Format for all related documentation.		
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41.02.00	(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. 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. (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		
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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.
- (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.

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41.03.00	(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 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.		
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. (1) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer. (2) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications. (b) Installation Materials		
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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, 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

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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.
- (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 requirements specified elsewhere in the technical specification may be referred.

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(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.

(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

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(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.		
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:		
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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 Adopting to providing safety training to all employees
09. Details of checklist for different jobs \ work and Responsible person to ensure compliance [copy of checklist to be enclosed]
10. Regular safety inspection methods and periodicity and list of members to be enclosed
11. Risk assessment; safety audit by professional agencies periodicity
12. Implementation of recommendations of Audit / Inspections. Procedures for implementation and follow up.
13. Provision for treatment of injured persons at work site.
14. Review of overall safety by top Management and Periodicity
15. System for Implementation of Statutory legislations.
16. Issue of PPEs to employees, Periodicity / stock on hand etc.

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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.	02 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	03 Nos. of Rope Grab Fall arrestor and Karbiner each. 05 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).	03 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	Safety Helment & Safety Shoes : 10 nos. each.

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marked)
Full Body Safety Harness (conforming IS:3521)

Full Body Safety
Harness : 10 Nos.

This is the minimum requirement. Bidder's has to arrange safety equipment's as per instruction of safety officers of BHLE/NTPC during execution of work.

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DETAILED TECHNICAL SPECIFICATION OF MECHANICAL

SURFACE PREPARATION AND PAINTINGS

1.00.0 GENERAL

This section defines the requirements for surface preparation and protective coating by paint application of structural steel supports, pipework systems, steel tanks and other mechanical and electrical equipment, for work carried out in supplier's works and on site.

Contractor's scope of work covers supply and delivery of all materials, furnishing services of skilled and unskilled labour, supervisors, arranging scaffolding, tools and any other equipment required to arrange a complete painting job.

2.00.0 CODES AND STANDARDS

2.01.0 The surface preparation and protective coating by paint application shall comply with all currently applicable statutes, regulations and safety codes in the locality where the painting is to be carried out. The surface preparation and painting shall also conform to latest applicable Indian/British /American standards. Other internationally acceptable standards, which ensure, equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the Contractor of the required statutory responsibility. In particular the surface preparation and application of paints shall conform to the latest edition of the following:

- (a) British Code of practice, BS:5493:1977 "Protection of Iron and steel Structures from Corrosion".
- (b) Swedish Standard SIS:055 900-1967.
- (c.) Steel Structures Painting Council Standards (SSPC)
- (d) DIN 55928
- (e) ASTM D 2200

Other publications to be taken into account are:

- (a) Paint manufacturers product data sheets and instructions for paint and use of paint.
- (b) Statutory regulations concerning safety of storage and handling and use of paint.

3.00.00 PAINT MATERIALS

3.01.01 Paint materials shall be of the type as specified in the painting schedule.

3.01.02 Contractor shall submit his painting procedure plan in accordance to (with) this specification and shall take the approval from the OWNER/ENGINEER, giving the name of manufacturers, name of each product and technical literature of each product offered by him.

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3.01.03 All paints shall be delivered to job site in manufacturer's sealed containers. Each container shall be labelled by the manufacture with the manufacturer's name, type of paint, number and colour.

3.01.04 The material noted herein shall not be applied on surfaces that will exceed 82°C at any time, as noted otherwise.

3.02.00 SURFACE PREPARATION

3.02.01 The surface preparation to be used for each item shall be as specified.

3.02.02 Steel surfaces to be painted shall be cleaned in accordance with the latest edition of the following Steel Structures Painting Council surface preparation specification:

Solvent cleaning.	:	SSPC-SP-1
Hand cleaning	:	SSPC-SP-2
Power tool cleaning	:	SSPC-SP-3
Commercial Blast	:	SSPC-SP-4 (37 to 75 cleaning Micron Anchor Pattern).

3.02.03 All surfaces to be painted shall be thoroughly cleaned of oil grease and other foreign matter. Surfaces shall be free of moisture and contamination from chemicals and solvents.

3.02.04 Any additional surface preparation specified by the paint manufacturer shall be considered a part of this specification.

3.03.00 Application

3.03.01 The paint manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered a part of this specification.

3.03.02 Paint shall not be applied to damp surfaces or in raining weather or when the temperature is below 13°C or above 82°C, except when specifically permitted to do so by the manufacturer's instructions.

3.03.03 Spray painting at the job site shall be permitted only at times and location approved by the OWNER/ENGINEER.

3.03.04 The primer coat shall be applied by brushing, rolling or spraying and on the same day as the surface is prepared.

3.03.05 Under coats, intermediate coats and finish coats shall be applied by brush, roller or spray with the specified amount of time allowed between coats.

3.03.06 The colour of each coat shall contract with the previous coats colour or avoid skip and holidays. Finish Colours shall be as specified in the painting schedule.

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3.03.07	The quality of workmanship shall be the best available. finish work shall be uniform, smooth and free from runs, sags, defective brushing and clogging.		
3.03.08	At completion, finish shall be touched up, restored, and left in good condition, where damaged.		
3.03.09	Steel surfaces that will be connected by building walls shall primed and finish painted before the wall is erected.		
3.03.10	Steel surfaces that will be concealed by building floors shall be primed and finish painted before the floor is cast.		
3.03.11	Adequate covers and drop clothes to protect the work of other trades and adjacent finishes from paint splatter shall be provided and maintained in place while painting. Any point spots or spillages which occur shall be promptly removed.		
3.03.12	Proper ventilation and circulation of air shall be taken care during application are recommended when spraying.		
3.03.13	Newly painted surfaces shall be protected with “Wet Paint” sign		
3.03.14	Apart from surface preparation of the piping etc. attention should be paid to the details, particularly the following: (a) Sharp edges that may have a deleterious effect on coating should be removed. (b) Burrs caused by removal of temporary lugs etc. should be ground flat. (c.) Welds should be dressed and weld spatter removed by grinding. (d) Nuts and bolts should be properly treated. (e.) Fasteners, such as pipe hangers clamp etc., should be treated before being fixed to the main structure.		
3.04.00	PAINTING REQUIREMENTS		
3.04.01	GENERAL		
3.04.02	Where the prime coat has been applied in the shop, the prime coat shall be carefully examined, cleaned and spot primed by one coat of the primer specified before applying the intermediate and finish coats.		
3.04.03	On the insulated equipment or piping, surfaces such as lugs, flanges, supports, etc. that protrude beyond the insulation shall be painted the same as uninsulated equipment or piping.		
3.05.00	Painting Schedule		
3.05.01	Structural steel and structural steel pipe supports, equipment, Base plates etc.		
	A)	Surface Preparation	: Commercial Blast Clean
	B)	Primer	: Conforming to BS: 5493, Table-4F Part-2,
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			Reference FP-3A.
	Binder	:	Alkyd or modified alkyd
	Main Pigment	:	Zinc Phosphate
	Nominal coating thickness	:	70 microns
C)	Under Coats	:	Conforming to BS : 5493, Table-4F, Part-3, Reference FU-2A.
	Binder	:	Alkyd of modified alkyd
	Main Pigments	:	Coloured pigments (full colours) suitably extended.
	Nominal coating thickness	:	70-80 microns
D)	Finish Coats	:	Conforming to BS : 5493, Table-4F, Part-4 Reference FF-38.
	Nominal thickness	:	70 to 80 microns
	Main Pigment	:	Fade-resistant coloured pigments.
	Nominal Coating thickness	:	50 to 80 microns
E)	Dry film thickness of system	:	190 to 240 microns

3.05.02

Where Blast cleaning is not feasible at job site, and approved by the OWNER/ENGINEER in writing, power tool cleaning may be substituted as follows:

A)	Surface Preparation	:	Power Tool Clean
B)	Primer	:	Conforming to BS: 5493, Table-4F Part-2, Reference FP-2A.
	Binder	:	Drying oil modified with phenolic or phenolic modified resin.
	Main Pigment	:	Zinc Phosphate
	Nominal thickness coating	:	70 microns

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C)	Under Coats	:	Conforming to BS : 5493, Table-4F, Part-3, Reference FUIA.
	Binder	:	Drying oil modified with phenolic or phenolic modified resin.
	Main Pigments	:	Coloured pigments (full colours) suitably extended.
	Nominal Coating thickness	:	25 to 40 microns
D)	Finish Coats	:	Conforming to BS : 5493, Table-4F, Part-4 Reference FFIA.
	Binder	:	Drying oil modified with phenolic or phenolic modified resin.
	Main Pigment	:	Fade-resistant coloured pigments.
E)	Dry film thickness of system	:	120 to 150 microns

- 3.06.01 Surfaces not to be painted (unless otherwise) specified.
- (a) Surface of insulation.
 - (b) Stainless steel, nickel, copper brass, monel, aluminium, hastelloy, lead galvanised steel.
 - (c.) Valve stem, pump shafts, gauges.
 - (d) Bearing and control surfaces, lined or clad surfaces.
- 3.06.02 For extraction and transportation piping, bituminous paint of IS:158 grade of minimum 250 micron thickness shall be provided.
- 3.07.00 Colour code for Identification**
- 3.07.01 The pipes shall be colour painted/banded for identification as per the color coding scheme of NTPC. These sheets shall be furnished during detailed engineering stage.

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<u>DETAILED TECHNICAL SPECIFICATION OF CIVIL</u>			
1.00.00	GENERAL		
1.01.00	Detailed technical specification of civil shall be read in line with the scope of supply and services under bidders scope for mill reject system. 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 Structural works included in Contractor's scope.		
1.02.00	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".		
1.03.00	The work to be performed under this Specification shall also include Design, Engineering and providing of all Labour, Materials, Plant & Equipment, Consumables, Construction Facilities as per scope of supply and services 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.		
1.04.00	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.		
1.05.00	All Materials required for works under the Bidder's scope shall be arranged and supplied by the Bidder.		
1.06.00	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.		
1.07.00	All mono-rails required for equipment handling, etc. shall be supplied and provided by the Contractor.		
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1.08.00	Collector tank tower, 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 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).		
1.09.00	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.		
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.		
2.00.00	SUBMISSIONS		
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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 under scope of bidder shall be submitted for approval of the NTPC/BHEL		
2.03.00	The Design Documents and Drawings submitted by the Bidder shall contain at least the following Minimum information : - General Arrangement for Equipment, Piping / Cables / Ducts. - Loading Plans indicating Floor Imposed Loads, Equipment Loads, Piping / Cables / Ducts Loads. - General Arrangement of Foundations including Loading Data, Bolt Details, Pocket Details, etc. - Insert Details, Anchor Fastener Details along with their General Arrangements. - Architectural floor plans, elevations, cross - sections and perspective view in colour of all buildings and facilities buildings. - Drawings of all architectural works including finish schedule, colour scheme (both internal and external), doors & windows, flooring including architectural facia and projections, miscellaneous architectural details, coping, flashing, khurras, water proofing, fillet, surface drain, rain water down comer, sanitary, plumbing etc. - General Notes which will be included in construction drawings. - Scheme of de-watering, steel erection etc. to Engineer at site, for his reference. - Material Test Certificates to Engineer at site, for his reference. - 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) - Shop drawings / fabrication drawings of all structural steel works (only for reference). - Project Design Intent Document covering Design Criteria including Loading assumptions, references, structural idealisation / Mathematical Model, Load Cases, Load Combinations, etc. - Analysis and Structural Design Calculations. 3-D Modelling of Structures, including Typical 2-D Structural Frame Analysis. - Details of Corrosion Protection Measures. - Any other submission, as indicated elsewhere in this Specification and / or as required by the Employer.		
3.00.00	DESIGN CRITERIA		
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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, Reject Loads, Dust Loads, Wind Loads, Seismic Loads, Temperature Loads, Erection Loads, Loads due to Differential Settlement, etc.		
3.02.0	Material		
	For Civil, Structural and Architectural works		
	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 MRS Bidder/ BHEL as per scope of supply and services of this specification. 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.		
3.02.01	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.		
3.02.02	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.		
3.02.03	All other Materials shall be as per applicable Standards and Codes.		
3.02.04	All Materials brought for incorporation in works shall be of best quality as per IS, unless specified otherwise.		
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3.02.05 Cement

Fly ash based Portland pozzolona cement conforming to IS: 1489 Part - I shall preferably be used.

3.02.06 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.

3.02.07 CONCRETE (only for drawing and design purpose)

All R. C. C. works to be done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows:

a)	M35	For all railway load bearing structures
b)	M25	For underground / sub structural R. C. C. work (other than railway load bearing structures), all superstructural work , drains and trenches

Fly ash based portland pozzolana cement conforming to IS : 1489 (Part - 1) shall preferably be used (unless required otherwise to counteract soil water chemical environment). However, the contractor may use portland slag cement conforming IS : 455 or ordinary portland cement conforming to IS : 269 or IS : 8112.

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

Fine aggregate – Sand shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Sand, when used as fine aggregate in concrete shall conform to IS : 383.

Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations except for water retaining/conveying structures where 100mm thick P.C.C M-7.5 shall be provided.

For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix.

Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.

For plaster, it shall conform to IS : 1542 and for masonry work to IS : 2116.

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

3.02.08 Bricks / Hollow Concrete Blocks (only for drawing and design purpose)

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, Reject 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.

Sl. No.	Locations / Areas	Imposed Loads (T. / Sq.m)

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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 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)	i)	Roof / Penthouse	
		Non – accessible (with no Equipment)	0.075
	ii)	Accessible	0.150
	iii)	Dust loads	Equivalent to 0.15M of Deposit

3.03.03

Equipment, Piping / Cables / Ducts and associated Loads

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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.

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 Density

- (a) Following density shall be considered for the Design :

SN.	Description	Density (Kg/M ³)
a)	For New ESP Supporting Structures	1350
b)	For existing ESP Supporting Structures of Stage-I & II	1050

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3.03.09	Deleted		
3.03.10	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	Deleted		
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, Reject 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. (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) The plinth / finished floor level of all buildings shall be kept at least 500 mm above existing G. L. / Formation level. (j) Buildings with brickwork cladding shall have minimum one brick or minimum 200 mm thick hollow concrete block cladding on exterior face.		
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	(k) 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. (l) All buildings shall be architecturally designed to meet the norms of National building code and local building bye – laws. (m) 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. 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.		
3.04.05	Underground structures 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.		
3.04.06	Footing Footing of all major structure shall be so proportioned so as to minimise the differential settlement.		
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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 tonne 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:

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	Span / 250

(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.

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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. 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.		
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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 60 ⁰ C unless specified otherwise.		
3.04.14	Deleted		
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 kept 200 mm lower than the finished Floor Level of Main Plant Building.		
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.		
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 ⁰ C - 300 ⁰ C for one hour and later on cooled in the same oven to 100 ⁰ C. It shall be transferred to a holding oven maintained at 60 ⁰ C - 70 ⁰ 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.		
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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

TABLE - 1

**MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR
WELDING MILD STEEL**

Welding Using		
Thickness of thicker part at Point of welding submerged arc welding	Low hydrogen electrode or hydrogen electrode	Other than low
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

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WELDING MEDIUM / HIGH TENSILE STEEL												
Welding Using												
<table><tr><th>Thickness of thicker part at Point of welding submerged arc welding</th><th>Low hydrogen electrode or hydrogen electrode</th><th>Other than low</th></tr><tr><td>Up to and including 20mm</td><td>None</td><td>Not Allowed</td></tr><tr><td>Over 20mm</td><td>120°C - 140°C</td><td>Not Allowed</td></tr></table>				Thickness of thicker part at Point of welding submerged arc welding	Low hydrogen electrode or hydrogen electrode	Other than low	Up to and including 20mm	None	Not Allowed	Over 20mm	120°C - 140°C	Not Allowed
Thickness of thicker part at Point of welding submerged arc welding	Low hydrogen electrode or hydrogen electrode	Other than low										
Up to and including 20mm	None	Not Allowed										
Over 20mm	120°C - 140°C	Not Allowed										
3.07.03	Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure. 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.											
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 as applicable for MRS work under bidders 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.											
4.00.00	MISCELLANEOUS REQUIREMENTS											
4.01.00	Corrosion Protection											
4.01.01	General											
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	(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.		
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		
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4.01.07	All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736. 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.		
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 underpinning 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 (Only of drawing and design purpose)		
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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 (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 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.		
4.07.02	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		
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(nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728.'

4.07.03 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.

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.

4.07.04 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.

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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. 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		
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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.

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 (only for drawing and design purpose)

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.

900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.

Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.

Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.

Roofs shall have water proofing treatment. Roof water proofing treatment shall be as follows:

1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat.

2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 898-89 and 836-89a).

3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping. Roof drain level shall be provided with 45cmx45cmx30mm thick khurras with 1 : 2 : 4 PCC over PVC sheet of 1mx1mx400 micron (thick) & finished with 12mm thick 1 : 3 cement sand plaster.

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4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C.

5) Rain water downcomers shall be medium grade galvanised mild steel pipes of minimum 100mm clear diameter provided with welded joint and with grating shoebends, junctions, brackets, cast iron clamps & painted with anticorrosive paint over the coat of primer. The number and size of down comers shall be governed by IS : 1239 and galvanization shall be as per IS:4736.

6) Drip Course shall be provided with 1 : 3 cement sand mortar for Parapets, chajjas, windows and doors head, facias, fins.

4.11.00 Floors and Grade level details (only for drawing and design purpose)

The floor slabs 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

Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, and other similar cutouts.

The grade slab shall consists of 230 mm thick rubble soling (63 mm downgraded hard stone aggregate as per IRC specification, watering and compaction to minimum of 90% Standard Proctor density, including filling the interstices of stone aggregates with sand), over well compacted earth, overlaid by 75 mm thick P. C. C. M-7.5 and 150 mm thick R. C. C. of grade M-25 with minimum 10 mm dia bars placed at 200 mm C / C in either direction respectively.

There will be minimum 50 mm thick metallic hardener finish over the R. C. C. slab for operating floors of all pump houses, MCC and switchgear rooms.

Isolation joint filled with preformed bituminous impregnated fibre board conforming to IS : 1838, at the junction with walls column, footing, foundation etc. to be provided.

All buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand.

4.12.00 Brickwork and allied masonry works (only for drawing and design purpose)

All brick walls shall be non - load bearing in-filled panel walls.

All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar.

Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.

Bricks to be used in brickwork shall be of minimum Class designation 50.

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4.13.00	Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness. Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar. 50 mm thick Damp proof course shall be provided at plinth level for all brick wall. All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster. Fencing (only for drawing and design purpose) Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be of minimum 3.75 M width and of height same as that of fence. The gate frame shall be fabricated from medium class MS pipe of nominal diameter not less than 75 mm. The panel plate shall be of minimum thickness 2.5 mm conforming to IS : 513. The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement tempered steel pivot, guide track of MS Tee bronze aluminium ball bearing arrangement, castrol wheel etc. Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing.		
4.14.00	Excavation Details (only for drawing and design purpose)		
4.14.01	Excavation in soil Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error, it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates), as directed by the Engineer. The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer.		
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4.14.02

Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer.

The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose.

Excavation in rock

For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency.

Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed.

The contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per Explosives Act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive materials.

Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer.

The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed.

4.14.03

Backfilling, Disposal and Stacking of materials

Backfilled earth shall be compacted to minimum 90 % of the standard proctor density at OMC. Sand filling shall be compacted to minimum 80 % of the relative density.

However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities.

The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer.

The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below:

The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes.

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For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer.

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.

4.14.04 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.

4.15.00 Deleted

4.16.01 Glazing (only for drawing and design purpose)

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) 4mm thk. float glass in tinted shade for accessible areas.

(ii) In Switchgear / M. C. C. buildings

(a) In air conditioned (A / C) areas:

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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. (b) In toilets: Ground glass of minimum thickness 6 mm. (c) Alumunium Glazed doors: Toughened glass of minimum thickness 6 mm (d)For glazed partition 10mm float glass The above mentioned glass thickness are bare minimum only and actual thickness will depend on the panel size of the glazing to be provided. Polycarbonate sheet shall be fire retardant, U.V. resistant and suitable for temperature of 1000C. Open end of the sheet shall be sealed as per manufacturer's recommendations. Glazing shall have uniform refractive index.			
4.16.02	False Ceiling (only for drawing and design purpose) All air - conditioned areas, shall be provided with False ceiling of 15 mm thick mineral fibre board, in tile form of size 600mm x 600mm, along with galvanised light gauge rolled form supporting system in double web construction pre painted with steel capping, of approved shade and colour, to give grid of maximum size of 1200x600. as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return air grills, light fixtures, etc., all complete. Under deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional requirements. This under deck insulation shall consist of 50 mm thick mineral wool insulation mat conforming to IS: 8183 having a density of 32 kg/cum for glass wool or 48 kg/cum for rock wool, backed with 0.05mm thick aluminium foil and 24G x 25 mm mesh wire netting and shall be fixed to the ceiling with 14G wire ties.		
4.16.03	Acid / Alkali Resistant Lining (only for drawing and design purpose) Battery Room For Floor and dado, bitumen primer followed by 12 mm thick bitumastic 6 mm thick potassium silicate mortar bedding and 20 mm thick A. R. tiles shall be provided. Dado height shall be minimum 2.1 m from floor. M. S. Grating / Chequered plate cover and any other steel structure likely to come in contact with chemicals shall be provided with epoxy coating 150 microns thick over epoxy primer. Acid / Alkali resistant lining material shall conform to the following: Bitumen primer shall conform to IS: 158. 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.		
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4.16.04	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 (only for drawing and design purpose) 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 (only for drawing and design purpose) 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. 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		
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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.

4.16.06 Interior Wall / Ceiling Finish (only for drawing and design purpose)

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 (only for drawing and design purpose)

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))

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The paint shall be (premium acrylic smooth exterior paint with silicon additives) of 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

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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.

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.

4.16.08

TOILET (only for drawing and design purpose)

One Toilet shall be provided in every building. Each toilets shall be provided with following fittings.

1. 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).
2. 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).
3. 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.
4. Stainless steel towel rods 600mm x 20mm – 1 No.
5. Stainless steel Liquid soap holder cum dispenser – 1 No.

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6. Stainless Steel paper holder-1No.
 7. Stainless Steel hand drier – 1No.
 8. Overhead polyethylene (IS : 12701) water tank of minimum 500 liter capacity – 1 No. Virgin HDPE granules of approved grade, suitable for drinking water shall be used.
 9. Janitor room – 1 No.
 10. Space for 1 No. water cooler with recessed floor and stainless steel grating for draining of spillage water including provision for potable water supply connection.
 11. Additional C.P. brass tap - 1 No.
- Toilet shall be provided with sunken floor slab so as to keep, the finished floor level atleast 12mm below that of the surrounding area.
- Bracket for wash basin, urinals etc. shall be embedded in 1 : 2 : 4 concrete block.
- Mirror shall be fixed at a nominal height of 1.45m.
- Sunken slabs shall be made water tight by suitable water proofing treatment.
- All fittings unless noted otherwise shall be of chromium plated (fancy type) from reputed manufacturer.
- Manholes shall be provided at every 30 M from the toilet upto the main sewer trunk route of the Owner.
- Connection of main water supply (owner's) to the toilet is in BHEL scope.

4.16.09 WATERSUPPLY, DRAINAGE & SEWAGE (only for drawing and design purpose)

All water supply pipes shall be medium class galvanised mild steel pipes conforming to IS : 1239 of approved make from reputed manufacturer. Underground pipes shall be painted with two coats of bituminous paint conforming to IS : 158. All internal / over ground pipe shall be concealed.

For all overground sanitary / sewerage work, sand cast iron pipe conforming to IS : 1729 to be used.

For all sewerage and drain below ground except at road crossing, concrete pipe NP - 2 conforming to IS : 458 to be used.

For all sewer / pipe drain at road crossing, concrete pipe NP - 3 conforming to IS : 458 to be used.

All joints shall be done with lead. Pipe shall be provided with bedding as per IS : 783 (Latest). All pipe shall be of approved brand from the reputed manufacturer.

For outer edge of plinth protection for all buildings and all along inner periphery of boundary wall / and fencing, surface drain shall be of one brick thick construction with perforated precast RCC covers of minimum 40mm thickness with provision of openable steel grating covers at about every 2m spacing. The minimum clear size of the drain shall be 200 mm (width) x 300mm (depth). Bed concrete shall be 100mm thick, 1 : 3 : 6 PCC. The inside of surface drain & top shall be plastered with 12mm thick cement sand mortar (1 : 4) & finished with floating coat of neat cement. In areas where vehicular loading is coming, precast RCC covers without perforation and designed for vehicular loading shall be provided. The surface drain shall be suitably sloped and connected with the nearest trunk drain / manhole Water body as per direction of Engineer.

All drains inside the building shall be of RCC with the minimum 40mm thick steel grating covers. At the areas of the equipment handling, precast RCC slabs shall be provided.

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Drains connecting rain water down comer to peripheral surface drain shall be of rectangular brick drains with inside face plastered in cement sand mortar (1:4). Minimum clear size of drain shall be 300 mm deep x 500mm base width.

4.16.10 Edge Protection angle

For all around cutout / openings in floor slab, edges of drain / trenches and manhole supporting cover, supporting edges of precast covers and any other place where breakage of the corner of concrete is expected, mild steel angle of minimum size 50x50x5mm provided with mild steel lugs for embedment in concrete / masonry is to be provided.

Around the edges of opening in roof, on external wall etc. for mounting exhaust fan, passage of pipe / conduits etc., mild steel angles / channels together with 6mm thick plates is to be provided.

4.16.11 DOORS, WINDOWS AND ROLLING SHUTTERS (only for drawing and design purpose)

4.16.12 Doors and Windows

All doors, windows and ventilators of control room building, shall have Electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet areas shall be of 35mm thk. Homogeneous particle board (decorative veneer prelaminate on both sides), bonded with BWP type Phenol Formaldehyde Synthetic resin conforming to IS:3087, Type-1 with 35x12mm thk. teak wood beading all around. Aluminum glazed doors shall be provided in air-conditioned areas, offices and in other areas as instructed by the engineer. All other buildings shall have steel doors.

Single glazed panels with aluminium framework shall be provided as partition between two air - conditioned areas wherever clear view is necessary.

Shall be of double flush type steel constructions of 35mm (minimum) thickness. Panels (two outer sheets) and connecting stiffeners shall be of 18G (1.25mm) thick sheet. Space between the two sheets (panels) shall be filled with mineral wool. The door frame shall be of pressed steel construction of 16G (1.6mm) thick sheet. The door shall be provided with rubber sealing for air tightness. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, etc. Stiffeners spacing shall be not more than 150mm, side, top and bottom edges of the shutters be reinforced by continuous pressed steel channel of minimum 1.2mm thickness.

Wherever functionally required rolling shutters shall be provided and these shall be electrically operated.

Fire - Proof doors with panic devices shall be provided at all fire exit points as per the recommendations of statutory regulatory bodies. These doors shall generally be as per IS : 3614 (Part I). Fire rating of the doors shall be as per requirements of statutory regulatory bodies. However minimum rating shall be 2 hours. These doors shall be double cover-plated types with mineral wool insulation.

Hollow extruded section of minimum 2 mm wall thickness as manufactured by INDAL or equivalent shall be used for all aluminium doors, windows, and ventilators.

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	All doors should have opening as indicated in the drawings. Doors and windows on external walls of the buildings having brick enclosures i.e. enclosure other than with permanently colour coated steel sheet cladding, shall be provided with sunshade over the openings with width 600 mm more than the opening width. Projections from the wall for the sunshade shall be 450 mm over window openings and 750 mm over door openings. Minimum size of door provided should be 2.1 m high and 1.2 m wide, except for toilet rooms, where door may be 0.75 m wide. All doors (other than those in W/C and urinal area) shall be double plate flush door shutters. Area of windows shall be at least 10 % of the floor area of the respective building. For buildings having roof height more than 4.0m, a continuous band of ventilator of height 600mm (minimum) shall be additionally provided. The area of translucent polycarbonate sheet panels shall also be at least 10 % of the floor area of the respective building. Monorail doors shall be provided with steel stays / chains etc for convenient operation of the shutters. The louvre blade shall be 'Z' shaped and made out of 18G sheets in EZ7 steel frames. The frames shall be of ISMC 100. 4.16.13 Rolling Shutters (only for drawing and design purpose) Rolling Shutters/ grills shall be with motor drives, gear arrangement including all accessories and shall conform to IS: 6248. All electrical work shall be in strict accordance with the relevant Indian Electricity Rules. After installing the shutters, the Contractor shall test the performance of the shutter in presence of the Engineer. The shutters shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance. 4.17.00 Geotechnical Investigation and Foundation System Geotechnical Investigation is in BHEL scope. The geotechnical investigation report shall be provided at successful bidder for design of civil foundation. Foundation system requirements are appended at detailed specification civil. For details, refer Annexure-III. 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 6.01.00 All Structural Steel work shall be Shop fabricated outside the Plant area. 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.		
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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.
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.

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IS : 3550	Methods of test for routine control for water used in industry.
IS : 3558	Code of practice for use of immersion vibrators for consolidating concrete.
IS : 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS : 4326	Code of practice for earthquake resistant design and construction of buildings.
IS : 4656	Specification for form vibrators for concrete.
IS : 4925	Specification for batching and mixing plant.
IS : 4990	Specification for plywood for concrete shuttering work.
IS : 5256	Code or practice for sealing joints in concrete lining on canals.
IS : 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
IS : 5624	Specification for foundation bolts.
IS : 6461	Glossary of terms relating to cement concrete.
IS : 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS : 6509	Code of practice for installation of joints in concrete pavements.
IS : 7861	Code of practice for extreme weather concreting. (Parts I & II)
IS : 9012	Recommended practice for shot concreting.
IS : 9103	Specification for admixtures for concrete.
IS : 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
IS : 10262	Recommended guidelines for concrete mix design.
IS : 11384	Code of practice for composite construction in structural steel and concrete.
IS : 12118	Specification for two - parts poly sulphide.
IS : 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
IS : 13311	Method of non - destructive testing of concrete.
Part - 1	Ultrasonic pulse velocity.
Part - 2	Rebound hammer.
SP : 23	Handbook of concrete mixes
SP : 24	Explanatory Handbook on IS : 456 - 1978
SP : 34	Handbook on concrete reinforcement and detailing.

7.00.05

PRECAST CONCRETE WORKS

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

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MASONRY AND ALLIED WORKS

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

7.00.07

FABRICATION AND ERECTION OF STRUCTURAL STEEL WORK

IS : 2016	Specification for plain washers.
IS : 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS : 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS : 3502	Specifications for chequered plate.
IS : 6911	Specification for stainless steel plate, sheet and strip.
IS : 3757	Specification for high strength structural bolts
IS : 6623	Specification for high strength structural nuts.
IS : 6649	High Tensile friction grip washers.
IS : 800	Code of practice for use of structural steel in general building construction.
IS : 816	Code of practice for use of Metal Arc Welding for General Construction.
IS : 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.
IS : 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS : 817	Code of practice for Training and Testing of Metal Arc Welders.
IS : 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS : 7215	Tolerances for fabrication steel structures.
IS : 12843	Tolerance for erection of structural steel.
IS : 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.
SP : 6 (Part 1 to 7)	ISI Hand book for structural Engineers.
IS : 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS : 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube
IS : 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.

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IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

PLASTERING AND ALLIED WORKS

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

7.00.09

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.
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

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	sanitary appliances.
IS : 2065	Code of practice for water supply in building.
IS : 2326	Automatic flushing cisterns for urinals.
IS : 2470 (Part - I & II)	Code of practice for installation of septic tanks.
IS : 2501	Copper tubes for general engineering purposes.
IS : 2548	Plastic seat and cover for water - closets.
IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
IS : 2963	Non - ferrous waste fittings for wash basins and sinks.
IS : 3114	Code of practice for laying of cast iron pipes.
IS : 3311	Waste plug and its accessories for sinks and wash basins.
IS : 3438	Silvered glass mirrors for general purposes.
IS : 3486	Cast iron spigot and socket drain pipes.
IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
IS : 4127	Code of practice for laying of glazed stone - ware pipes.
IS : 4764	Tolerance limits for sewage effluents discharged into inland - surface waters.
IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS : 5822	Code of practice for laying of welded steel pipes for water supply.
IS : 5961	Cast iron grating for drainage purpose.
IS : 7740	Code of practice for road gullies.
IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.
IS : 8934	Cast copper alloy fancy pillar taps for water services.
IS : 9762	Polyethylene floats for ball valves.
IS : 10446	Glossary of terms for water supply and sanitation.
IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
IS : 12592	Specification for precast concrete manhole covers and frames.

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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.

7.00.10

DOORS, WINDOWS AND ALLIED WORKS

IS : 204	Tower Bolts
Part – I	Ferrous metals.
Part – II	Nonferrous metals.
IS : 208	Door Handles.
IS : 281	Mild steel sliding door bolts for use with padlocks.
IS : 362	Parliament Hinges.
IS : 420	Specification for putty, for use on metal frames.
IS :1003 (Part-I)	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.

7.00.11

ROOF WATER PROOFING AND ALLIED WORKS

IS : 1203	Methods of testing tar and bitumen.

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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

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IS : 162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.
IS : 1477	Code of practice for painting of ferrous metals in buildings.
Part – I	Pretreatment.
Part - II	Painting.
IS : 1650	Specification for colours for building and decorative finishes.
IS : 2074	Specification for red oxide - zinc chrome, priming, ready mixed paint air drying.
IS : 2338	Code of practice for finishing of wood and wood based materials.
Part - I	Operations and workmanship
Part - II	Schedules
IS : 2395	Code of practice for painting concrete, masonry and plaster surfaces.
Part - I	Operations and workmanship.
Part - II	Schedule.
IS : 2524	Code of practice for painting of nonferrous metals in buildings.
Part - I	Pretreatment.
Part - II	Painting.
IS : 2932	Specification of synthetic enamel paint, exterior, under - coating and finishing.
IS : 2933	Specification enamel paint, under coating and finishing.
IS : 4759	Code of practice for hot dip zinc coating on structural steel and other allied products.
IS : 5410	Specification for cement paint
IS : 5411 (Part - I)	Specification for plastic emulsion paint - for exterior use
IS : 6278	Code of practices for white washing and colour washing.
IS : 10403	Glossary of terms relating to building finishes.

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7.00.14	PILING AND FOUNDATION		
	IS : 1080	Code of practice for design and construction of simple spread foundations.	
	IS : 1904	Code of practice for design and construction of foundations in Soils; General Requirements.	
	IS : 2950 (Part-I)	Code of practice for designs and construction of Raft foundation.	
	IS : 2974 (Part-I TO V)	Code of practice for design and construction of machine foundations.	
	IS : 6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.	
	IS : 8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.	
	Part - I	Shallow foundations.	
	Part - II	Deep foundations.	
	IS : 12070	Code of practice for design and construction of shallow foundations on rocks.	
	DIN : 4024	Flexible supporting structures for machines with rotating machines.	
	VDI : 2056	Criteria for assessing mechanical vibrations of machines.	
	VDI : 2060	Criteria for assessing rotating imbalances in machines.	
	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.	
7.00.16	IS : 11855	General requirements for rubber seals for hydraulic gates.	
	ROADS		
	IRC : 5	Standard specifications and Code of practice for road bridges,	
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	section - I general Features of Design.
IRC : 14	Recommended practice of 2cm thick bitumen and tar carpets.
IRC : 16	Specification for priming of base course with bituminous primers.
IRC : 19	Standard specifications and code of practice for water bound macadam.
IRC : 21	Standard specifications and Code of practice for road bridges, section - III - Cement concrete (plain and reinforced).
IRC : 37	Guidelines for the Design of flexible pavements.
IRC : 86	Geometric Design standards for urban roads in plains.
IRC : SP : 13	Guidelines for the design of small bridges & culverts.
IRC – Publication	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.
IS : 73	Specification for paving bitumen

7.00.17

Loading

IS : 875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.
IS : 1893	Criteria for earthquake resistant design of structures.
IS : 4091	Code of Practice for design and construction of foundation for transmission line towers & poles.
IRC : 6	Standard specifications & code of practice for road bridges, Section - II Loads and stresses.
M.O.T.	Deptt. of railways Bridge Rules.

7.00.18

SAFETY

IS : 3696 (Part I & II)	Safety code for scaffolds and ladders.
IS : 3764	Safety code for excavation work.
IS : 4081	Safety code for blasting and related drilling operations.
IS : 4130	Safety code for demolition of buildings.
IS : 5121	Safety code for piling and other deep foundations.
IS : 5916	Safety code for construction involving use of hot bituminous materials.
IS : 7205	Safety code for erection on structural steelwork.
IS : 7293	Safety code for working with construction machinery.
IS : 7969	Safety code for handling and storage of building materials
IS : 11769	Guidelines for safe use of products containing asbestos.
Indian Explosives Act. 1940 as updated.	

7.00.19

Acid and Alkali Resistant Lining

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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

ANNEXURE-I

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):2002 and IS:1893 (Part 4):2005. Pending finalisation of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures.

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 Annexure-I includes the effect of the seismic environment of the site, the importance

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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 and 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)	01.01.01. 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).

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 .

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be

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computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Annexure-I. Further, 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.

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.

APPENDIX-A

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 : 0.098
 - b) for braced steel frames designed and detailed as per IS:800 : 0.074
 - c) for moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.059
 - d) for design of structures not covered under 2 (a) to 2 (c) above and under 3 below : 0.098
- 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

Note: g = Acceleration due to gravity

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

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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 Annexure – II 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:

- 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.

ANNEXURE-III

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.

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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:

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.

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 “Vb” at ten metres above the mean ground level	47 metres/second
b)	The risk coefficient “K1	1.07
c)	Category of terrain	Category -2

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ANNEXURE-III			
FOUNDATION SYSTEM AND GEOTECHNICAL DATA			
1.00.00	SOIL DATA AND FOUNDATION SYSTEM Bearing capacity for design of foundations and few borelogs in the vicinity of ESP area are given at Appendix - C of this specification.		
1.01.0	Soil Data		
1.01.01	The geotechnical investigation report of the nearest area comprising of Boreholes, Laboratory tests, Chemical analysis, etc. in respect of the sub-strata prevailing at site will be made available for the Bidder's study at the Employer's office, if required. The specification has been prepared considering the borelogs available in the vicinity of ESP area. The onus of correct assessment/interpretation and understanding of the existing subsoil condition/data is on the Bidder.		
1.01.02	Ground water level is at a depth of about 1.0 m below natural ground level at the time of investigation Fluctuation may occur in ground water table due to seasonal variation.		
1.01.03	The Bidder shall fully satisfy himself about the nature of the subsoil expected to be encountered including the type of foundation & ground water table, construction method etc. prior to the submission of the bid. The bidder shall also carry out separate 100/150mm dia borehole and conduct SPT to ensure the pile termination as per Annexure-II.		
1.02.00	Foundation System		
	The requirements for the foundation system to be adopted are as given in subsequent clauses.		
1.02.01	General Requirements		
	(a) All structures/equipment shall be supported on either suitable open foundations (isolated, combined, raft) or pile foundation. (b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drain and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. (c) No other foundation shall rest on the filled up ground / soil. (d) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost.		
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(e) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.

(f.) The water table for design purpose shall be considered at Finished Ground Level.

(g.) Foundation for equipments on ground floor

For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m². Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications.

For equipment of static weight more than 1.5 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Annexure-I. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.

1.02.02 Open Foundations

In case open foundations are adopted, following shall be adhered to.

- (a.) The minimum width of foundation shall be 1.0 m.
- (b.) Minimum founding level, bearing capacity and permissible settlements shall be as given in the Annexure - 1 to this specification.

1.02.03 Pile Foundations:-

In case piles are adopted, following shall be adhered to :

- i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using conventional rigs by Direct Mud circulation (DMC)/Reverse Mud Circulation (RMC) method. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer.
- ii) The minimum diameter of pile shall be 600 mm. The allowable load carrying capacities of the pile shall be limited to the values given at Annexure - I. However, the pile capacities to be adopted shall be the least of the estimated design values and that obtained from the initial pile load tests.
- iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m.

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- iv) The bidder shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, locations of initial test piles etc.) for Engineer's approval.
- v) Reinforcement for job piles shall be designed as following:
 - (a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered.
 - (b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package.
- vi) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval.
- vii) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under.
 - Vertical
 - Lateral Minimum of 2 Nos. in each mode.
 - Uplift
- viii) The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part).
- ix) Load test shall be conducted at pile cut of level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter.
- x) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under :
 - i) Vertical : 0.5% of the total number of piles provided.
 - ii) Lateral : 0.5% of the total number of piles provided.
- xi) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer.
- xii) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required.
- xiii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm.

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- xiv) The test load on initial test piles shall be applied by means of reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge.
- xv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency approved by Engg. department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM.
- xvi) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least three numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 1.02.03 (x) shall be total of static routine vertical load test and high strain dynamic load tests.
The procedure to carry out the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile.
- xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles.
- xviii) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions.

1.03.00 Excavation, Filling and Dewatering

- 1.03.01 For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth .
- 1.03.02 Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M 7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.

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1.03.03 Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 75% of relative density for non cohesive soils.

1.03.04 The founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.

1.04.00 Sheeting & Shoring

The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation, executing the work. Sheeting and shoring, bracing and maintaining suitable slopes, draining, dewatering etc. shall be provided as per requirement and installed by the Contractor, to the satisfaction of the Engineer.

APPENDIX-C

SOIL DATA AND FOUNDATION SYSTEM

- Logs of representative boreholes in the vicinity of ESP area are enclosed with this Annexure.
- The foundation system to be adopted for different structures shall be as given in Table – 1 below

Table – 1: Foundation System

STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED
ESP Modification structures, Foundation for silo, Foundation for buffer hopper tower	Pile
ESP Control Room, Vacuum pump foundations, any other lightly loaded structure.	Open/Pile

- In case of open foundation:** The minimum founding level and the corresponding net allowable bearing pressure shall be as given in Table – 2 below.

Structure	Founding Level in RL	Net Allowable Bearing Pressure	
		Isolate/Strip for a permissible	Raft (width $\geq$ 6m)

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		settlement of 40 mm		for a permissible settlement of 75mm
		Width upto 3.0 m	Width >3 & < 6 m	
ESP Control Room, Vacuum pump foundations, any other light loaded structure	33	5.0	-	5.0
	32	6.0	5.0	6.0
	31	7.0	6.0	7.0

* Wherever the existing buildings/structures if any have been dismantled, in such cases the founding level shall not be above the founding level of the existing buildings/structures.

The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.

d)Permissible Settlement of Foundations:

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

Isolated & Strip	40 mm
Raft (widths greater than 6 m)	75 mm

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

a) The diameter, corresponding allowable capacity and length of the pile to be considered for bidding shall be as given below:

Diameter	Length of Bored Pile Bellow Cut-off Level	Safe Load Capacity in

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	(m)	Vertical	Comp. (MT)	Pullout (MT)	Lateral (MT)
600	27.0	100.0		20.0	6.0

- Cut off Level (COL) is assumed at 2.0 m below Finished Ground Level.

Bidder to refer clause (g) "special conditions" below for piling works and commercial implication due to the change in length of pile (if any).

f) The criteria for Pile Termination (founding level) shall be as given below:

For pile termination, SPT shall be conducted in a separate borehole of 100/150mm dia as per IS:1892. In this borehole, SPT shall be conducted at 3.0m interval upto 25m below ground level and 1.0m interval beyond 25m to at least 5.0m below the pile termination level. For no of boreholes to be carried out refer Annexure-II.

i) The termination level (level where pile terminates) and the minimum pile length for each group of piles shall be determined based on the nearest borehole log. Pile shall be terminated in very stiff clay/medium dense sand with SPT 'N' value > 30. This criterion shall be ensured while determining the minimum length of pile.

g) Special Conditions:

Bidder in his bid shall submit the numbers/quantity of 600/760mm bored cast-in-situ piles envisaged based on the design carried out by him for the execution of this contract. Bidder shall also furnish the cost of piling works in the identified schedule of Bid Proposal Sheet. Bid without indicating number of piles and detailed break up/cost of piling works shall not be considered as valid bid.

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DETAILED SPECIFICATION OF ELECTRICAL
*** MOTORS**
*** LT SWITCHGEAR**
*** LT POWER CABLE**
*** LT CONTROL CABLE**
*** CABLING, EARTHING & LIGHTNING**
*** ILLUMINATION**

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
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.00.00	TYPE				
3.01.00	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.				
3.02.00	DC Motors		Shunt wound.		
4.00.00	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.				
5.00.00	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.				
6.00.00	OPERATIONAL REQUIREMENTS				
6.01.00	Starting Time				
6.01.01	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.				
6.01.02	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.				
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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)
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC			
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 Pressure 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.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
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.			
	(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			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
10.01.04 10.01.05 10.01.06	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. 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. 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				एनटीपीसी NTPC
	(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
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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></table> 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: <table><tr><th>Motor MCR in KW</th><th>Clearance</th></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	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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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-05

LT SWITCHGEAR & BUSDUCT

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC				
1.00.00	GENERAL REQUIREMENTS				
1.01.00	The requirements, conditions, appendices etc stated in any other bid documents shall apply to and shall be considered as a part of this specification as if bound together. In case of any discrepancy between conditions specified in any other volume and this volume, the requirements, specified in this volume shall prevail.				
1.02.00	The equipment offered by the Bidder shall be complete in all respects. Any material and component not specifically stated in this specification but which is necessary for trouble free operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded. All such equipment / accessories shall be supplied without any extra cost. Also, all similar components shall be interchangeable and shall be of the same type and rating for easy maintenance and low spare inventory.				
1.03.00	Bidder shall furnish the technical information and data as mentioned elsewhere.				
1.04.00	All drawings, schedules and annexure appended to this specification shall form part of the specification, specific reference in this specification and documents to any material by trade name, make, or catalogue number shall be construed as establishing standard of quality and performance and not as limiting competition. The bidder may offer other similar equipment provided it meets the specified standard design and performance requirements.				
1.05.00	Each section of the LT switchgears / MCCs shall be provided with at least 20% (minimum 1 no.) of spare modules of each type and rating in addition to owner's requirement, if any, as specified elsewhere.				
2.00.00	CODES AND STANDARDS				
2.01.00	All equipment shall, generally, comply with the updated issues of (a.) Applicable Indian Standards (b.) Indian Electricity Act. (c.) Indian electricity rules				
2.02.00	Equipment complying with any other authoritative / internationally recognized standards such as IEC, British, U.S.A., German, etc. will also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases the bidder shall clearly indicate the standard adopted and furnish the copy of latest English version of the same along with the bid and bring out the salient features for comparison.				
2.03.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as published one month prior to the date of opening of bids. 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 codes and standards. IS: 5 Colors for ready-mixed paints and enamels.				
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 1 of 57

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	IS: 694	PVC insulated cables for working voltages upto and including 1100V.			
	IS: 722	A.C. Electricity Meters			
	IS: 1248	Electrical Indicating instruments			
	IS/IEC: 60947–1	Degree of protection provided by enclosures for low voltage Switchgear and Control gear			
	IS/IEC: 60947-2	A.C. circuit Breakers			
	IS: 2551	Danger Notice Plates			
	IS: 2629	Hot dip galvanising			
	IS: 2705	Current Transformers			
	IS/IEC: IEC-60947-4-1	Contactors and motors starter for voltages not exceeding 1000 V AC or 1200 V DC			
	IS: 3043	Code of practice for earthing.			
	IS: 3072	Code of practice for installation and maintenance of Switchgear			
	IS: 3156	Voltage Transformers			
	IS: 3202	Code of practice for climate proofing of electrical equipment.			
	IS: 3231	Electrical relays for power system protection.			
	IS/IEC 60947	Air-Break Switches, air break disconnectors, air break disconnector and fuse combination units for voltages not exceeding 1000V AC or 1200 V DC.			
	IS/IEC 60947-1 / IEC-60947-1	General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V.			
	IS: 5082	Wrought Aluminum and Aluminum alloys for electrical purposes.			
IS: 6005	Code of practice of phosphating of iron and steel.				
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 2 of 57	

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																																
	<table><tr><td>IS/IEC 60947-5-1 / IEC-60947-5-1</td><td colspan="3">LV switchgear and Control gear Control current devices and switching element.</td></tr><tr><td>IS: 8623 (3 parts) / IEC: 60439</td><td colspan="3">Specification for factory built assemblies of Switchgear & Control gear for voltages upto and including 1000 V AC & 1200 V DC.</td></tr><tr><td>IS: 8686</td><td colspan="3">Static Relays</td></tr><tr><td>IS: 13703 / IEC: 60269</td><td colspan="3">HRC Cartridge fuses</td></tr><tr><td>IS: 10118 (4 parts)</td><td colspan="3">Code of practice for selection, installation and maintenance of switchgear and control gear.</td></tr><tr><td>IS: 11171</td><td colspan="3">Specification for dry type transformers.</td></tr><tr><td>IEC: 60255</td><td colspan="3">Electrical Relays</td></tr><tr><td>IEC: 61850</td><td colspan="3">Communication networks and systems in substations</td></tr><tr><td>IS: 11353</td><td colspan="3">Guide for uniform system of marking and identification of conductors and apparatus terminals</td></tr><tr><td>IS: 12021</td><td colspan="3">Specification of control transformers for switchgear and Control gear for voltage not exceeding 1000V AC.</td></tr><tr><td>IEC: 60947-7-1</td><td colspan="3">Terminal blocks for copper conductors</td></tr><tr><td>IS :513 (2008)</td><td colspan="3">Cold Rolled Low Carbon Steel Sheets and Strips</td></tr></table>				IS/IEC 60947-5-1 / IEC-60947-5-1	LV switchgear and Control gear Control current devices and switching element.			IS: 8623 (3 parts) / IEC: 60439	Specification for factory built assemblies of Switchgear & Control gear for voltages upto and including 1000 V AC & 1200 V DC.			IS: 8686	Static Relays			IS: 13703 / IEC: 60269	HRC Cartridge fuses			IS: 10118 (4 parts)	Code of practice for selection, installation and maintenance of switchgear and control gear.			IS: 11171	Specification for dry type transformers.			IEC: 60255	Electrical Relays			IEC: 61850	Communication networks and systems in substations			IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals			IS: 12021	Specification of control transformers for switchgear and Control gear for voltage not exceeding 1000V AC.			IEC: 60947-7-1	Terminal blocks for copper conductors			IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips		
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3.00.00	TECHNICAL PARAMETERS																																																			
3.01.00	POWER SUPPLY																																																			
3.01.01	AC SYSTEM																																																			
	1) Voltage		415 V $\pm$ 10%,3 Phase, 4 wire, solidly earthed																																																	
	2) Frequency		50 Hz +/- 5%																																																	
	3) Combined variation	(in volts & frequency)	10% absolute sum																																																	
	4) Fault Level		45KA(RMS)																																																	

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-05 LT SWITCHGEARS & LT BUSDUCT	Page 3 of 57

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC	
3.01.02	DC SYSTEM 1) System Voltage 220V/110V DC 2-Wire, Unearthed 2) Fault Level 20 KA				
3.01.03	CONTROL SUPPLY VOLTAGE 1) Trip & closing coil of circuit breaker 220V DC/110V DC 2) Spring charging motor 220V DC/110V DC 3) MCC control supply 110V AC Neutral solidly earthed 4) Space heater & lighting 240V AC Neutral solidly earthed				
3.02.00	CUBICLE DATA Busbar Rating 1) Continuous Current rating As per requirement 2) Short time rating where a) CB is used as incomer 45KA(RMS) for one sec b) Fuse protection is used in Incomer Prospective current of 45KA(RMS) for the fuse clearing time 3) Dynamic Rating where a) CB is used as incomer 105KA(PEAK) b) Fuse Protection is used in incomer Prospective current of 105KA (PEAK) as limited by fuse 4) Busbar insulation a) For switchgear PVC Sleeve insulated b) For MCC PVC Sleeve insulated c) ACDB PVC Sleeve insulated d) DCDB PVC Sleeve insulated e) For fuse boards PVC Sleeve insulated/ epoxy coated				
3.03.00	CIRCUIT BREAKER 1) Type Air break spring charged stored energy type 2) Operating duty B-3 MIN-MB-3 MIN-MB 3) Symmetrical interrupting 45KA(RMS) 4) Short circuit rating 105KA(PEAK) 5) Short Circuit Breaking current				
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एन.टी.पी.सी. NTPC			
3.04.00	a)	AC Component	45KA(RMS)			
	b)	DC Component	As per IS:13947			
	6)	Short time withstand	45KA(RMS) for one sec			
	7)	No of aux. contacts	4 NO + 4 NC for employer use			
	METERS					
3.05.00	1)	Accuracy class	2.0			
	2)	One min. power frequency withstand test voltage	2.0 KV (rms)			
	CURRENT TRANSFORMERS					
	1)	Type	Cast Resin Bar Primary			
	2)	Voltage class and frequency	650 V, 50 HZ			
	3)	Class of insulation	E or better			
	4)	Accuracy class & burden				
	a)	For protection	5P20, 5VA			
	b)	For metering	PS Class for REF class 1.0, 5VA (min)			
	5)	Short time withstand				
3.06.00	a)	For CT Associated with circuit breaker	45KA(RMS) for 1 sec			
	b)	For CT Associated with fuse protected feeders	Prospective current of 45KA(RMS) for the Fuse clearing time			
	6)	Dynamic withstand				
	a)	For CTs Associated with circuit breaker	105KA(PEAK)			
	b)	For CT Associated with fuse protected feeders	Prospective current of 105KA(PEAK) as Limited by fuse			
	BUSDUCT					
	1)	Type	Non-Segregated			
	2)	One minute power frequency withstand voltage	2.5 kV			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC		
3.07.00	3)	One second short ckt withstand current	45KA(RMS)		
	4)	Momentary dynamic current withstan	105KA(PEAK)		
	VOLTAGE TRANSFORMERS				
	1)	Type	Cast Resin		
	2)	Voltage Ratio	415 / 110 V for line PT		
			415/ $\sqrt{3}$ / 110/ $\sqrt{3}$ V for Bus PT		
	3)	Method of Construction	Vee Vee		
	4)	Accuracy Class	0.5		
3.08.00	5)	Rated Voltage factor	1.1continuous, 1.5 for 30 sec.		
	6)	Class of insulation	E or better		
	7)	One minute power frequency withstand voltage	2.5 KV		
	HRC FUSES				
	1)	Voltage Class	650 Volts		
	2)	Rupturing capacity	80 KA (rms) for AC ckt. 20 KA for DC ckt.		
	3.09.00	CONTACTORS			
			Type	Air break electro magnetic	
2)		Utilising Category	AC3 of IS:13947 for non reversible AC4 of IS:13947 for reversible drives		
3.10.00	RELAYS				
	1)	Power frequency withstand voltage	2.5KV for 1 sec. or 2.0 KV for 1 min.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
3.11.00	CONTROL TRANSFORMERS			
	1) Type	Dry / Cast Resin		
	2) Voltage Ratio	415 / 110 with taps ± 5% in steps of 2.5%		
	3) Class of insulation	Class-B or better		
	4) One minute power frequency withstand voltage	2.5 KV		
	5) Rating	1.5 x Adequate for application.		
3.12.00	LIGHTING TRANSFORMER / WELDING TRANSFORMER (IF APPLICABLE)			
	1) Type & Rating	Dry type / 50KVA/100 KVA		
	2) Voltage Ratio	415/415V, +/- 5% taps in steps of 2.5%		
	3) Class of insulation	B or better		
	4) One minute power frequency withstand voltage	2.5 KV		
	5) Enclosure protection	IP-42		
3.13.00	TRANSDUCERS			
	1) Current transducers			
	a) Input	0-1 A (CT secondary)		
	b) Rated frequency	50HZ		
	c) Output	4-20 mA (2 Nos. decoupled)		
	d) Over current	Transducer for motor current ammeters shall be capable of withstanding min. 6 times CT sec. current of 1A for a min period of 30 seconds		
	e) Accuracy	1.0		
	2) Voltage Transducers			
	a) Input	110 V(VT secondary) ,50 HZ (for AC)/240 V/120 V DC (for DC)		
	b) Output	4-20 mA (2 Nos. decoupled)		
	c) Accuracy	1.0		
3.14.00	MCCB			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC			
	1) Rated voltage 415V 2) Rated insulation level 690V 3) Rated ultimate & Service S.C. breaking capacity 45KA 4) Rated making capacity 105KA 5) Utilization category A				
4.00.00	CONSTRUCTIONAL DETAILS OF SWITCHBOARDS				
4.01.00	All Switchboards i.e., 415 V Switchgears, Motor Control Centres (MCCs), AC Distribution Boards (ACDBs), 220 V DC Distribution Boards (DCDBs) , shall be of metal enclosed, indoor, floor-mounted, free-standing type.				
4.02.00	All switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.				
4.03.00	All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.				
4.04.00	The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cutouts shall be true in shape and devoid of sharp edges.				
4.05.00	All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS: 13947. However, the busbar chambers having a degree of protection of IP: 42 are also acceptable where continuous busbar rating is 1600A and above. Provision shall be made in all compartments for providing IP: 5X degree of protection, when circuit - breaker or module trolley has been removed. All cutouts shall be provided with EPDM / Neoprene gaskets.				
4.06.00	Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating is 1600 A and above.				
4.07.00	All switchboards shall be of uniform height not exceeding 2450 mm.				
4.08.00	Switchboards shall be easily extendable on both sides by the addition of vertical sections after removing the end covers.				
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4.09.00	Switchboards shall be supplied with base frames made of structural steel sections, alongwith all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) to be done by Contractor after erection of the switchboards does not obstruct the movement of doors, covers, withdrawable modules etc.				
4.10.00	All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments: (a.) BUSBAR COMPARTMENT A completely enclosed bus bar compartment shall be provided for the horizontal and vertical busbars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power busbars shall be in separate compartments. (b.) SWITCHGEAR / FEEDER COMPARTMENT All equipment associated with an incomer or outgoing feeder shall be housed in a separate compartment of the vertical section. Two-tier breaker arrangement in a vertical section shall be offered for outgoing breaker feeders of rating up to 1600A. The design of the vertical section for such an arrangement shall ensure ease of termination of power cables of size & quantity as specified in clause 42.00.00. The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. Insulating sheet at rear of the compartment is also acceptable. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure. (c.) CABLE COMPARTMENT OR CABLE ALLEY A full-height vertical cable alley of minimum 250mm width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley shall be designed to meet the Form IVb Type 7 (as per IEC 60439) for safety purpose. The termination for each module shall have its own integral glanding facility. Wherever cable alleys are not provided for distribution boards, segregated cable boxes for individual feeders shall be provided at the rear for direct termination of cables. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley. Cable alley door shall be hinged. (d.) CONTROL COMPARTMENT A separate compartment shall be provided for relays and other control devices associated with a circuit breaker.				
4.11.00	Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. EPDM / Neoprene gasket shall be provided between the panel sections to avoid ingress of dust into panels.				
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4.12.00	After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose. Wherever two breaker compartments are provided in the same vertical section insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.				
4.13.00	All 415V switchgear (circuit-breaker) panels shall be of single-front type. MCCs and DBs shall be of single-front / double-front construction as per the requirements. All single-front switch boards shall be provided with single-leaf, hinged or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 deg or more. In case of double-front MCCs, if this cannot be achieved for panels adjacent to a breaker panel, suitable dummy panel shall be provided by the Bidder wherever necessary.				
4.14.00	All ACDBs, DCDBs and other DBs shall be of fixed module type. All 415V circuit-breaker modules and contactor controlled motor modules shall be of fully draw out type having distinct 'Service' and 'Test' positions. The equipment pertaining to a draw out type incomer or feeder module shall be mounted on a fully withdrawable chassis which can be drawn out without having to unscrew any wire or cable connection. Suitable arrangement with cradle/ rollers, guides along with tool/lever operated racking in/out mechanism shall be provided for smooth and effortless movement of the chassis. For modules of size more than half the panel height, double guides shall be provided for smooth removal or insertion of module. All identical module chassis of same size shall be fully interchangeable without having to carryout any modifications.				
4.15.00	All disconnecting contacts for power and control circuits of drawout modules shall be of robust and proven design, fully self aligning and spring-loaded. Both fixed and moving contacts shall be silver-plated and replaceable. The spring-loaded power and control drawout contacts shall be on withdrawable chassis and the same on fixed portion shall not be accepted. Detachable plug and socket type control terminals shall also be acceptable.				
4.16.00	Individual opening in the vertical bus enclosure shall permit the entry of moving contacts from the drawout modules into vertical droppers.				
4.17.00	As indicated in schematic drawings of DDC / PLC controlled modules, contractor shall supply & mount two (2) coupling relays in the corresponding modules.				
4.18.00	All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to employer's approval. The Contractor shall submit dimensional drawings showing complete internal details of busbars and module components, for each type and rating for approval of Employer.				
4.19.00	Employer reserves the right to alter the cable entries, if required during detailed engineering, without any additional commercial implication.				
4.20.00	Each switchboard shall be provided with undrilled, removable type gland plate, which shall cover the entire cable alley. Bidder shall ensure that sufficient cable				
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4.21.00	glanding space is available for all the cables coming in a particular section through gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall preferably be provided in two distinct parts for the easy of terminating addition cables in future. The gland plate shall be provided with gasket to ensure enclosure protection. Recommended drilling chart of gland plates for all power and control cables in the vertical panels shall be indicated by the Contractor in the respective G.A. drawings of the boards. The Bidder shall consider layout of panels in a switchboard consisting of various feeder modules in a straight line, unless specified otherwise. The actual composition and disposition of various modules in a switchboard shall be finalised during detailed engineering. The switchboards fed from outdoor transformers of rating more than 1MVA and above shall preferably be connected through busducts. Busduct connections wherever applicable shall be preferably in a straight line alignment. The centre line of the busduct will be finalized during detailed engineering. Adopter panels and dummy panels shall be provided wherever required.			
4.22.00	CLEARANCES The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars and bus-link connections at circuit-breaker shall be 25 mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be atleast ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal and vertical busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars upto switch / fuses shall be fully shrouded / insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits.			
5.00.00	CONSTRUCTIONAL DETAILS OF AC & DC FUSE BOARDS			
5.01.00	All fuse boards shall be metal enclosed, fixed type, non-compartmentalized construction, suitable for indoor/ outdoor mounting on wall or steel structure.			
5.02.00	The fuse board frame shall be fabricated using suitable mild steel structures or pressed and shaped cold rolled sheet steel of thickness not less than 2.0 mm. The frames shall be enclosed by cold rolled sheet steel of thickness not less than 1.6 mm.			
5.03.00	The fuse boards shall be provided with doors on the front. The doors shall preferably be in two halves with hinges at the extreme ends and locking facility at the centre.			
5.04.00	Suitable EPDM/Neoprene gaskets shall be provided to make fuse boards completely dust and vermin-proof with a degree of protection of IP-52 for indoor and IP-54 for outdoor application, as per IS: 13947.			
5.05.00	Each DC fuse board shall comprise of the following : (a.) 1 no. 63 A switch as incomer (b.) 100 A fully insulated (PVC sleeved or epoxy coated) busbars. (c.) 8 nos. 16A outgoing Fuse feeders.			
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5.06.00	(d.) 1 no. auxiliary contactor for supply monitoring. (e.) 1 no. indicating lamp with resistor and blue coloured lens. Each AC fuse board shall comprise of the following : (a.) 1 no. 63A TPN switch as incomer. (b.) 100 A, 3-phase, 4-wire, fully insulated (PVC sleeved or epoxy coated) busbars. (c.) 9 nos. 16 A single phase switch fuse units and 3 nos. 16 A TPN switch fuse units as outgoing feeders or alternatively 16 amps MCCB can be provided. (d.) 3 nos. indicating lamps with resistors and coloured lenses (R, Y, B) for incoming supply monitoring.			
5.07.00	The fuses shall be mounted in an insulating fuse carrier and it shall be possible to replace the outgoing feeder fuses without disturbing the other feeders. The handle of incoming switch shall be mounted on the door of the fuse board, with padlocking facility in both 'ON' and 'OFF' positions. The outgoing feeder switches shall preferably be of rotary type.			
5.08.00	Cable entry facilities shall be provided at top / bottom with removable gland plates of suitable thickness. All incoming and outgoing cables shall be terminated on suitable terminal blocks.			
6.00.00	POWER BUSBARS AND INSULATORS All 415 V Switchboards, MCCs and ACDBs shall be provided with three phase and neutral busbars. Two separate sets of vertical busbars shall be provided in each panel of double front MCCs. Interleaving arrangement for busbars shall be adopted for switchboards with a rating of more than 1600A. DCDBs shall be provided with two (2) busbars. Entire busbar system shall be insulated with PVC sleeves. 6.01.00 All busbars and jumper connections shall be of high conductivity aluminum alloy / copper of adequate size. 6.02.00 The cross-section of the busbars shall be uniform throughout the length of switchboard section and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars. 6.03.00 All busbars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet moulded compound or equivalent type polyester fiber glass moulded insulator. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulator and barriers of inflammable material such as Hylam shall not be accepted. The busbar insulators shall be supported on the main structure. 6.04.00 All busbar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be applied just before making a joint. All bolts shall be tightened			
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	by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar. All copper to aluminum joints shall be provided with suitable bimetallic washers.			
6.05.00	All busbars shall be colour coded as per IS: 375.			
6.06.00	Wherever the busbars are painted with black Matt paint, the same should be suitable for temperature encountered in the switchboard under normal operating conditions.			
6.07.00	The Bidder shall furnish calculations establishing the adequacy of bus bar sizes for specified current ratings.			
7.00.00	AUXILIARY BUSBARS AND CONTROL TRANSFORMERS			
7.01.00	AC CONTROL SUPPLY BUSBAR			
	Each bus-section of all Switchgears and MCCs shall be provided with two (2) nos. 415V / 110V control transformers. The 110V AC control supply from the control transformers shall be run through the MCC by means of two sets of control supply busbars of electrolytic copper. In case of one transformer failure, whole bus section can be fed through single transformer. The control supply to different modules shall be tapped individually from the control supply busbars.			
7.02.00	DC CONTROL SUPPLY BUSBARS			
	Electrically controlled circuit breaker boards shall be provided with DC control supply busbars. The manually controlled breakers shall also be provided with such busbars in case relays are provided. Each section of the switchboard shall be provided with a DC supply by the Contractor. The Contractor shall provide suitable terminals, switch-fuse etc. to receive the DC supply and distribute the same through above mentioned control busbars to the required modules of the respective section. The DC control supply bus of one section shall be coupled to the control supply of other section through a switch located in the bus-coupler breaker panel. The DC supply to the bus-coupler breaker may be given from any of the control buses. For emergency switchgear, Contractor shall provide two DC supplies. The contractor shall provide suitable diodes to derive the control supply through diode auctioneering from the above two supplies.			
7.03.00	SPACE HEATER BUSBARS			
	Panel and motor space heaters shall be fed from separate AC auxiliary busbars running throughout the switchboard. The supply for these busbars shall be tapped from incomer, before the isolating switch/ circuit breaker. Incoming circuit to space-heater bus shall have an isolating switch, HRC fuse and neutral link of suitable rating. Suitable terminals shall also be provided to facilitate energisation of space-heater bus from outside during long shutdowns of unit / switch-board.			
7.04.00	CONTROL TRANSFORMERS			
	The control transformers shall be 415 V/110 V with neutral point-earthed, of insulation class 'B' or better. The sizing of Control transformers shall be carried out by Bidder considering the actual load of power contactors, auxiliary contactors, indicating lamps and other equipment in the module circuit. An additional load of 15			
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	watts should also be considered for each module, for remote auxiliary relays and lamps to be connected in the control circuit of modules. Bidder shall also ensure that control transformers are adequately designed for meeting the momentary loading requirements & the voltage drop during this condition shall not be more than 5%.				
8.00.00	EARTH BUS AND EARTHING				
8.01.00	A galvanized steel / Copper / Aluminium earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded / bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.				
8.02.00	The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth, as indicated in "Technical Parameters", without exceeding the allowable temperature rise.				
8.03.00	Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Contractor's earthing conductors. The horizontal earth bus shall project out of the switchboard ends and shall have predrilled holes for this connection. All joint splices to earth bus shall be made through atleast two bolts, and taps by proper lug and bolt connection.				
8.04.00	All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.				
8.05.00	The carriage and breaker frame shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel.				
8.06.00	Each module frame shall get engaged to the vertical earth bus before the disconnecting contacts on the module are engaged to the vertical busbars.				
8.07.00	All metallic cases of relays, instruments and other panel-mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections, which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipment to provide alternative paths to earth bus is acceptable.				
8.08.00	VT and CT secondary neutral point earthing shall be at one place only, i.e. on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.				
8.09.00	All hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/ braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/ hinge pins of proven design may also acceptable. The Contractor shall establish earth continuity at site also.				
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9.00.00 9.01.00 9.02.00 9.03.00 9.04.00 9.05.00 9.06.00 9.07.00 9.07.01	CIRCUIT BREAKERS Circuit breakers shall be three pole, air break, horizontal draw out type, and shall have fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameters of continuous current rating and fault making / breaking capacity only after provision of cooling fans or special device shall not be acceptable. Circuit breakers along with its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimise misalignment of the breaker. There shall be "SERVICE", "TEST" and "FULLY WITHDRAWN" positions for the breakers. In "Test" position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the "SERVICE", "TEST" or "FULLLY WITHDRAWN" position. It shall be possible to close the door in "Test" position. All circuit breakers shall be provided with "4 NO" and "4NC" potential free auxiliary contacts. These contacts shall be in addition to those required, for internal mechanism of the breaker and should be directly operated from breaker operating mechanism. In case the manufacturer does not have a proven arrangement for providing the required number of circuit breaker auxiliary contacts on the fixed portion of the cubicle, necessary electrically reset latched relays shall be provided complete with all wiring in series with service position limit switch contacts, for multiplying the circuit breaker mounted auxiliary contacts and provide 4 NO and 4 NC contacts. Separate limit switches, each having required numbers of contacts shall be provided in both "SERVICE" and "TEST" position of the breaker. All contacts shall be rated for making, continuously carrying and breaking 10 Amp at 240 V AC and 1 Amp (Inductive) at 240 V DC respectively. Suitable mechanical indications shall be provided on all circuit breakers to show "OPEN", "CLOSE", "SERVICE ", "TEST" AND "SPRING CHARGED" positions. Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half a cycle of rated frequency. All circuit breakers shall be provided with the following interlocks : Movement of a circuit breaker between "SERVICE" and "TEST" position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In case the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exists between the fixed and draw out contact at the time of breaker trip so that no arcing takes place even with the breaker carrying its full rated current.				
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9.07.02	Closing of a circuit breaker shall not be possible unless it is in "SERVICE" position, "TEST" position or in "FULLY WITHDRAWN" position.				
9.07.03	Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.				
9.07.04	A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.				
9.07.05	Circuit breakers shall be provided with coded key / electrical interlocking devices, as per requirements.				
9.08.00	Circuit breaker shall be provided with anti-pumping feature (soft) and trip free feature, even if mechanical anti-pumping feature is provided.				
9.09.00	Mechanical tripping shall be possible by means of front mounted Red "trip" push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.				
9.10.00	Complete shrouding / segregation shall be provided between incoming and outgoing bus links of breakers. In case of bus coupler breaker panels the busbar connection to and from the breaker terminals shall be segregated such that each connection can be approached and maintained independently with the other bus section live. Dummy panels if required to achieve the above feature shall be included in the Bidder's scope of supply.				
9.11.00	Circuit breaker shall be provided with Power operated mechanism as follows.				
	1.	Power operated mechanism shall be provided with a universal motor suitable for operation on 220 V DC / 110 DC Control supply, with voltage variation from 90% to 110% of rated voltage. Motor insulation shall be class "E" or better.			
	2.	The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring at minimum available control voltage.			
	3.	Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.			
	4.	The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.			
	5.	Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.			
	6.	All circuit breakers shall be provided with closing and trip coils. The closing coil shall operate correctly at all values of voltage from 85% to 110% of rated voltage. The trip coil shall operate satisfactorily at all values of voltage			
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9.12.00		from 70% to 110% of rated voltage			
	7.	Provision for mechanical closing of the breaker only in "Test" and "WITHDRAWN" positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible; accessibility being rendered only after deliberate removal of shrouds.			
	Note: The circuit breakers for DC applications shall have manually operated mechanism of spring charged, stored energy type. The closing operation of the circuit breaker shall charge the tripping spring. Necessary interlocks shall be provided to inhibit closing of the circuit breaker unless the closing spring is fully charged.				
	TELESCOPIC TROLLEY				
	Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit-breaker module in a cubicle. The trolley shall be such that the top most breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. The telescopic trolley shall be such that all type, size and rating of breaker can be withdrawn /inserted of particular switchgear. The quantity of telescopic trolleys to be supplied shall be adequate for the number of switchgears / switchgear rooms.				
	AIR BREAK SWITCHES				
	10.01.00	Air break switches shall be of heavy duty, single throw, group operated, load break, fault make type when associated with fuses. All switches for motor circuits shall be of utilisation category AC-23A with 1NO +1NC auxiliary contact, which shall be wired to the control circuit as shown in the schematic drawings. All switches for other outgoing feeders shall be of utilization category AC-22A. All switches for DC circuits shall be suitable for 220 V DC and shall be of DC-22 utilisation category.			
	10.02.00	Continuous current rating of the switches for various feeders shall be selected from the 'Module Selection tables' attached at the end of this subsection.			
	10.03.00	The combination of switch-fuse unit would be preferred. However, if separate switch and fuses are provided, switch shall be located before fuses.			
	10.04.00	The main switches shall be operable from outside the module door. The switch handle shall clearly indicate the position of switch. Switch operating handles shall be provided with padlocking facilities. However, incomer switches of switchboards shall be provided with padlocking facility in both 'ON' and 'OFF' positions.			
10.05.00	Interlocks shall be provided such that the cubicle door will not open when the switch is in closed position and the switch will close only when the door is closed.				
10.06.00	Switches and fuses for AC/DC control supply and heater supply wherever required, shall be mounted inside the cubicles. Toggle switch is not acceptable.				
10.07.00	Even if a single phase feeder is asked, Bidder shall provide TPN switch, fuse-bases and cable/ link connections between switch/fuse and vertical busbars for all the three				
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	phases, so that changing from single phase feeder to three phase feeder is possible without any modification other than inserting fuses at site.										
11.00.00	MCCB										
11.01.00	MCCB shall be fixed type/part of withdrawable feeder module as per specification, three pole, air break type having trip free mechanism with quick make and quick break type contacts. MCCB shall have current limiting feature. MCCB of identical ratings shall be physically and electrically interchangeable. MCCB shall be provided with 1 NO and 1NC auxiliary contacts.										
11.02.00	MCCB shall be provided with Microprocessor based inbuilt front adjustable releases (overload & short circuit) and shall have adjustable earth fault protection unit also. The protection settings shall have suitable range to achieve the required time & current settings. LED indications shall also be provided for faults, MCCB status(on/off etc).										
11.03.00	MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit rating. Extended cable terminal arrangement for higher size cable may also be offered. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door can not be opened unless the MCCB is in OFF position. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked. The MCCBs being offered shall have common/interchangeable accessories for all ratings like aux. switch ,shunt trip, alarm switch etc. The MCCBs shall have the current discrimination up to full short circuit capacity and shall be selected as per manufacturers discrimination table.										
12.00.00	CONTROL AND SELECTOR SWITCHES										
12.01.00	Control and selector switches shall be of heavy duty, rotary type with escutcheon plates clearly marked to show the positions. The control & selector switches should be as per IS 13947 Part V section 1. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.										
12.02.00	Ammeter and voltmeter selector switches shall have four stay put positions with adequate number of contacts for 3-phase 4-wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.										
12.03.00	Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.										
12.04.00	The contact ratings shall be at least the following : <table><tr><td>1.</td><td>Make and carry, continuously, 10 A at 240 V DC and 110 V AC</td></tr><tr><td>2.</td><td>Breaking current at 240 V DC, 1 A (inductive)</td></tr><tr><td>3.</td><td>Breaking current at 110 V AC and 0.3 lagging p.f., 5A</td></tr></table>					1.	Make and carry, continuously, 10 A at 240 V DC and 110 V AC	2.	Breaking current at 240 V DC, 1 A (inductive)	3.	Breaking current at 110 V AC and 0.3 lagging p.f., 5A
1.	Make and carry, continuously, 10 A at 240 V DC and 110 V AC										
2.	Breaking current at 240 V DC, 1 A (inductive)										
3.	Breaking current at 110 V AC and 0.3 lagging p.f., 5A										
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 18 of 57						

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
13.00.00 13.01.00 13.02.00 13.03.00 13.04.00 13.05.00 13.06.00	CONTACTORS Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS: 13947 Part-4 Section- 1. Contactors shall be double-break, non-gravity type and their main contacts shall be silver faced. Direct-on-line contactors shall be of utilization category AC3. Reversing starters shall comprise of Forward and Reverse contactors mechanically and electrically interlocked with each other. These contactors shall be of utilization category AC4. DC contactors shall be of DC3 utilization category. For CHP conveyor motors, minimum rating of power contactors shall be 240% of full load current of the motors. For other drives, minimum rating of power contactors shall be 160% of full load current of motor. The number of normally open (NO) and normally closed (NC) auxiliary contacts of a contactor shall be as per requirement shown in the respective module drawings. It shall, however, be not less than 2NO+2NC. Operating coil of contactors shall be of 110 V AC unless otherwise specified elsewhere. The contactor shall operate satisfactorily between 85% and 110% of the rated voltage. The contactor shall not drop out at 70% of the rated voltage but shall definitely drop out at 20% of the rated voltage. Contactors for DC drives shall have a coil voltage of 240 V DC. DC operated contactor coil shall have an economy resistor and shall be suitable for satisfactory continuous operation at 85% to 110% of rated voltage.			
14.00.00 14.01.00 14.02.00 14.03.00 14.04.00 14.05.00	FUSES All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be rated for 80kA rms (prospective) breaking capacity at 415V AC and for DC circuits, 20kA rms breaking capacity at 220V DC. Fuse shall have visible operation indicators. Insulating barriers shall be provided between individual power fuses. Fuse shall be mounted on insulated fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchboard. Fuse ratings for various feeders shall be selected by the Bidder from the 'Module Selection Tables' attached at the end of this subsection. However, the fuse ratings for motor feeders given in the 'Motor Module Selection Table' are indicative only, and the same shall be coordinated by the Bidder to achieve class-II protection coordination and also to match the motor characteristics. Switch rating shall in no case be less than the fuse rating. The Neutral links shall be mounted on fuse carriers which shall be mounted on fuse bases.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
15.00.00	INSTRUMENT TRANSFORMERS			
15.01.00	All current and voltage transformers shall be completely encapsulated, cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the specified ambient temperature. The class of insulation shall be 'E' or better.			
15.02.00	All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum RMS short circuit breaking and peak making current ratings of the associated switchgear.			
15.03.00	All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block where star point formation and earthing shall be done.			
15.04.00	Current transformers may be multi or single-core type. All voltage transformers shall be single phase type.			
15.05.00	The bus VTs shall be housed in a separate compartment. All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.			
15.06.00	All CTs shall be provided with supports independent of busbar / busbar supports.			
15.07.00	The CTs shall be located in such a way that they can be easily approached for maintenance without necessitating shut down of adjacent feeders.			
16.00.00	NUMERICAL RELAYS			
16.01.00	All relays in protective circuits shall be flush mounted on panel front with connections from the inside. The protective relays shall be communicable numerical relays. These numerical relays shall be of types as proven for the application and shall be subject to Employer's approval. Numerical relays shall have appropriate setting ranges, accuracy, resetting ratio and other characteristics to provide required sensitivity. All equipments shall have necessary protections as detailed in the standard scheme drawings.			
16.02.00	The circuit breaker will normally be controlled from remote control panels (PLC) through closing and shunt trip coils. The Local control console of the relay flush mounted on the switchgear would normally be used only for testing of circuit breaker in isolated position, and for tripping it in an emergency. Provision for closing & tripping of the circuit breaker locally from laptop through serial port shall be possible to facilitate commissioning activities. The basic control scheme of breaker feeders shall be developed as per the schematic logics in the relay. The schematics shall be developed in soft inside the relay. Numerical relays shall be interfaced with PLC appropriately for closing / opening operations.			
16.03.00	The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings. The alarm / status of each of protection function and trip operation shall be communicated to PLC. The numerical relays shall have built in feature / hardware interface to provide such inputs to PLC for analog / digital values. All the numerical relays shall have communications on two ports; local front port communication to laptop and a rear port on IEC 61850 to communicate with the data concentrator through LAN.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC			
16.04.00	All relays and timers shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used.				
16.05.00	The protective relays shall have at least 10 Nos. programmable potential free contacts. Programmable Auxiliary relays shall have contacts as required.				
16.06.00	Failure of a control or auxiliary supply and deenergisation of a relay shall not initiate any circuit breaker /contactor operation. All relay digital output contacts shall withstand a minimum test voltage of 2kV AC rms for one minute.				
16.07.00	All the numerical relays shall have adequate processor memory for implementing the programmable scheme logic required for the realization of the protection / control schemes, in addition to the built in protection algorithms.				
16.08.00	Relays shall be suitable for electrical measurement including voltage, current, power (active/reactive) and energy parameters.				
16.09.00	Relays shall have separate output for individual functionality and the master trip shall be software configurable in case of multi output relays. Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping				
16.10.00	Preferably comprehensive single numerical relay shall have provision of both current and voltage inputs. The current operated relay shall have provision for 4 sets of CT inputs, 3 nos. for phase fault & 1 CT input for earth fault. Relay shall be suitable for both residually connected CT input as well as CBCT input. The voltage-operated relay shall have provision for 3 PT inputs. Relays shall be suitable for CT secondary current of 1A / 5A selectable at site. Relays used in incomers and bus couplers shall have provision of two sets of voltage signal inputs for the purpose of synchronization.				
16.11.00	All CT & PT terminals shall be provided as fixed type terminals on the relay to avoid any hazard due to loose connection leading to CT opening or any other loose connection. In no circumstances Plug In type connectors shall be used for CT / PT connections. Vendor to ensure the same for all protective relay models offered.				
16.12.00	All numerical relay shall have key pad / keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote.				
16.13.00	Relays shall have suitable output contact for breaker failure protection.				
16.14.00	Relays shall have self diagnostic feature with self check for power failure, programmable routines, memory and main CPU failures.				
16.15.00	Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC / ANSI programmable characteristics. Relays shall have self reset auxiliary contacts of programmable type.				
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16.16.00	Design of the relay must be immune to any kind of electromagnetic interference. Vendor to submit all related type test reports for the offered model along with the offer.				
16.17.00	Relay shall be immune to capacitance effect due to long length of connected control cables. Any external hardware, if required for avoiding mal operation of the relay due to cable capacitance shall be included as a standard feature.				
16.18.00	All I/Os shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.				
16.19.00	Numerical relays shall have two level password protections, one for read only and other for authorization for modifying the setting etc.				
16.20.00	Time clock synchronization feature shall be provided for synchronization of clocks of numerical relay and metering LAN with data concentrator time clock. Required hardware and software interface to receive GPS/Time signal to achieve time synchronization shall be supplied by the vendor. The resolution of time synchronization shall be +/- 1.0 millisecond or better throughout the entire system.				
16.21.00	Relays shall be suitable to accept both AC & DC supplies of 220V/110 V with tolerance of 70 % to 120 % of rated voltage & shall be finalized during detailed engineering.				
17.00.00	OTHER PROTECTIONS AND CONTROL FUNCTIONS IN THE RELAYS				
17.01.00	For control from PLC control commands shall be hardwired to the numerical relays. Preferably, no separate coupling relays shall be provided.				
17.02.00	Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker trip circuit both in pre trip and post trip conditions.				
17.03.00	Schematics requiring auxiliary relays /timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer function for protection function shall be as required. Auxiliary relays for interlocking purpose shall be of self reset type.				
17.04.00	Bus no volt condition shall be configured to a output contact of the relay of all incomers for suitably interfacing with PLC. All important signals like breaker status, protection trip (86), etc shall be configured and hardwired for feedback / display in PLC.				
17.05.00	Timer functions shall be programmable for on/off delays.				
17.06.00	The numerical relay shall be able to provide supervisory functions such as trip circuit monitoring, circuit breaker state monitoring, PT and CT supervisions and recording facilities with Post fault analysis.				
17.07.00	The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery back up for real time clock in the event of power supply failure shall be provided.				
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17.08.00	100 time tagged events /records should be able to store with time stamping Last 5 faults storage including the indication, protection operated , fault location relay and operating time, currents, voltage and time.			
17.09.00	Diagnostics Automatic testing, power on diagnostics with continuous monitoring to ensure high degree of reliability shall be shall be provided. The results of the self reset functions shall be stored in battery back memory. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be shall be available on the user interface.			
17.10.00	The alarm/status of each individual protection function and trip operation shall be communicated to PLC.			
17.11.00	Sequence of events shall have 1 ms resolution at device level.			
17.12.00	Measurement accuracy shall be 1 % for RMS Current and voltage (20-120% of rated value).			
17.13.00	It shall be possible to carryout open / close operation of breakers from a laptop by interfacing from the relay front port during initial commissioning.			
17.14.00	Incomers and motor modules shall have 4-20 mA analog output (current signal) for display in PLC. This may be provided as analog output from the numerical relay or using a suitable CT & current transducer. 4-20 mA analog signal shall be provided for display of each bus voltage in PLC.			
17.15.00	At least two licensed copies of necessary software for numerical relay configuration / setting / disturbance analysis and other utilities shall be supplied. Numerical relay configuration for all relays being supplied under the package shall be carried out in line with the approved schematics and shall be submitted for owner’s approval. Setting calculations and relay settings configured in relay software for all relays shall be submitted for owner’s approval. Approved relay configuration / settings shall be loaded in all the relays prior to dispatch to site.			
18.00.00	INDICATING INSTRUMENTS			
18.01.00	All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96mm square size with 90 degree linear scale and shall have an accuracy class of 1.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.			
18.02.00	All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.			
18.03.00	All instruments shall have white dials with black numerals & lettering. Black knife edge pointer shall be provided for meters.			
18.04.00	Ammeters provided for motor feeders (for motors of rating ≥ 30kW & < 110kW) shall have a compressed scale at the upper current region to cover the starting current upto 6.0 times the CT primary current.			
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18.05.00	All motor feeders of rating ≥ 30 kW and < 110 kW and all motors of Dust Suppression System shall be provided with Multifunction Digital Energy Meter with communication facility to display the current, voltage, power factor, power energy related data locally as well as communicate these for remote metering/audit/analysis purposes. These meters shall The technical specification for Digital indicating energy meter shall be as follows: a) Input Voltage:110VAC / 220V/110 V DC b) Input Current:1A c) Size:96X96 SQ.MM d) Power & Energy Accuracy: 1.0 e) Mounting: Flush mounting f) Type: True RMS 3-PHASE V,I, kW,PF & kWH indication g) 4 Digit, seven segment LED display/LCD display, with floating decimal h) Communication: In built RS 485 bus port i) Operating Frequency: 45 HZ-65HZ j) Dielectric Test: 2KV RMS for 1 minute k) Over Current: 10 times for 3 sec. l) Aux supply: 90V-300V AC/DC m) Compliance: EMC/EMI n) Field programmable CT ratio o) Analog Current and Energy Output (4-20 mA)			
19.00.00	PUSH BUTTONS			
19.01.00	Push-buttons shall be of spring return, push-to-actuate type. Their contacts shall be rated to make, continuously carry and break 10 A at 110 V AC and 1 A (inductive) at 240 V DC.			
19.02.00	All push buttons shall have two (2) normally open and two (2) normally closed contact, unless specified otherwise. The contact faces shall be of silver alloy.			
19.03.00	All push-buttons shall be provided with integral escutcheon plates marked with its function.			
19.04.00	The color of the button shall as follows :			
Green for motor START, breaker CLOSE, valve/ damper OPEN commands				
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19.05.00 19.06.00	Red for motor trip, breaker open, valve / damper close commands. Black for all annunciation functions, overload reset and miscellaneous commands including reverse for clinker grinder etc. All push buttons on panels shall be located in such a way that Red push button shall always be to the left of Green push button. In case of clinker grinder etc. the push buttons would be black - red-green from left to right. All emergency push buttons shall have mushroom knobs.
20.00.00	INDICATING LAMPS
20.01.00	Indicating lamps shall be of CLUSTER LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.
20.02.00	Lamps shall have translucent lamp-covers of the following colours, as warranted by the application : Red for motor ON, valve / damper OPEN, breaker CLOSE. Green for motor OFF , valve / damper CLOSE, breaker OPEN. White for motor AUTO TRIP. Blue for all healthy conditions (e.g. control supply, and also for SPRING CHARGED"). Amber for all Alarm Conditions (e.g. overload). Also for "SERVICE" and "TEST" position indications.
20.03.00	Bulbs and lamp covers shall be easily replaceable from the front of the cubicle. The method of mounting indicating lamp fittings on panels shall prevent their rotation under the action of lamp removal or replacements, reliance upon the tightness of ring nut for the purpose is not sufficient.
20.04.00	Indicating lamps should be located just above the associated push-button / control switches. Red lamps shall invariably be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along the centre line of control switch / push button pair. Blue and Amber should normally be located above the Red and Green lamps.
20.05.00	When associated with push-buttons, red lamps shall be directly above the green push-button and green lamp shall be directly above the red push button.
20.06.00	All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.
21.00.00	SPACE HEATER
21.01.00	Space heaters shall be provided in the switchboards wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.
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21.02.00	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary switches and fuses shall be provided.				
21.03.00	The circuit for each panel and motor space heater should have an isolating switch, HRC fuse and isolating link. In addition, the space heater circuit of each panel shall also have a thermostat of suitable rating.				
22.00.00	INTERNAL WIRING				
22.01.00	All switchboards shall be supplied completely wired internally upto the terminals, ready to receive external cables.				
22.02.00	All intercubicle and interpanel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the Bidder.				
22.03.00	All auxiliary wiring shall be carried out with 650V grade, single core stranded copper conductor, colour coded, PVC insulated wires. Conductor size shall be 1.5 mm ² (min.) for control circuit wiring and 2.5 mm ² (min) for CT and space heater circuits.				
22.04.00	Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.				
22.05.00	All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.				
22.06.00	All internal wiring terminations shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor or an equally secure method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible. Screw-less (spring loaded) / cage clamp type terminal shall also be provided with lugs.				
22.07.00	Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring.				
22.08.00	Wiring for equipment, which are to be supplied by the Contractor and for which the Contractor has to provide mounting arrangement in his panels, shall also be provided by the Contractor, upto the terminal blocks.				
22.09.00	All connections from vertical busbars for individual modules above 100 A shall be by Copper / Aluminum links only. The cable connections for modules less than 100 A shall be selected in such a way that there will not be any melting / shorting in case of a short circuit inside the module and the cable shall have current rating to carry the let through energy of the corresponding fuses in case of a fault. The insulation of the cable and its cross section shall be decided considering the high ambient temperature within the module. For all modules where use of cable is envisaged by the Contractor specific approval from the Contractor regarding cable details are to be taken. For power wiring colour coded wire insulation / tapes shall be provided.				
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23.00.00	CONTROL TERMINAL BLOCKS				
23.01.00	Terminal blocks shall be 650V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be either 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.				
23.02.00	Terminal blocks for CT and VT secondary leads shall be of stud type, made up of unbreakable polyamide 6.6 grade. They shall be provided with links to facilitate testing, isolation star / delta formation and earthing. Terminal blocks for CT secondary shall have the short circuiting facility. The terminals for remote ammeter connection etc. shall also be disconnecting type only. All metal parts shall be of non-ferrous material. Screws shall be captive.				
23.03.00	In all circuit breaker panels MCC modules at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks.				
23.04.00	All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded copper conductors of size upto 2.5 sq. mm each, or alternatively, the terminal blocks shall have the possibility of double shorting space to facilitate looping. However for PLC terminals shall be suitable for 1.5 mm2 cable.				
23.05.00	All terminals shall be numbered for identification and grouped according to the function. Engraved white-in-black labels shall be provided on the terminal blocks.				
25.06.00	Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.				
25.07.00	Terminal blocks shall be arranged with atleast 100mm clearance between two sets of terminal blocks. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250 mm.				
24.00.00	POWER CABLE TERMINATION				
24.01.00	Cable termination compartment and arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded aluminum conductor, PVC/ XLPE insulated, armoured / unarmoured and PVC sheathed cables. The size and type of cable for individual modules shall, preferably, be as indicated in the 'Module Selection Tables'. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc. for cables shall be provided by the contractor to suit the final cable sizes.				
24.02.00	All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.				
25.00.00	LOCAL PUSH BUTTON STATIONS				
25.01.00	The local push button stations shall be metal enclosed, suitable for outdoor / indoor mounting on wall or steel structures. The enclosure shall be die-cast aluminum or				
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	cold-rolled sheet steel of at least 1.6 mm thickness. The enclosure shall be provided with a hinged guard at the front, covering full length, to avoid inadvertent operation of push buttons. LPBS shall be powder coated with shade no. RAL: 9002. The minimum thickness of powder coating shall be 50 microns. Support structure for mounting the LPBS shall also be supplied by Contractor.												
25.02.00	The local push button stations shall be dust and vermin proof and shall have a degree of protection of IP -55 as per IS : 13947. The DOP shall be IP-65 in case the same are located in dusty areas.												
25.03.00	The push button stations shall be suitable for bottom cable entry and shall be provided with removable undrilled gland plates or knockouts. Adequate space shall be available inside the push button station enclosure for terminating external cables directly on pushbutton terminals. Overall size of push button stations shall be subject to Employer's approval.												
25.04.00	The push button station shall comprise of a latched type EMERGENCY STOP push button with two (2) NO and two (2) NC contacts.												
26.00.00	LOCAL MOTOR STARTERS												
26.01.00	Local motor starters shall be suitable for manual switching of 415 V, 3-phase, squirrel cage motors rated upto 5.5 KW. They shall have constructional features similar to those specified for local push button stations.												
26.02.00	Each starter shall comprise of : <table><tr><td>1.</td><td>A 3-pole contactor, mechanically latched type.</td></tr><tr><td>2.</td><td>Start push button, colored green.</td></tr><tr><td>3.</td><td>Stop push button, colored red.</td></tr><tr><td>4.</td><td>Ambient temperature compensated, thermal over load relay with single phasing protection. The continuously variable relay setting range shall be suitable for the motor rating which shall be advised to the Contractor in due course. The relay shall trip the contactor.</td></tr></table>					1.	A 3-pole contactor, mechanically latched type.	2.	Start push button, colored green.	3.	Stop push button, colored red.	4.	Ambient temperature compensated, thermal over load relay with single phasing protection. The continuously variable relay setting range shall be suitable for the motor rating which shall be advised to the Contractor in due course. The relay shall trip the contactor.
1.	A 3-pole contactor, mechanically latched type.												
2.	Start push button, colored green.												
3.	Stop push button, colored red.												
4.	Ambient temperature compensated, thermal over load relay with single phasing protection. The continuously variable relay setting range shall be suitable for the motor rating which shall be advised to the Contractor in due course. The relay shall trip the contactor.												
26.03.00	The start push button, when pressed, shall preferably remain in depressed position and shall be released along with the contactor when the stop push button is pressed or when thermal overload relay operates.												
26.04.00	Local starters shall be suitable for loop-in and loop-out of incoming cable and for one outgoing cable to motor. Final cable sizes and number of lugs required will be intimated to the contractor. Support structure for mounting in local motor starters shall be supplied by the Contractor.												
27.00.00	NAME PLATES AND LABELS												
27.01.00	All Switchgears, MCCs, Distribution Boards, Fuse boards, all feeders, local push-button stations and local motor starters shall be provided with prominent, engraved												
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	identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear switchgear also.				
27.02.00	All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black background. Inscription & lettering sizes shall be subject to Employer's approval.				
27.03.00	Suitable stenciled paint mark shall be provided inside the panel/module for identification of all equipment in addition to the plastic sticker labels, if provided. These labels shall be positioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring drawings.				
27.04.00	Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.				
28.00.00	METAL ENCLOSED NON SEGREGATED PHASE BUSDUCT				
28.01.00	Three phase and neutral metal enclosed non segregated phase bus duct assemblies shall be supplied for incoming connections from the transformers to the switch boards and inter connecting sections between switch boards, wherever called for.				
28.02.00	The enclosure shall be made of minimum 3 mm thick aluminum alloy. The section of the bus duct shall be rectangular. The design of the bus duct enclosures shall be of sturdy construction such that it will withstand the internal or external forces resulting from the various operating conditions.				
28.03.00	The entire bus duct shall be designed for dust, vermin and weather proof construction. A suitable aluminum sheet flange-protection hood shall be provided to cover all outdoor bus duct enclosure joints to facilitate additional protection against rain water ingress. All horizontal runs of busducts shall have a suitable sloped enclosure top to prevent retention of water for both indoor and out door portion of bus ducts. Bus duct enclosure shall have a degree of protection of IP-55.				
28.04.00	The inside of the bus enclosure may be treated with black paint to enable efficient heat dissipation. The matt paint used shall be suitable for temperature experienced during continuous loading of the bus conductor. The busduct exterior paint shade shall be RAL 5012. The thickness of finish coat shall be minimum 50 microns (with minimum total DFT of 100 microns).				
28.05.00	Flexible expansion joints for the enclosure shall be provided wherever deemed necessary by the Bidder. Necessary bonding shall be provided at the expansion joints if made of insulating materials.				
28.06.00	Enclosures shall be provided with flanged ends with drilling dimensions to suit the flanges at the switchgear and transformer terminals. Any adapter boxes required for this purpose are in the Bidder's scope of supply. The prices of such adopter boxes shall be included in the prices of respective switchboards. The flanges shall be provided with gaskets, nuts, bolts, etc. Details of the flanges provided on transformer ends will be furnished to the successful Bidder.				
28.07.00	Suitable Inspection covers shall be provided for periodic inspection of insulators. Handle shall be provided on each inspection cover to facilitate easy lifting				
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28.08.00	The EPDM / Neoprene gaskets shall be provided so as to satisfy the operating conditions imposed by temperature, weathering, durability etc. Flange gaskets shall be provided at the equipment terminal connections.				
28.09.00	Necessary earthing arrangement as applicable shall be provided with clamps to receive 's station earthing bus. All accessories and hardware required for the earthing arrangement shall be provided by the Bidder. This shall be a GI strip of adequate size, continuously running along the bus duct and shall be earthed at both ends. Bus duct enclosures shall be bolted type.				
28.10.00	The material of the conductor shall be aluminum. The minimum clearance in air between phase to phase, phase to neutral and phase to earth for the entire run of busduct shall be 25 mm The bus bars shall be rated in accordance with the service conditions and the rated continuous and short time current ratings specified elsewhere in specification.				
28.11.00	All steel structures required for bus duct support shall be hot dip galvanised.				
28.12.00	Space heaters shall be provided in the busduct wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.				
28.13.00	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz single phase supply and shall be automatically controlled by thermostats. Necessary wiring upto junction boxes mounted on bus duct and from junction boxes to switch boards shall be provided by the Bidder.				
29.00.00	LIGHTING / WELDING TRANSFORMERS Each AC Lighting Distribution Board (LDB) shall consist of:- (i) Two (2) Nos. x 100% rated Lighting transformers (415V/415V, delta/star, epoxy insulated. The transformer shall be of 50KVA/100KVA rating for 10/15 nos. outgoing feeder. (ii) TPN SFU on primary and secondary side of the transformer. (iii) 63A TPN SFU as outgoing feeders including 20% spares. (iv) Voltmeter, ammeter with selector switches, indicating lamps. (v) The two incomers (One from Bus-A and One from Bus-B of the MCC) and one bus-coupler for the power supply to each MLDB shall be provided with castle key networks The lighting transformer may, preferably, be located inside the LDB panel itself. Otherwise, the same shall be located by the side of respective LDB. Lighting transformers shall be dry type, natural air cooled with class B insulation or better. Impedance of lighting transformer shall be so selected that the fault level of lighting system shall be reduced to 3 to 5 KA. Lighting transformers shall be tested as per IS: 2026. Off-circuit tap changer with ± 2.5% and ± 5% tapping shall be provided. In case the transformers are not mounted inside the LDB panels, the same shall be housed in a separate 2 mm thick CR sheet steel enclosure with IP-42 degree of protection as per IS : 13947. However, the transformer terminal box shall have IP-52 degree of protection.				
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30.00.00	PAINTING All sheet steel work shall be pretreated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.			
31.00.00	GASKETS The gaskets, wherever specified, shall be of good quality EPDM / Neoprene with good ageing, compression and oil resistance characteristics suitable for panel applications.			
32.00.00	TEMPERATURE –RISE The temperature rise of the horizontal and vertical busbars and main bus links including all power drawout contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg C with silver plated joints and 40 deg C with all other types of joints over an outside ambient temperature of 50 deg C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20deg. C. The temperature rise of manual operating means shall not exceed 10deg. C for metallic & 15 deg. C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current. The above temperature rise limits are applicable for busducts also without any current derating.			
33.00.00	DERATING OF EQUIPMENTS The Bidder shall ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per Indian Standards / Specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified. The Bidder shall indicate clearly the derating factors if any employed for each component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and ambient temperature of 50 deg C.			
34.00.00	PROTECTION CO-ORDINATION It shall be the responsibility of the Contractor to fully coordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers / fuses / motor starters, to provide satisfactory discrimination. Further the various equipment supplied shall meet the requirements of Type II class of Co-ordination as per IS: 8544.			
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35.00.00	TESTS AND TEST REPORTS			
	GENERAL			
	(a.) All equipments to be supplied shall be of type tested design. The Contractor shall submit for Owner’s approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to 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.) In case the Contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to 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 either at third party lab or in presence of client/owners’s representative and submit the reports for approval.			
	(c.) All 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 following type test certificates on each type & rating of L.T. Switchgear and MCC panel shall be submitted.			
	1)	Switchgear / MCC panels of each rating		
		a)	Short time withstand test.	
		b)	Temperature rise test.	
		c)	Degree of protection test	
	2)	Circuit breaker of each rating		
		a)	Test sequence 1	
			-	Dielectric properties.
			-	Mechanical operation and operational performance capability
			-	Verification of dielectric withstand.
			-	Verification of temperature-rise
		b)	Combined test sequence (With Circuit breakers mounted inside the Switchgear panel)	
			-	Rated short-time withstand current
			-	Rated service short-circuit breaking capacity
			-	Verification of dielectric withstand
			-	Verification of temperature-rise
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	3)	MCC modules of any three ratings, as selected by the Employer, for class - II protection Co-ordination.																																	
	4)	Test for single phasing protection feature on 3 nos. bimetallic thermal overload relay selected by Employer. The relay shall be tested for compliance with manufacturer's printed / declared characteristic curve.																																	
35.01.00	For the following equipment the contractor shall submit the reports of all the type tests as per applicable standards and carried out not earlier than ten years prior to 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. In case the Contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to 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/owner's representative and submit the reports for approval. (a.) NUMERICAL RELAYS (b.) LIGHTING / WELDING TRANSFORMER (c.) MCCB																																		
35.02.00	Type test reports for the following tests on the model of the Numerical relays, Ethernet switches shall be submitted for employer's review. <table><thead><tr><th>Test</th><th>Specification</th></tr></thead><tbody><tr><td colspan="2">1 Functional requirements</td></tr><tr><td>1 Features and logics</td><td>IEC61850</td></tr><tr><td>2 Checking of compatibility with co-operating devices</td><td>IEC61850</td></tr><tr><td>3 Communication</td><td>IEC61850</td></tr><tr><td colspan="2">2 Mechanical construction requirements</td></tr><tr><td>1 General inspection</td><td>Manufacturer's document</td></tr><tr><td>2 Inspection of marking and data</td><td>IEC 60255-6</td></tr><tr><td>3 Clearances and creepage distances</td><td>IEC 60255-5</td></tr><tr><td>4 Degree of protection by enclosure</td><td>IEC 60529</td></tr><tr><td colspan="2">3 Insulation requirements</td></tr><tr><td>1 Dielectric test</td><td>IEC 60255-5</td></tr><tr><td>2 Impulse voltage test</td><td>IEC 60255-5</td></tr><tr><td>3 Insulation resistance measurements</td><td>IEC 60255-5</td></tr><tr><td colspan="2">4 Accuracy requirements</td></tr></tbody></table>					Test	Specification	1 Functional requirements		1 Features and logics	IEC61850	2 Checking of compatibility with co-operating devices	IEC61850	3 Communication	IEC61850	2 Mechanical construction requirements		1 General inspection	Manufacturer's document	2 Inspection of marking and data	IEC 60255-6	3 Clearances and creepage distances	IEC 60255-5	4 Degree of protection by enclosure	IEC 60529	3 Insulation requirements		1 Dielectric test	IEC 60255-5	2 Impulse voltage test	IEC 60255-5	3 Insulation resistance measurements	IEC 60255-5	4 Accuracy requirements	
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	1 Measurement accuracy of characteristic quantity and specified time IEC 60255-6 2 Limits of frequency range and frequency dependence IEC 60255-6 3 Limits of ambient temperature and ambient temperature dependence IEC 60255-6 4 Limits of operative range of auxiliary energizing inputs and auxiliary voltage dependence IEC 60255-6 5 Rated burden requirements 1 Measuring circuits IEC 60255-6 2 Auxiliary circuits IEC 60255-6 3 Signalling inputs IEC 60255-6 6 Thermal requirements 1 Temperature rise IEC 60255-6 2 Limiting continuous thermal withstand values IEC 60255-6 3 Limiting short-time thermal withstand values IEC 60255-6 7 Limiting dynamic value requirements IEC 60255-6 8 Power supply requirements 1 Limiting duration of interruptions to dc auxiliary voltage IEC 60255-11 2 Limiting value of ripple in dc auxiliary voltage IEC 60255-11 3 Limiting value of voltage dips to ac auxiliary voltage IEC 61000-4-11 4 Limiting duration of interruptions to ac auxiliary voltage IEC 61000-4-11 5 Limiting variations of ac auxiliary voltage IEC 61000-4-11 9 Electromagnetic compatibility requirements 1 High frequency disturbance test IEC 60255-22-1 2 Electrostatic discharge test IEC 60255-22-2, 61000-4-2 3 Radiated, radio-frequency, electromagnetic field immunity test IEC 60255-22-3, 61000-4-3			
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37.05.00	4 Fast transient disturbance test IEC 60255-22-4, 61000-4-4 5 Surge immunity test IEC 60255-22-5, 61000-4-5 6 Immunity to conducted disturbances, induced by radio-frequency fields IEC 60255-22-6, 61000-4-6 7 Power frequency immunity test IEC 60255-22-7 8 Conducted and Radiated radio-frequency emission tests IEC 60255-25, EN55011-CISPR 11 9 Power frequency magnetic field immunity test IEC 61000-4-8 10 Environmental requirements 1 Dry cold test IEC 60068-2-1 2 Dry heat test IEC 60068-2-2 3 Storage temperature test IEC 60068-2-8 4 Damp heat test, cyclic (12 + 12 hour cycle) IEC 60068-2-30 11 Contact performance requirements 1 Make and carry for dc IEC 60255-23 2 Breaking capacity for dc IEC 60255-23 3 Make and break ac IEC 60255-23 12 Mechanical performance requirements 1 Durability of relay operation IEC 60255-6 2 Durability of plug-in relays IEC 60255-6 3 Durability of relay setting controls IEC 60255-6 4 Vibration response and endurance test IEC 60255-21-1 5 Shock response and withstand test IEC 60255-21-2 6 Bump test IEC 60255-21-2 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. All routine tests as per the specification and relevant standard IS 8623 shall be carried out. Charges for these shall be deemed to be included in the equipment price			
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37.06.00	An indicative lists of tests / checks is mentioned as QA chapter . However, the manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.			
	All procedures for type tests shall be approved by Employer before commencement of type tests. However, the following points may be specifically noted.			
	1)	For temperature rise tests, the connection arrangement between the source and the test equipment shall be such that the temperature gradient in the connection piece of cable at a distance of one meter away from the test equipment shall be restricted to 5 deg C.		
	2)	Milli Volt drop test shall be done on switching devices before and after the type tests.		
37.07.00	3)	Bolt tightness of busbar joints shall be checked with torque wrench before and after short time rating tests on the circuit breaker and MCC panels.		
	Routine checking to observe compliance to degree of protection, first numeral, on switchboard enclosures and busbar chambers shall be as under:			
	1) IP -4 X	It shall not be possible to insert a one mm dia. Steel wire into the enclosure from any direction, without using force.		
38.00.00	2) IP-5X	It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.		
	ERECTION / INSTALLATION OF SWITCHBOARDS AND OTHER EQUIPMENTS			
38.01.00	Each equipment shall be installed in a neat, workman-like manner so that it is leveled, plumbed, squared and properly aligned and oriented. Tolerances shall be as established in Contractor's drawings or as stipulated by Employer. No equipment shall be permanently fixed down to foundations until the alignment has been checked and found acceptable by the Employer.			
38.02.00	Contractor shall furnish all supervision, labour, tools, equipment, rigging materials, bolts, wedges, anchors, etc., in proper time, required to completely install, test and commission the equipment.			
38.03.00	Manufacturer's and Employer's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.			
38.04.00	Contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilised to lift or erect any equipment without prior permission of Engineer.			
38.05.00	All switchboards shall be installed in accordance with Indian Standard, IS: 3072, and Employer's instructions.			
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38.06.00	Switchboard panels shall be installed on concrete floor or supported on steel channel / edge angle in concrete trenches. The Contractor shall provide steel insert plates in the concrete floor and / or steel channels / edge angle on the trenches as applicable. The base frame of switchboards shall be welded to the insert plates by the Contractor. The Contractor shall be required to install and align the panels using suitable metallic shims before welding the base frame. In joining shipping sections of switchboards together, adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been completed.				
38.07.00	Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied separately they shall be mounted only after the associated panels have been erected and aligned. the blocking materials employed for safe transit of instruments and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Any damage shall be immediately reported to Engineer.				
38.08.00	Equipment furnished with finished coats of paint shall be touched up by Contractor if their surface is spoiled or marred during erection / commissioning.				
38.09.00	The room and floor finishing work would be done after erection of the panels and the Contractor shall suitably cover up the panels to protect them from injury and marring of finish.				
38.10.00	In case of relocation of existing switchgear, complete dismantling, shifting to new location, installation along with necessary civil foundation, inter-panel wiring, testing, commissioning and putting into service of all such switchgears shall be carried out by the contractor in co ordination with the site in charge.				
39.00.00	COMMISSIONING CHECKS / TESTS				
39.01.00	After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards / panels and correctness of all equipment in each and every respect.				
39.02.00	The Contractor shall carry out the following commissioning checks, in addition to other checks and tests recommended by the manufacturers.				
39.03.00	GENERAL				
	(a.) Check name plate details according to the approved drawings.				
	(b.) Check for physical damage.				
	(c.) Check tightness of all bolted connections, by torque wrench.				
	(d.) Check earth connections.				
	(e.) Check cleanliness.				
	(f.) Check all moving parts for proper lubrication.				
39.04.00	Circuit Breakers				
	(a.) Check alignment of breaker truck for free movement.				
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39.05.00	(b.) Check correct operation of shutters. (c.) Check control wiring for correctness of connections, continuity And IR values. (d.) Manual operation of breakers completely assembled. (e.) Closing /opening operation, manually and electrically. (f.) Trip free and anti-pumping operation. (g.) I.R. values of contacts. (h.) Contact resistance. (i.) Check on spring charging motor, correct operation of limit switches and time or charging. (j.) All functional checks (k.) Breaker closing and tripping time, if required.				
	Current Transformers				
	(a.) Visual inspection.				
	(b.) IR Value				
	(c.) Ratio check.				
	(d.) Magnetising current.				
	(e.) Wiring connection.				
	(f.) Spare CT cores, if any, to be shorted and earthed				
39.06.00	Voltage Transformers				
	(a.) Visual inspection.				
	(b.) IR Value				
	(c.) Ratio check				
	(d.) Mangnetising current				
39.07.00	(e.) Line connection as per connection diagram				
	Cubicle Wiring				
	(a.) Check all switch developments				
	(b.) Each wire shall be traced by continuity tests and it shall be ensured that the wiring is as per relevant drawing. All inter-connections between panels / equipment shall be similarly checked.				
	(c.) All the wires shall be meggered to earth.				
39.08.00	(d.) Functional checking of all control circuit e.g., closing, tripping, control, interlock, supervision and alarm circuit.				
	Relays 1. Check connections and wiring.				
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39.09.00	2. Megger				
	a) Megger all terminals to body.				
	b) Megger AC to DC terminals.				
	3. Check operating characteristics by secondary injection.				
	4. Check minimum pick up voltage of DC coils.				
	5. Check operation of electrical / mechanical targets.				
	6. Relay settings.				
	7. Check CT and VT connections with particular reference to their polarities.				
	Meters				
	(a.) Visual inspection.				
40.00.00	(b.) Megger all insulated partitions.				
	(c.) Check CT and VT connections with particular reference to their polarities for power type meters.				
	(d.) Calibration.				
	40.01.00				
AC MODULES DESCRIPTION					
Module type DAE (Circuit Breaker Module)					
40.02.00	(a.) One (1) Triple-pole circuit breaker, complete with all accessories and power operated mechanism, as specified.				
	(b.) Three (3) Current transformers for Protection and metering.				
	(c.) One (1) DC isolating Switch				
	(d.) Six (6) HRC Control fuses.				
	(e.) Numerical relay for the following:				
	• Short Circuit Protection				
	• Earth Fault Protection				
	• Over Load protection				
	• Energy Metering				
	• Current and Voltage metering				
• Trip Circuit Supervision					
• CB Monitoring					
• Synchronizing Check feature					
40.02.00					
Module Type DAET (Circuit Breaker Incomer From Transformer)					
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	Similar to module type DAE; but with additional PS Class Current transformers for Restricted Earth Fault Protection. The Numerical relay shall have provision for REF protection in addition to the features listed against module type DAE.			
40.03.00	Module Type CS (AC Control Supply Module) (Note: Module type CS will be of non-drawout type) Two (2) 415/110 V control transformers. Four (4) 110V auxiliary relays. Two (2) Earth links. Eight (8) HRC Control fuses. Two (2) Selector switches			
40.04.00	Module Type E/E1/E2 (Switch Fuse Module/MCCB) (a) One (1) Triple pole switch-fuse unit with three pole isolating switch and three / one / two HRC fuses for E/E1/E2 modules, respectively. (b) One (1) Neutral link.			
40.05.00	Module Type G1 (VT Module with Under Voltage / No Volt Relay) (a.) Three (3) 415/ $\sqrt{3}$ / 110/ $\sqrt{3}$ V single phase voltage transformers, mounted on a common draw-out chassis (b.) Three (3) HRC fuses for VT primary. (c.) Three (3) HRC control fuses.			
40.06.00	Module Type H (Isolating Switch Module) (a) One (1) Triple pole load break isolating switch (b) One (1) Neutral link			
40.07.00	Module type K1 (Non Reversible Motor Rated Below 30 kW Controlled from MCC) (a) One (1) Triple pole fuse switch unit with three pole load break isolating switch and three HRC fuses. (b) One (1) Triple pole contactor. (c) One (1) Bimetallic thermal overload relay with single phasing preventer. (d) Two (2) Push buttons. (e) Three (3) Indicating lamps with resistors and coloured lenses. (f) One (1) HRC control fuse. (g) One (1) Control link.			
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-05 LT SWITCHGEARS & LT BUSDUCT
Page 40 of 57				

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
40.08.00	Module Type K11 (Non reversible Motor Rated 30kW to 200kW Controlled from MCC) Similar to module type K1 but with the following additions: One (1) Current transformer for metering. One (1) Ammeter One (1) Single-pole switch and fuse for motor space heater.				
40.09.00	Module type DK2 (Non Reversible Motor rated below 30kW Controlled from PLC) (a) One (1) Triple pole switch fuse unit with three pole load break Isolating switch and three HRC fuses. (b) One (1) Triple pole contactor. (c) One (1) Bimetallic thermal overload relay with single phasing preventor. Modules marked with * (DK2* / PK2*) shall not have this relay. (d) Three (3) Indicating lamps with resistors and coloured lenses. (e) One (1) HRC control fuse. (f) One (1) Control link (g) One (1) Auxiliary contactor (h) Two (2) Coupling relays suitable for 24V DC.				
40.10.00	Module Type DK21 (Non Reversible Motor rated 30kW to up to 110KW controlled from PLC). (a) Similar to module type DK2 but with the following additions : (b) One (1) Current transformer for metering. (c) One (1) Ammeter (for motors of rating ≥ 30kW & < 110kW) (d) One (1) Single-pole switch and fuse for motor space heater. (e) One (1) Digital Energy Meter with Analog output of Current (4-20 mA) (for motors of rating ≥ 30kW & < 110kW and all dust suppression motors)				
40.11.00	Module Type DN1 (Reversible Motor Controlled from PLC) (a.) One (1) Triple pole fuse switch unit with three pole load break solating switch and three HRC fuses. (b.) Two (2) Triple pole mechanically interlocked, forward / reverse contactors. (c.) One (1) Bimetallic thermal overload relay with single phasing preventor. (d.) One (1) Indicating lamp with resistor and coloured lens.				
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 41 of 57

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC			
40.12.00	(e.) One (1) HRC control fuse (f.) One (1) Control link (g.) One (1) Auxiliary contactor (h.) Two (2) Coupling relays suitable for 240V DC. Module Type VM (Voltmeter Module) (a.) Three (3) HRC fuses. (b.) One (1) Voltmeter (0-500 V.) (c.) One (1) Four position voltmeter selector switch (d.) One (1) 415 V auxiliary contactor with 2 NO + 2 NC contacts. (e.) One (1) Voltage transducer with output of 4-20mA between R & Y phases				
40.13.00	Module Type DM (Circuit Breaker (DDC /PLC Controlled) Motor Feeder for motor rated 110 KW & above. (a.) One (1) Triple-pole circuit breaker, complete with all accessories and power operated mechanism, as specified. (b.) Three (3) Current transformers for Protection and metering. (c.) One (1) DC isolating Switch (d.) Six (6) HRC Control fuses. (e.) One (1) Single-pole switch and fuse for motor space heater (f) Numerical relay for the following: Short Circuit Protection (50) Thermal Over Load protection(51I) Earth fault Protection(50N) Negative sequence Protection(46) Restart inhibit protection(49) Locked Rotor Protection Energy Metering Current and Voltage metering Trip Circuit Supervision CB Monitoring				
41.00.00	DC MODULES DESCRIPTION				
41.01.00	Module Type -CH (Incomer from Charger) (a) One (1) Double pole, 250 V DC fuse -switch unit				
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 42 of 57	

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
41.02.00	Module Type -DB (Incomer from Battery) (a) Two (2) HRC fuses with striker pins and Fuse monitoring relays with contacts for alarm. These fuses shall be mounted in a separate fiber glass / plastic enclosure and located in the battery room. (b) One (1) DC ammeter with shunt and centre zero. This shall be mounted in the DCDB.			
41.03.00	Module Type - DC (a) One (1) Double pole 250V DC switch / circuit breaker with 2NO+2NC auxiliary contacts.			
41.04.00	Module Type - HD (DC Isolating Switch / Circuit - Breaker Module) (a) One (1) Double pole , 250 V DC switch isolator / circuit breaker			
41.05.00	Module Type-S (DC Metering and Protection Module) (a) One (1) Voltmeter, 0-300V DC (b) One (1) Three position voltmeter selector switch (c) One (1) Instantaneous under voltage relay (27) with a setting of 95% of 240V DC. The resetting ratio of relay should not be more than 1.05. (d) One (1) Instantaneous over voltage relay (59) which shall operate at 110% of 240 V DC. The resetting ratio of relay should not be less than 0.95. (e) One (1) Earth leakage relay having adjustable pick up range between 3 to 7mA. The relay shall be suitable for 240V / 50V DC and 240V AC auxiliary supply. The relay shall be Alstom type CAEM-21 or equivalent. (f) Two (2) Indicating lamps with resistors & coloured lenses, one each for 'Earth fault' and 'DC supply failure ' indications. (g) Three (3) HRC control fuses. (h) One (1) Neutral link			
41.06.00	Module Type -X (DC Isolating Switch Fuse Module) (a) One (1) Double pole , 250 V DC fuse switch unit with two HRC fuses.			
41.07.00	Module Type DW1 (DC Solenoid Valve Controlled from DDC) (a) One (1) Double pole 250 V DC isolating switch (b) Two (2) HRC fuses (c) One (1) Contactor with coil suitable for 240 V DC. (d) One (1) Auxiliary contactor with coil suitable for 240 V DC			
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 43 of 57

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
41.08.00	(e)	One (1)	Coupling relay		
	(f)	One (1)	Diode with peak inverse voltage of 440 V.		
	Module Type Q (Incomer to DC Lighting DB)				
	(a)	One (1)	Double pole , 250 V DC switch isolator		
	(b)	One (1)	Power Contactor		
	(c)	Two (2)	Instantaneous under voltage relays (27) with a setting of 60% of 110V AC.		
	(d)	One (1)	Timer having a delay of 0.5 to 3 sec. on pick-up with 2 self reset NO contacts, suitable for 240 Volts DC.		
	(e)	Two (2)	Indicating lamps with resistors & coloured lenses, one each for 'On' and 'Off' indications.		
42.00.00	(f)	Four (4)	HRC control fuses		
	(g)	Two (2)	Neutral links		
42.01.00	SELECTION TABLES				
	Feeder Module, Other than Motor Selection Table (415 V AC)				
	No.	Feeder Rating (Amp.)	Switch/MCC B Rating (Amp.)	Fuse Rating (Amp.)	Cable Size (sq. mm)
	1.	0-16	16	16	4CX6
	2.	17-32	32	32	4CX16
	3.	33-45	63	63	3 ¹ / ₂ CX35
	4.	46-63	63	63	3 ¹ / ₂ CX70
	5.	64-125	125	125	3 ¹ / ₂ CX70
	6.	126-160	160	160	3CX150+1-1CX150
	7.	161-200	250	200	3CX240+1-1CX150
	8.	201-250	250A MCCB		3-1CX300+1-1CX150
	9.	251-400	400A MCCB		3-1CX630+1-1CX300
	10.	401-630	630A MCCB		3-1CX630+1-1CX300
	11.	631-1120 (Breaker)			7-1CX630
12.	1121-1680 (Breaker)			10-1CX630	
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 44 of 57

CLAUSE NO.	TECHNICAL REQUIREMENTS						
42.02.00	Note i) The cables of size below 120 sq. mm shall be PVC insulated and those of size above 120 sq. mm shall be XLPE insulated						
	ii) All cables shall be of aluminium conductor except for 2.5 sq. mm size which shall be copper conductor.						
	Motor Module Selection table						
	Sl. No.	Motor rating kW	Max. Motor Amp.	Switch rating Amp.	Fuse rating Amp.	Contactor rating Amp.	Cable size Sq. mm
	1.	1.1-1.5	3.5	16	6/16	16	3CX2.5
	2.	1.6-3.0	7	32	20	16	3CX2.5
	3.	3.1-5.5	11	32	32	16	3CX6
	4.	5.6-7.0	14.4	63	50	32	3CX6
	5.	7.1-13.0	27.3	63	63	32	3CX16
	6.	13.1-24.0	45	125	80/100	63	3CX35
	7.	24.1-37.0	70	125	125	70 (upto 30kW) 100 (above 30kW)	3CX70
	8.	37.1-55.0	100	250	160	100(upto 40kW) 160 (upto 55kW)	3CX120
	9.	55.1-80.0	150	250	200	200	3CX150
	10.	80.1-100	180	As per selected fuse	Suitable for type-II	225	3CX150 (upto 90kW) 3CX240 (above 90kW)
	12.	110.0-200.0	CIRCUIT BREAKER				3-1CX300
Note i) The cables of size below 120 sq. mm shall be PVC insulated and those of size above 120 sq. mm shall be XLPE insulated.							
ii) All cables shall be of aluminum conductor except for 2.5 sq. mm size which shall be copper conductor.							
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 45 of 57

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC				
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-05 LT SWITCHGEARS & LT BUSDUCT	Page 46 of 57	

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LEGEND DESCRIPTION

52	CIRCUIT BREAKER
42	CONTACTOR
S.A.	SURGE ARRESTOR
	CURRENT TRANSFORMER
	CORE BALANCE CURRENT TRANSFORMER
	VOLTAGE TRANSFORMER
50	TRIPLE POLE IDMTL/DMT O/C PROTECTION
51	TRIPLE POLE INSTANTENIOUS O/C PROTN.
50N	IDMTL / DMT SENSITIVE E/F PROTECTION
51N	INSTANTENIOUS E/F PROTECTION
49	THREE PHASE THERMAL O/L PROTN. WITH O/L ALARM & RESTART INHIBITE FUNCTION
50L/R	STALLING / LOCKED ROTOR PROTECTION
46	THREE PHASE NEGATIVE PHASE SEQUENCE PROTECTION
66	NUMBER OF START LIMITATION/REPATETIVE START PROTECTION
2	TIME DELAY RELAY
60	FUSE FAILURE PROTECTION
87M	3 PHASE MOTOR DIFFERENTIAL PROTECTION

LEGEND DESCRIPTION

64R	RESTRICTED EARTH FAULT PROTECTION
51G	STAND BY EARTH FAULT PROTECTION
87T	3 PHASE BIASED TRANSFORMER DIFFERENTIAL PROTECTION
27M	3 PHASE UNDER VOLTAGE PROTECTION FOR MOTOR TRIPPING
27U	3 PHASE BUS UNDER VOLTAGE
27N	NO VOLT PROTECTION FOR BUS
50BF	CIRCUIT BREAKER FAILURE PROTECTION
86	LOCKOUT FUNCTION
3I	3 PHASE CURRENT MEASUREMENT
Io	NEUTRAL CURRENT MEASUREMENT
3U	3 PHASE VOLTAGE MEASUREMENT
Uo	RESIDUAL VOLTAGE MEASUREMENT
P	ACTIVE POWER MEASUREMENT
Q	REACTIVE POWER MEASUREMENT
E	ENERGY MEASUREMENT
PF	POWER FACTOR MEASUREMENT
HZ	FREQUENCY MEASUREMENT
HM	HOUR RUN METER

FOR TENDER PURPOSE ONLY

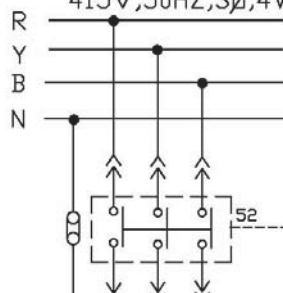
एनटीपीसी लिमिटेड NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)							
CLEARED BY							
C	E	M	C&I	ES			
PROJECT							
STANDARD							
TITLE							
LEGEND DETAILS							
DRN	DGN	CHKD	APPD	DATE	SCALE	DRAWING No.	REV.
-				10/01/07	NA	0000-206-PDE-A-003	0

LEGEND.DWG

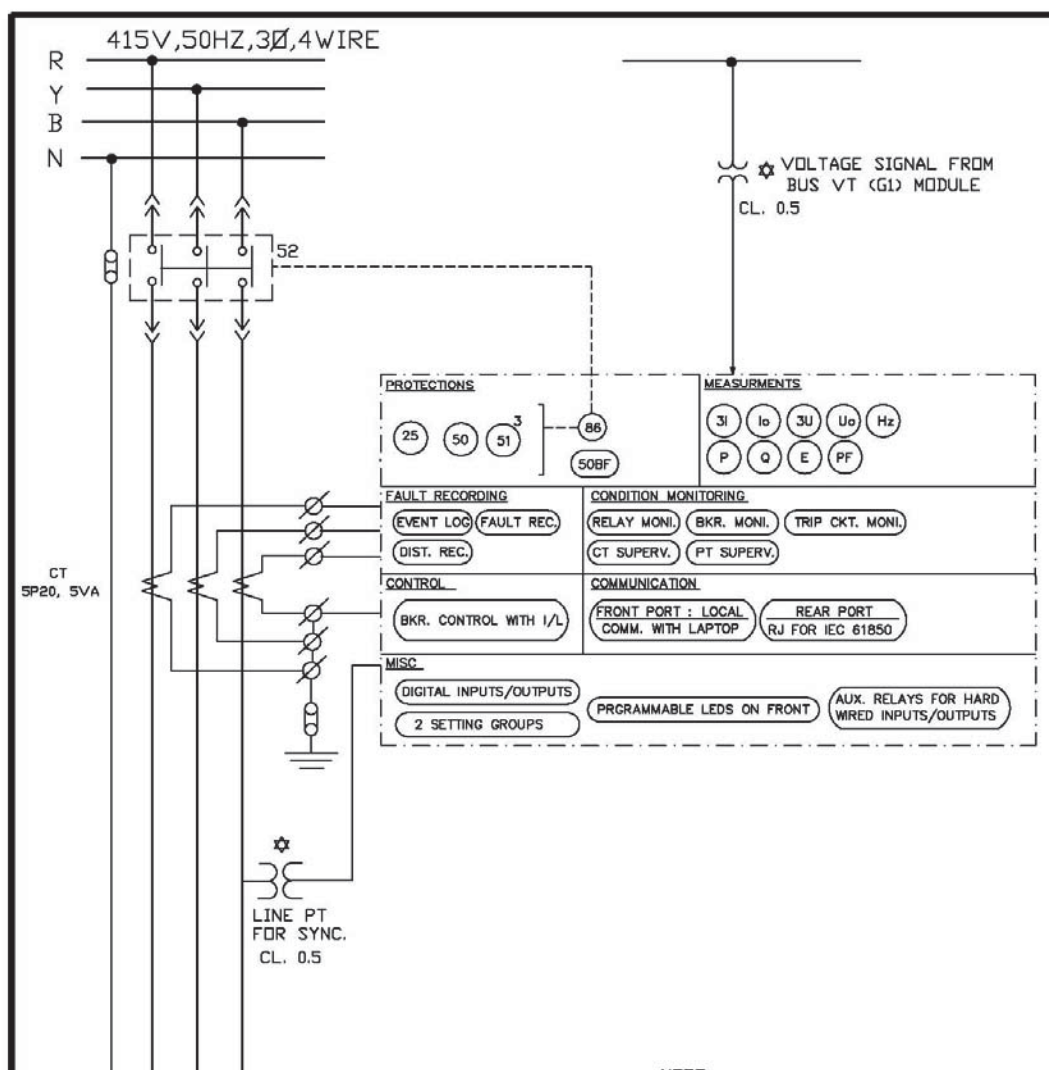
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must not be
or prosecution.

415V, 50HZ, 3Ø, 4WIRE



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NOTE:

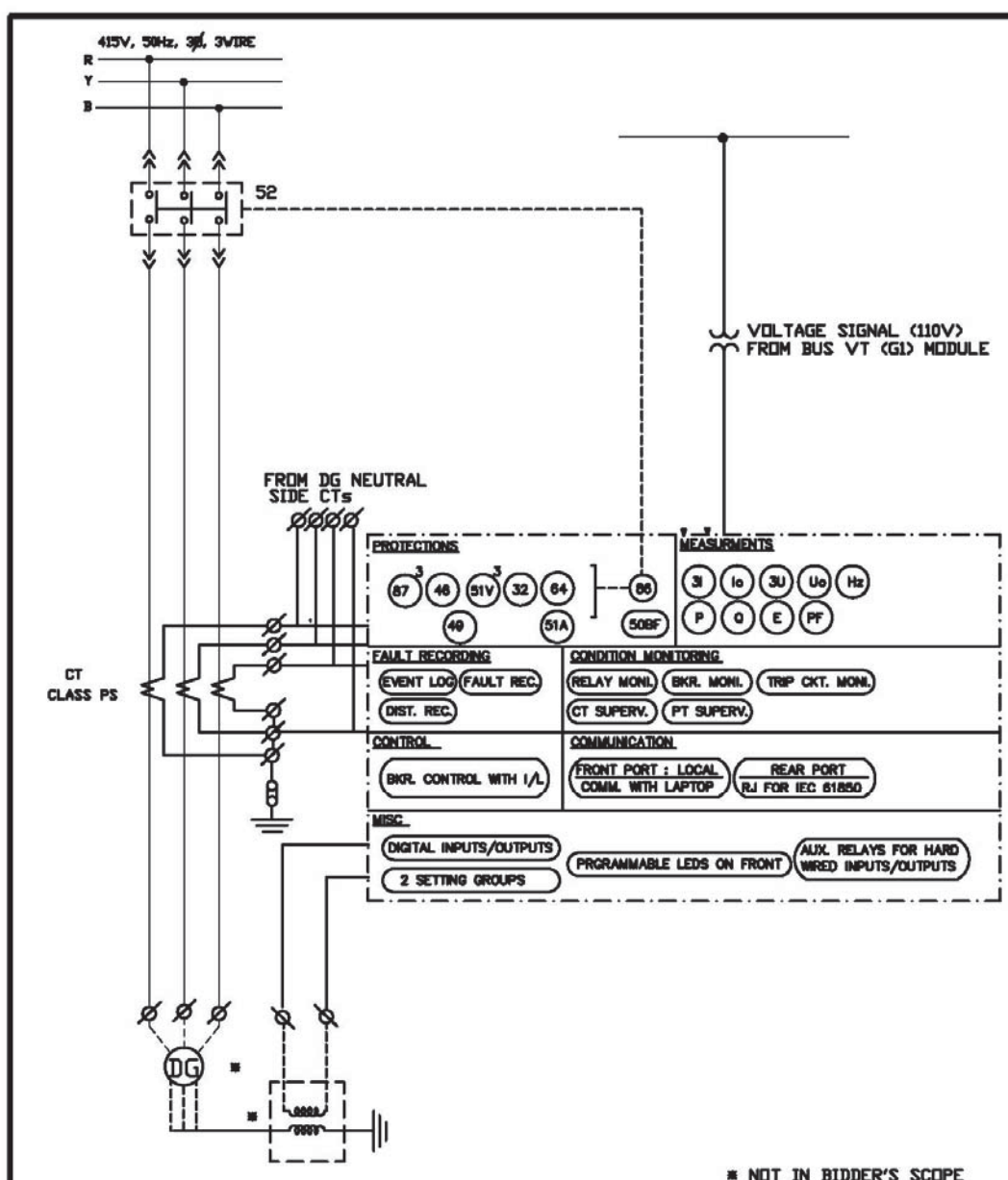
★ APPLICABLE ONLY FOR INCOMERS OF BOARDS WHERE G1 MODULE IS PROVIDED

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CLEARED BY		PROJECT	
C	E	M	C&I ES
TITLE		STANDARD	
SCHEME FOR FEEDER TYPE-DAE (INCOMER / OUTGOING / BUS COUPLER)		DRAWING No.	
DRN	DCN	CHKD	APPD
-	✓	✓	✓
DATE	SCALE	0000-206-PDE-A-005	
10/04/07	NA	REV. 0	

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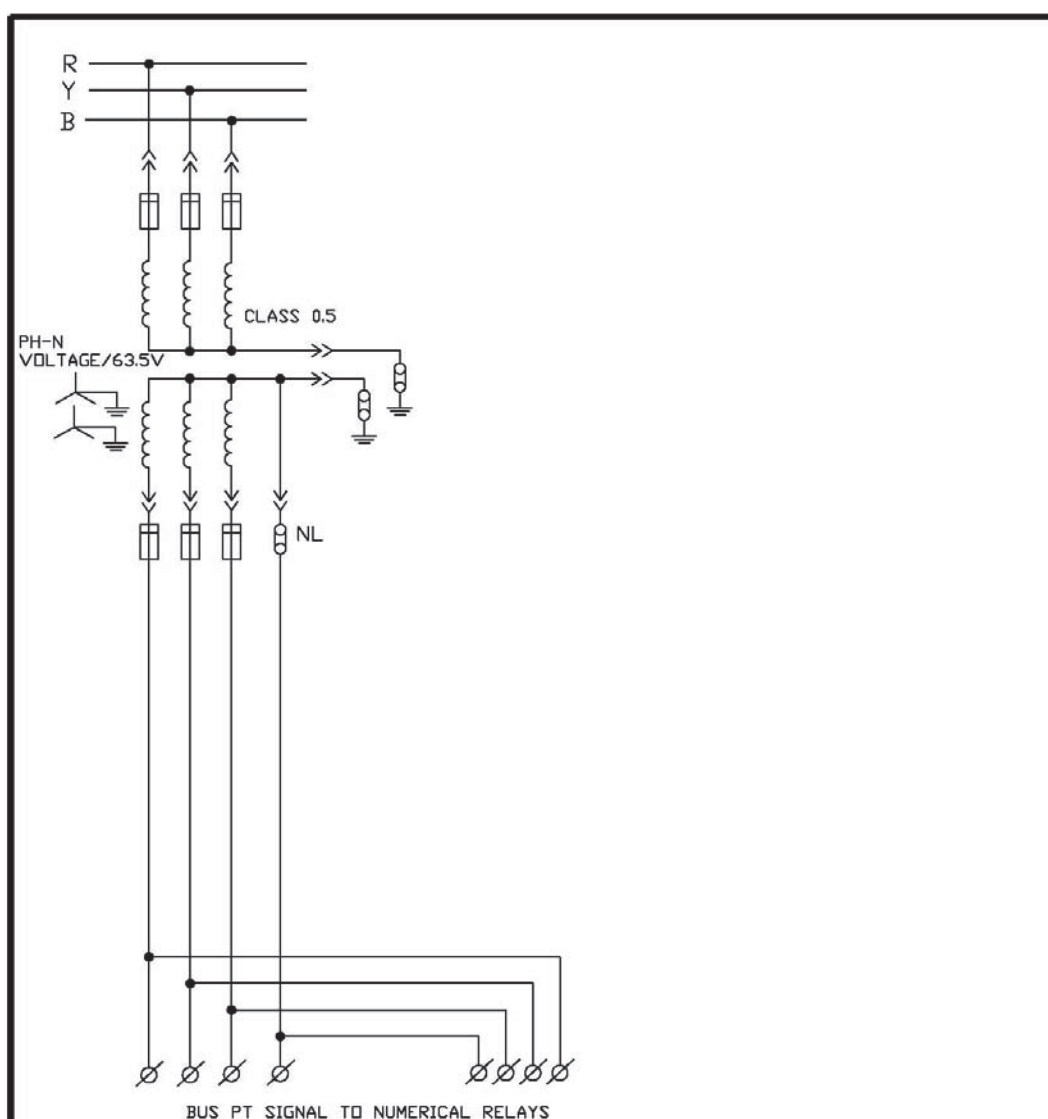
✱ NOT IN BIDDER'S SCOPE

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CLEARED BY					PROJECT				
C	E	N	CAI	ES	STANDARD				
					TITLE				
					SCHEME FOR FEEDER TYPE-DG (INCOMER FROM DG)				
DRN	DGN	CHKD	APPD	DATE	SCALE	DRAWING No.			REV.
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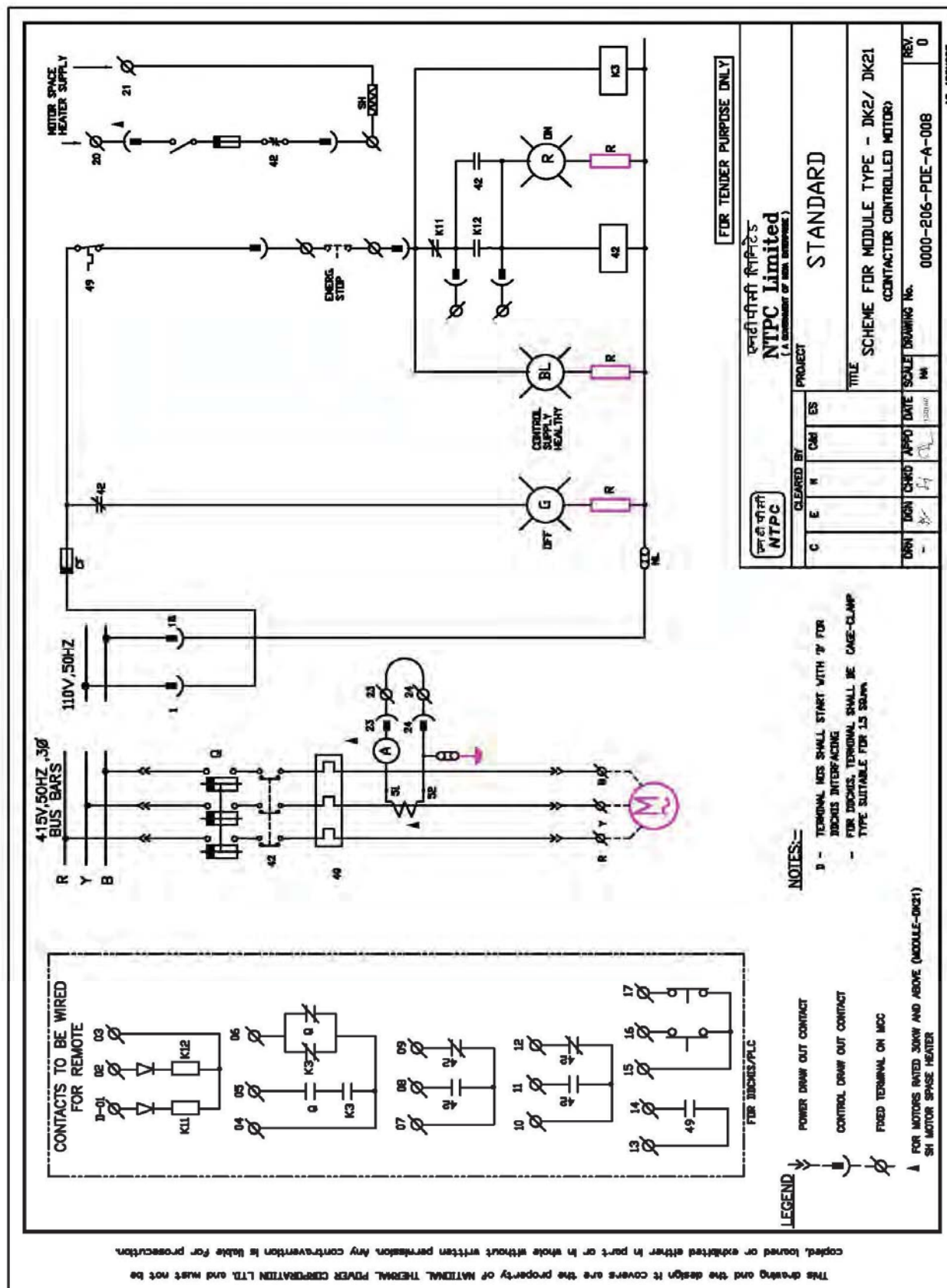
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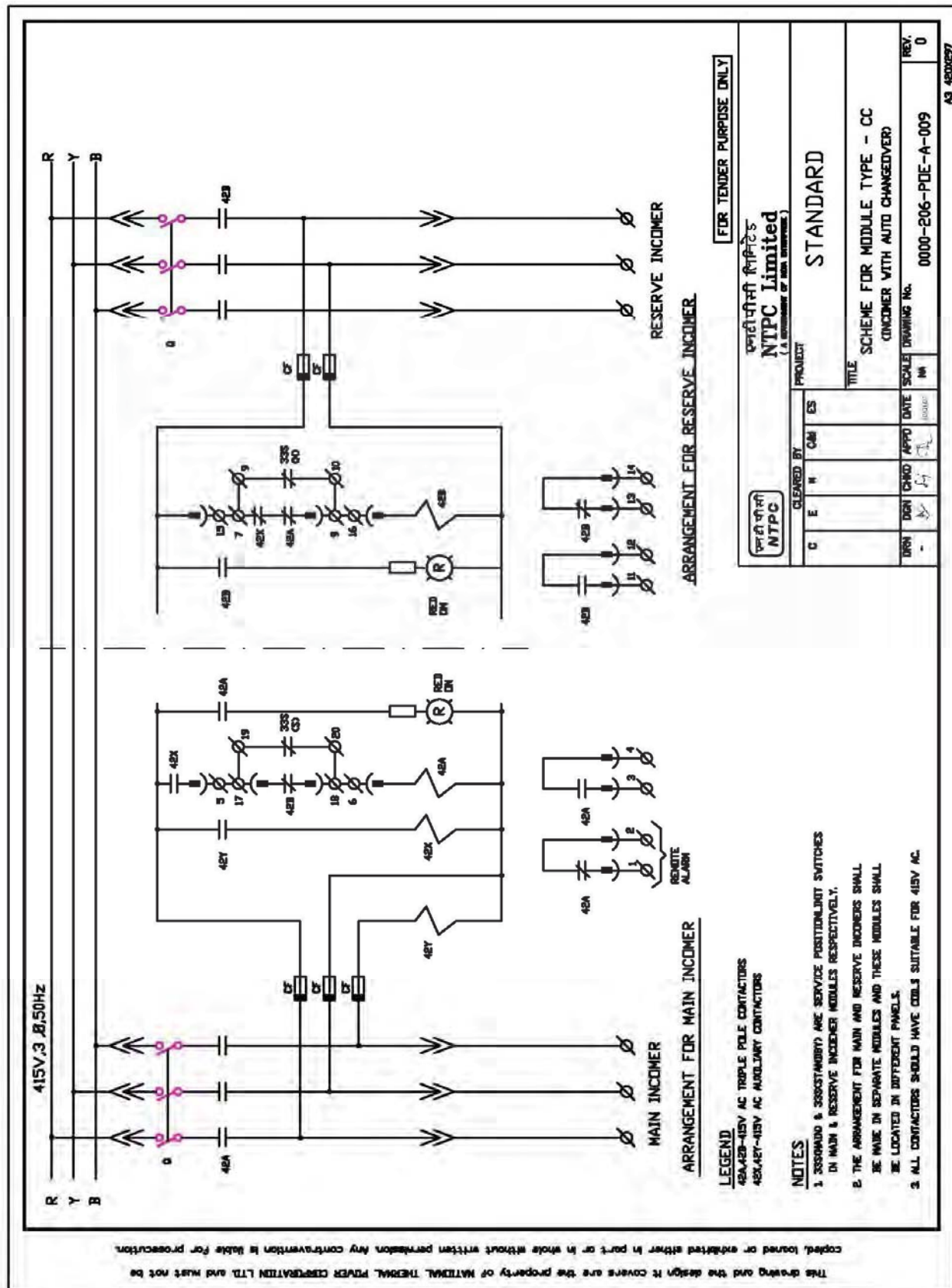


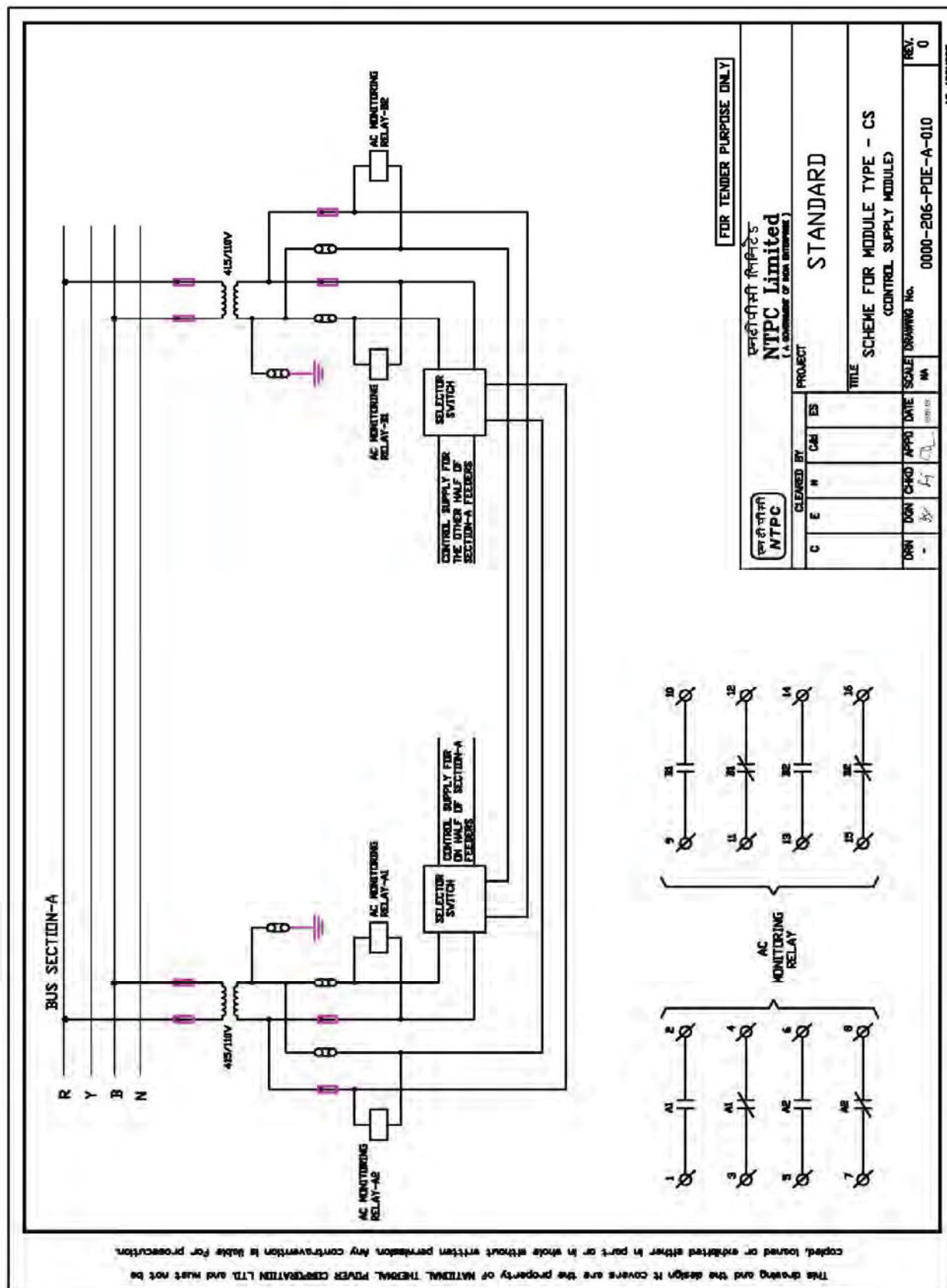
FOR TENDER PURPOSE ONLY

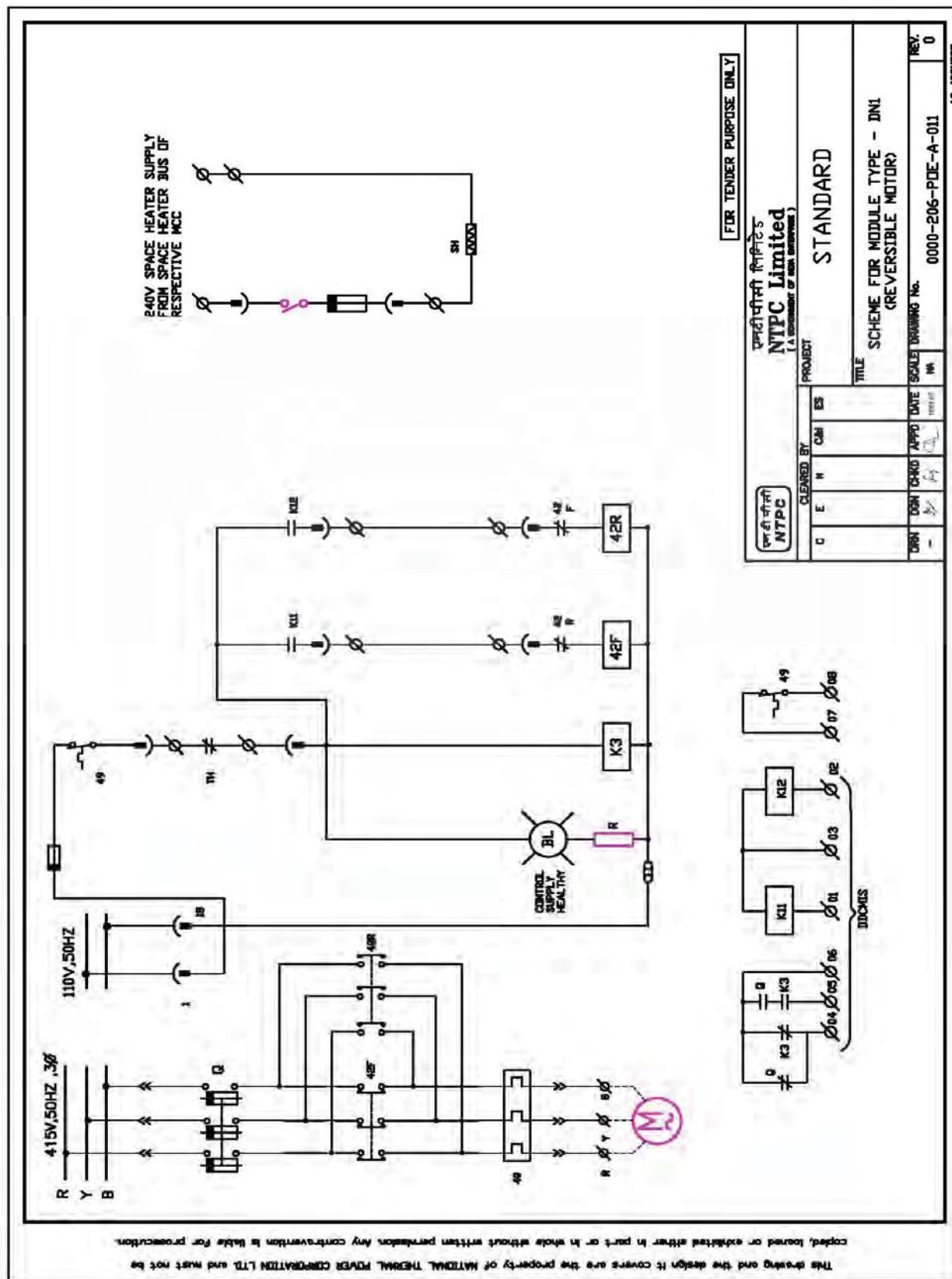
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					TITLE				
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DRN	DGN	CHKD	APPD	DATE	SCALE	DRAWING No.		REV.	
-				10/01/07	NA	0000-206-PDE-A-007		0	

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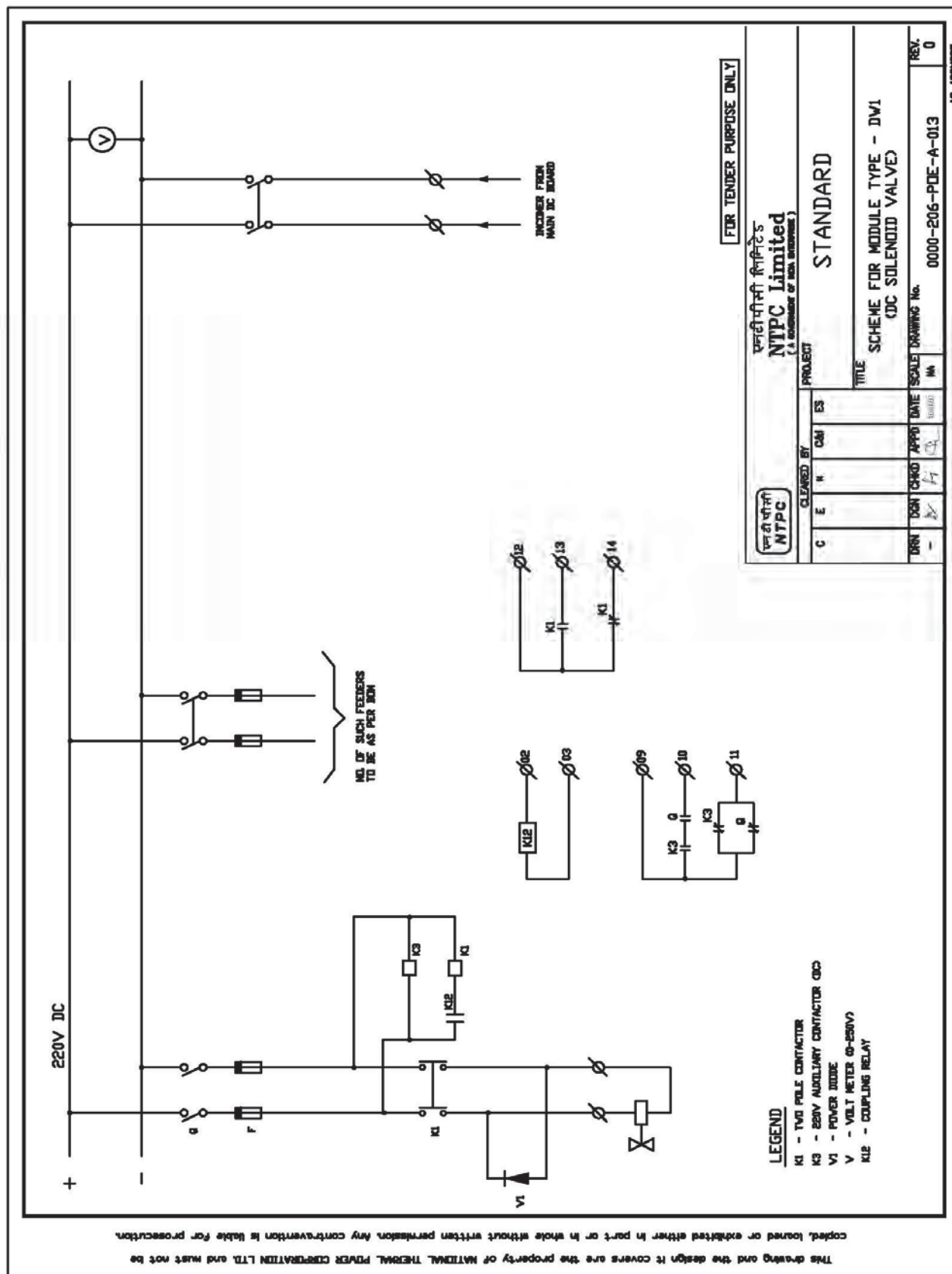
**KAHALGAON SUPER THERMAL
POWER STATION
STAGE-I (4x210 MW)**

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

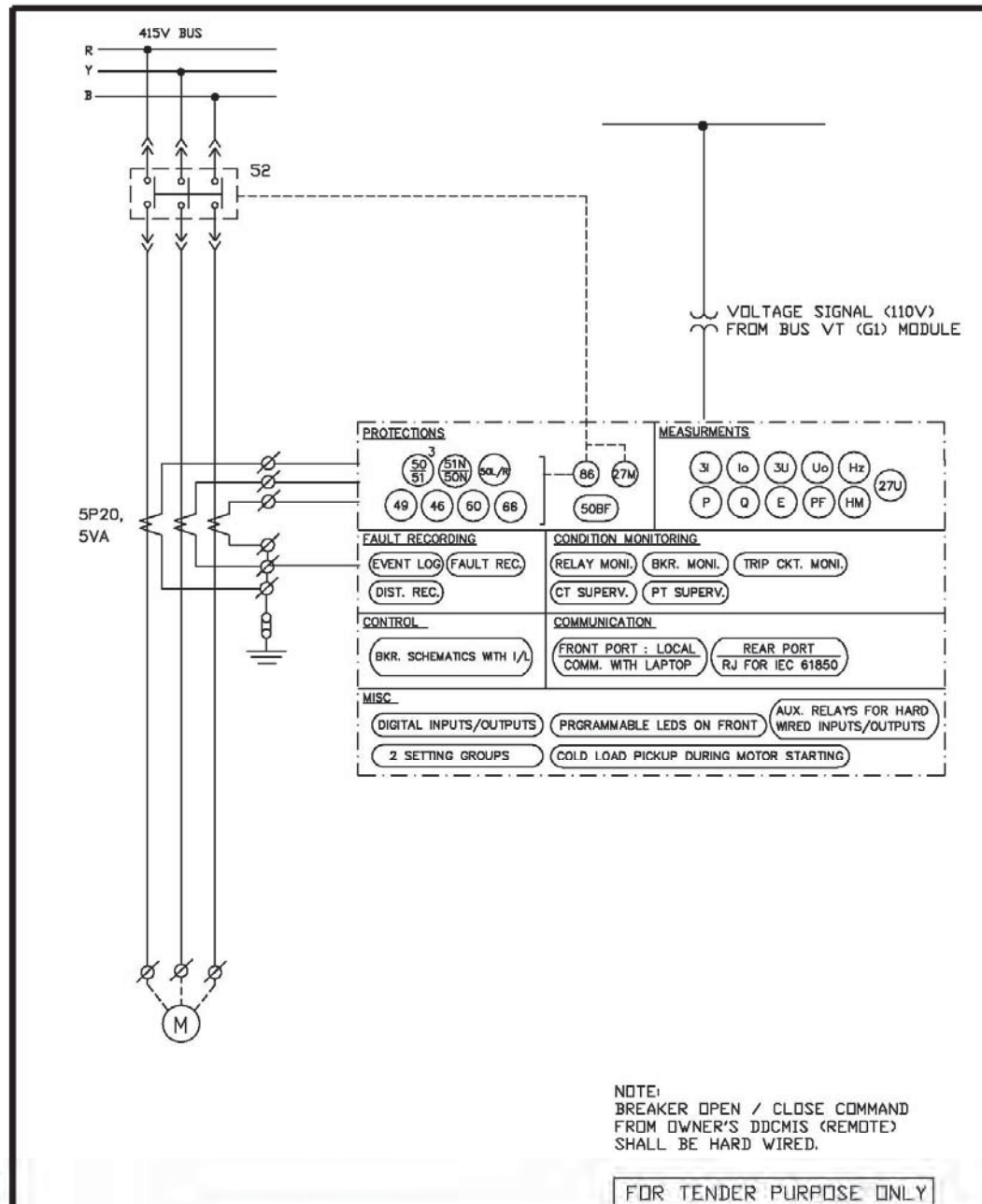
TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP

PART – B
SUB-SECTION II- E-05
LT SWITCHGEARS & LT
BUSDUCT

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CLEARED BY C E M C&I ES		PROJECT STANDARD	
DRN DGN CHKD APPD DATE SCALE - 10/11/07 NA		TITLE SCHEME FOR FEEDER TYPE-DM (MOTOR RATING 110kW AND ABOVE)	
DRAWING No. 0000-206-PDE-A-014		REV. 0	

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SUB-SECTION-II-E-06

LT POWER 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).				
2.00.00 2.01.00 2.02.00 2.03.00 2.04.00 2.05.00	TECHNICAL REQUIREMENTS The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water. 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. Conductor of control cables shall be made of stranded, plain annealed copper. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C. 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																		
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
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																		
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				
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																		
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				एन टी पी सी 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
No. of cores in cable	Min. No. of spare cores														
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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 3 of 6										

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
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC																																							
5.01.00 5.01.01	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.																																											
	TYPE TESTS																																											
	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																																											
	<table><tr><th>S. No.</th><th>Type Test</th><th>Remarks</th></tr><tr><td colspan="3">For Conductor</td></tr><tr><td>1.</td><td>Resistance test</td><td></td></tr><tr><td colspan="3">For Armour Wires / Formed Wires (If applicable)</td></tr><tr><td>2.</td><td>Measurement of Dimensions</td><td></td></tr><tr><td>3.</td><td>Tensile Test</td><td></td></tr><tr><td>4.</td><td>Elongation test</td><td></td></tr><tr><td>5.</td><td>Torsion test</td><td>For round wire only</td></tr><tr><td>6.</td><td>Wrapping test</td><td>For aluminium wires / formed wires only.</td></tr><tr><td>7.</td><td>Resistance test</td><td></td></tr><tr><td>8(a).</td><td>Mass of zinc Coating test</td><td>For GS wires/formed wires only</td></tr><tr><td>8(b).</td><td>Uniformity of zinc coating</td><td>For GS wires/formed wires only</td></tr><tr><td>9.</td><td>Adhesion test</td><td>For GS wires/formed wires only</td></tr></table>					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-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).				
2.00.00 2.01.00 2.02.00 2.03.00 2.04.00 2.05.00	TECHNICAL REQUIREMENTS The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water. 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. Conductor of control cables shall be made of stranded, plain annealed copper. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C. 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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Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire																		
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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CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी 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.														
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी 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				एन टी पी सी 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				एन टी पी सी 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.				

SUB-SECTION-II-E-08

CABLING, EARTHING & LIGHTNING

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.00.00 1.01.00	CODES AND 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 work shall be carried out as per the following standards/ codes as applicable . 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.			
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-08 CABLING, EARTHING & LIGHTNING PROTECTION	Page 1 of 23

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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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. The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling. 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. 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			
2.01.06				
2.01.07				
2.01.08				
2.01.09				
2.01.10				
2.01.11				
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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 galvanised 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 galvanised. - 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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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
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														
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
No. of cores in cable	No. of spare cores											
2C,3C	NIL											
5C	1											
7C-10C	2											
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	14C and above	3		
4.04.16	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.			
4.04.17	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.			
4.04.18	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.			
4.05.00	Cable Terminations & Connections			
4.05.01	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.			
4.05.02	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: <table><tr><td>1)</td><td>Conductors above ground level and in built up trenches.</td><td>-</td><td>Galvanized steel</td></tr><tr><td>2)</td><td>Conductors buried in earth</td><td>-</td><td>Mild steel</td></tr><tr><td>3)</td><td>Earth electrodes</td><td>-</td><td>Mild steel rod</td></tr></table>				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 colspan="2">Equipment</th><th>Earth conductor buried in earth</th><th colspan="2">Earth conductor above ground level & in built-up trenches</th></tr></thead><tbody><tr><td>a)</td><td>Main earth grid</td><td>40 mm dia. MS rod</td><td colspan="2">65 x 8mm GS flat</td></tr><tr><td>b)</td><td>33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear</td><td>---</td><td colspan="2">65 x 8mm GS flat</td></tr><tr><td>c)</td><td>415 V MCC/ Distribution boards / Transformers</td><td>---</td><td colspan="2">50 x 6mm GS flat</td></tr><tr><td>d)</td><td>LT Motors above 125 KW</td><td>---</td><td colspan="2">50 x 6mm GS flat</td></tr><tr><td></td><td>25 KW to 125 KW</td><td>---</td><td colspan="2">25 x 6mm GS flat</td></tr><tr><td></td><td>1KW to 25 KW</td><td>---</td><td colspan="2">25 x 3mm GS flat</td></tr><tr><td></td><td>Fractional House power motor</td><td>---</td><td colspan="2">8 SWG GS wire</td></tr><tr><td>e)</td><td>Control panel & control desk</td><td>---</td><td colspan="2">25 x 3 mm GS flat</td></tr><tr><td>f)</td><td>Push button station / Junction Box</td><td>---</td><td colspan="2">8 SWG GI wire</td></tr><tr><td>g)</td><td>Columns, structures, cable trays and bus ducts enclosures</td><td>---</td><td colspan="2">50 x 6mm GS flat</td></tr><tr><td>h)</td><td>Crane, rails, rail tracks & other non-current carrying metal parts</td><td></td><td colspan="2">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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	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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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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	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

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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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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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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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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			
	4.00.00	DESIGN PHILOSOPHY			
		1.	A comprehensive illumination system shall be provided in the entire areas.		
2.		All outdoor lighting system shall be automatically controlled by synchronous timer. Provision to bypass the timer shall be provided in the panel.			
3.		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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	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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	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. (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 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,				
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	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 fluorescent fixtures, shall have energy efficient 'T5' type fluorescent lamps except the fluorescent fixtures used for division 2 hazardous area. The louvers of these fixtures shall be designed for 'T5' type fluorescent lamps. All fluorescent lamps shall have "Cool day light" colour designation. The mirror optics type fluorescent 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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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			
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-09 ILLUMINATION	Page 14 of 14

DETAILED SPECIFICATION OF C&I

- * MEASURING INSTRUMENTS**
- * PROCESS CONNECTION & PIPING**
- * INSTRUMENTATION & POWER SUPPLY CABLES**
- * TYPE TEST REQUIREMENTS**
- * RELAY BASED LOCAL CONTROL PANELS**

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	एनटीपीसी NTPC		
	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		एनडीपीसी 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.				
	Specification 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			एनटीपीसी NTPC
	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) Page 6 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC																																
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				
	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				एनडीपीसी 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. <tr><td>2.04.03</td><td colspan="5"> 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). </td></tr> <tr><td>3.00.00</td><td colspan="5"> 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. </td></tr> <tr><td colspan="2">KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW)</td><td>BIDDING DOC. NO.: CS-4210-104A(R&M)-2</td><td>TECHNICAL SPECIFICATION FOR RENOVATION & RETROFITTING OF ESP</td><td>PART – B SUB-SECTION-III-C&I-01 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)</td><td>Page 9 of 18</td></tr>					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)	Page 9 of 18
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)	Page 9 of 18																		

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनडीपीसी NTPC
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.
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 10 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनडीपीसी 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				
	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			
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				एनटीपीसी NTPC
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				
	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					
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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.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	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			एनटीपीसी NTPC																								
	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/Nm ³ (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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CLAUSE NO.	TECHNICAL REQUIREMENTS		एन टी पी सी NTPC		
10.03.00	(m) Type of Electronics	display reading in mg/Nm3 as well as diagnostics and alarms.			
	(m) Mean interval between maintenance cleaning	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.			
	(n) Auto calibration interval	Not less than 90 days			
	1 to 24 hours (remote selectable)				
10.04.00	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.				
	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.				
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SUB-SECTION-III-C&I-02

PROCESS CONNECTION & PIPING

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	PROCESS CONNECTION AND PIPING				
1.00.00	PROCESS CONNECTION PIPING				
1.01.00	The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-section on as required basis for the connection of instruments and control equipment to the process and make the system complete. Contractor shall furnish during detailed engineering all relevant drawings, material and tech. specifications of various items service wise for Employer's approval.				
1.01.01	All materials supplied under this Sub-section shall be suitable for intended service, process, operating conditions and type of instruments used and shall fully conform to the requirements of this specification. The material offered by the Bidder shall be from reputed, experienced manufacturer whose guaranteed and trouble free operation has been proven at least for two years in not less than two pulverized coal fired utility stations.				
1.02.00	IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS				
1.02.01	All impulse pipe shall be of seamless type conforming to ANSI B36.10 for schedule numbers, sizes and dimensions etc. The material of the impulse pipe shall be same as that of main process pipe. For various applications specification of associated fittings and valves shall be as given in Table PCP. For protection against sea environment all impulse pipes fittings etc. shall be provided with durable epoxy coating with poly urethane finish.				
1.02.02	Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. For high pressure/temperature applications (piping class A, B, C &D of the table no. PCP) the material shall be ASTM A 213 TP 316H and for other applications material shall be ASTM A 213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard.				
1.02.03	All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. Tee, elbow etc.) shall be ASTM A 182 Gr. 316 H for high pressure/ temperature applications (as defined above) and ASTM A 182 Gr. 316L for other applications. The material for bar stock tube fitting (for straight application) shall be 316 SS. Metal thickness in the fittings shall be adequate to provide actual bursting strength equal to or greater than those of the impulse pipe or SS tube, with which they are to be used.				
1.02.04	The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. The disc and seat ring materials of carbon steel and alloy steel valves be ASTM A-105 and ASTM A-182, Gr. F22, hard faced with stellite (minimum hardness - 350 BHN.) The surface finish of 16 RMS or greater is required in the area of stem packing. The valve design shall be such that the seats can be reconditioned and stem and disc may be replaced without removing the valve body from the line.				
1.02.05	The valve manifolds shall be of 316 stainless steel with pressure rating suitable for intended application. 2 valve manifold and 3 valve manifold shall be used for pressure measurements using pressure transmitters/ pressure switches and diff. pressure transmitter/ switches respectively. 5-valve manifold shall be used for remaining applications like DP, flow and level measurements.				
1.02.06	For Pr./D.P gauges in fluid application two-way globe valve on each impulse line to the instrument and in A/F application two-way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three ways gauge cock provided along with the pressure /D.P gauges.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC			
2.00.00	AIR SUPPLY PIPING				
2.01.00	All pneumatic piping, fittings, valves, air filter cum regulator and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided.				
2.01.01	This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements of etc.				
2.02.00	The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard.				
2.03.00	All other air supply lines of 1/2 inch to 2 inch shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. The threads shall be as per ASA B.2.1. Fittings material shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs.				
2.04.00	For air supply to various devices mentioned above, the bidder shall provide 2 inch size GI pipe header with isolation valve from the instrument air and service air terminal points. In the boiler area the 2 inch head shall be provided upto top most elevation of boiler floor and from this 2 inch header, 1 inch sub-header shall be branched off at each floor with isolation valve. From this 1 inch sub-header, branch line of 1/2 inch, with isolation valve shall be provided upto various devices. Similar system is to be followed for service air required for intermittent purging in the Local Instrument Enclosures (LIEs) etc.				
2.05.00	All-instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering. However, for Ash handling system air filter cum regulator set shall be provided for instrument air header/ each location.				
2.06.00	All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.				
2.07.00	Purge Air Connection for Air and Flue gas Applications The continuous purging with instrument air shall be done, for all air and flue gas measurements excepting instrument air and service air instruments, at the process source connection end. Necessary arrangements required for continuous purging shall be provided inside all the Air and Flue gas enclosures as per enclosed drawing no. 0000-110-POI-A-034. For intermittent purging with service air, necessary arrangements inside all the air and Flue gas enclosures shall be provided. The SS three way valve provided in the SS tubing shall be used for isolating the transmitter & connecting the service air quick disconnect line. Purging arrangement is not required for Instrument air and service air measurement applications.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.00.00	INSTALLATION AND ROUTING				
3.01.00	Instrument Piping System				
3.01.01	For steam and liquid measurements, the impulse pipe should preferably slope downward from source connection to instrument and instrument shall be installed below the source point. If due to any reason instrument is installed above the source point, the impulse pipe should slope upwards continuously and a 'pigtail' should be provided at the instrument to assure water seal for temperature protection. For vacuum measurements instrument shall be installed above source point and impulse pipe should slope upwards.				
3.01.02	Impulse piping for air and flue gas shall slope upwards and instrument shall be installed above source point. If this requirement cannot be met special venting or drain provision shall be provided with vent & drain lines along with isolation valves and other accessories including drainpipes. This drain is to be connected to plant drain through open funnel also.				
3.01.03	All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.				
3.01.04	Special accessories such as condensing pots/ reservoirs shall be provided and installed wherever required. In any case condensing pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and flow measurements water services above 120 Deg.C.				
3.01.05	Color coding of all impulse pipes shall be done by the bidder in line with the colour coding being followed for the parent pipes.				
3.02.00	Instrument Air & Service Air Piping/ Tubing System				
3.02.01	Instrument air & service air headers and their branches with all associated fittings & accessories shall be provided for giving supply to all consumers, as per the requirements. Air piping shall be installed always with a slope of over 1/20 to prevent accumulation of water within the pipe.				
3.02.02	Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy checkup and for connections.				
4.00.00	PIPING/TUBING SUPPORT				
4.01.00	Impulse piping and sample piping shall be supported at an interval not exceeding 1.5 meters. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports. Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls, ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant metals and hot-dip galvanized.				
5.00.00	SHOP AND SITE TESTS				
5.01.00	General Requirements				
5.01.01	The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-Q (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.01.02	Hydrostatic and pneumatic tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.			
5.02.00	Hydrostatic Testing			
5.02.01	All instrument piping/ tubing shall be hydrostatically tested upon completion of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve). In both the cases the instrument shall be isolated by closing the shut-off valve.			
5.03.00	Air Testing			
5.03.01	All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 kg/ sq. cm. through a bubbler sight glass. The boiler draft and vacuum piping shall be air tested by the same method as long signal tubing.			
6.00.00	LOCAL INSTRUMENT ENCLOSURE AND RACKS Transmitters, switches, devices ,temperature transmitters etc. (except for all fuel oil applications which shall be mounted close to be tapping points) mounted in the field shall be suitably grouped together and mounted (i) local instruments enclosure in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas. Gauges are to be mounted on a channel or a frame or a rack (Gauges shall not be mounted directly on process pipe). These local instrument enclosures and racks shall be furnished as per the actual requirements finalized during detailed engineering stage. The exact grouping of instruments in a particular instrument enclosure/instrument rack shall be as finalized during detailed engineering stage subject to Employer's approval. For mounting of PT/DPT/LT/FT, LIEs / LIRs shall be of three types depending on the number of transmitters located in it as elaborated in the typical GA of the LIE/LIR, drawing no. 0000-999-POI-A-064 (Sh Nos. 1 to 3 of 5). These dimensions and number of instruments indicated therein are only indicative and the exact dimensions along with the number of instruments shall be as finalized during detailed engineering stage without any price repercussions. The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.			
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-02 PCP	Page 4 of 6

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC		
	Gaskets shall be used between all mating sections to achieve protection class of IP-55. The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalized during detailed engineering stage. The junction box for racks also shall conform to IP 55 protection class. Enclosures/racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided. Each transmitter enclosure housing instruments requiring purge air for continuous air purging, shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubing and individual purge meters for each purge line etc. as required and indicated in Instrument Installation drawings enclosed herewith. A 15 mm NB service air header shall be furnished in each instrument enclosure housing air & flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge, and quick disconnect connections. A hose for connecting each header to the draft instrument line four-way valves shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure of 15 kg/sq. cm. The size of the hose shall be 1/2" minimum. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates. The contractor shall prepare the piping drawings and the general arrangement layout drawings for each of the enclosures and racks. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within, the enclosure/racks and shall be subject to Employer's approval. All liquid filled blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blow down into a drain. The material of the blow down header shall be carbon steel as per ASTM A 106 Gr. C. The Contractor shall submit to the Employer with his proposal a copy of his welding procedure specification together with proof of his compliance with the latest applicable welding ANSI code. Prior to any welding being performed, the Contractor shall submit the qualifications of the craftsmen who will perform the work.			
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7.00.00 TABLE PCP

System/Line Description	Piping Class	Schedule (Size)	Materials for Fitting/Valve Body	Valve Stem Material	Rating of Piping/ Fittings	Pr. Class of Valve
ACW, CW Applications, Sea Water Applications (if applicable)	S	80(1/2 inch)	ASTM-A 182 316L	-do-	3000lb	800
Air/ Flue Gas Outside Boiler, Instrument Air, Service Air	M	80 (3/4 inch)	ASTM-A105	-do-	3000 lb	800
Air/ Flue gas inside furnace	N	80 (3/4 inch)	ASTM-A182 Gr. F-22	-do-	3000 lb	800

NOTE:

1	Rating of piping/fittings/valves etc. is subjected to the final design pressure & temperature during the detailed engineering.
2	Specification for fittings and valves in this table are minimum requirement. Bidder to provide fittings and valves meeting process requirements and as per piping specified in Mechanical Sub-Section- Power Cycle piping System & LPP. Materials for fittings, specialties and valves shall be compatible with process pipe material.

9.00.00 Painting Color scheme for Impulse Piping:

Sl. No.	Area / Equipment	Impulse Pipe Ground Color		Identification Tag/Band		
		Color	RAL	Color	ISC No.	RAL
1.	Air	Grey	9002	Sky Blue	101	
2.	Water	Grey	9002	Sea Green	217	
3.	Steam	Aluminum		Signal Red	537	3001
4.	Air Steam Mixture	Aluminum		Sky Blue	101	
5.	Gas	Grey	9002	Canary Yellow	309	
6.	Oils	Grey	9002	Light Brown	410	
7.	Fire Installations	Fire Red	536 (ISC) 3001 (RAL)	White		9010
8.	Ash Piping	Grey	9002	French Blue	166	

Note: Ground color indicated against each piping shall be followed in case piping is not insulated /cladded.

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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					

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

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RENOVATION & RETROFITTING OF ESP

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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC																																								
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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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 2 of 15

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी 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			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी 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				एनडीपीसी 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.				
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 6 of 15

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC																																		
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																																						
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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																																			
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 7 of 15																																		

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	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.					
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 8 of 15	

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC									
	<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></table> 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.					Application		Type Of Termination		Type Of Cable	FROM (A)	TO (B)	END A	END B
Application		Type Of Termination		Type Of Cable										
FROM (A)	TO (B)	END A	END B											
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													
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 9 of 15									

CLAUSE NO.	TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
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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CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC
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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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
	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 pigtailed. 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.			
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 12 of 15

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
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.			
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 13 of 15

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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				
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 14 of 15

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
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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SUB-SECTION-III-C&I-04

TYPE TEST REQUIREMENTS

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
	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 एनटीपीसी NTPC																																																																																		
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> <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> <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> </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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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
		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	

CLAUSE NO.		TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
			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	
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 4 of 5

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC																
	<table border="1"> <tr> <td></td><td></td><td>test</td><td></td><td></td><td></td></tr> <tr> <td>15</td><td>Junction Box</td><td>Degree of protection test</td><td>IS-2147</td><td>No</td><td>Yes</td></tr> </table> 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.							test				15	Junction Box	Degree of protection test	IS-2147	No	Yes
		test															
15	Junction Box	Degree of protection test	IS-2147	No	Yes												
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 5 of 5													

RELAY BASED LOCAL CONTROL PANEL
* PICTURES OF EXISTING CONTROL PANEL AT SITE HAVE BEEN ATTACHED. SIMILAR LOCAL CONTROL PANEL IS TO BE PROVIDED FOR THE NEW SYSTEM.



**CENTRAL COAL MILL
REJECT CONTROL PANEL**



FULL CORD SWITCH OPERATED	BELT SWA SWITCH OPERATED	BELT UNDER SPEED	CONV. MRC-1 OVERLOAD TRIPPED
CONV. MRC-2 OVERLOAD TRIPPED	REJECTS BIN LEVEL HIGH	REJECTS BIN LEVEL HIGH HIGH	

PULL CORD
SWITCH OPERATED

BELT SWA
SWITCH OPERATED

BELT UNDER
SPEED

CONV. MRC-1
OVERLOAD TRIPPED

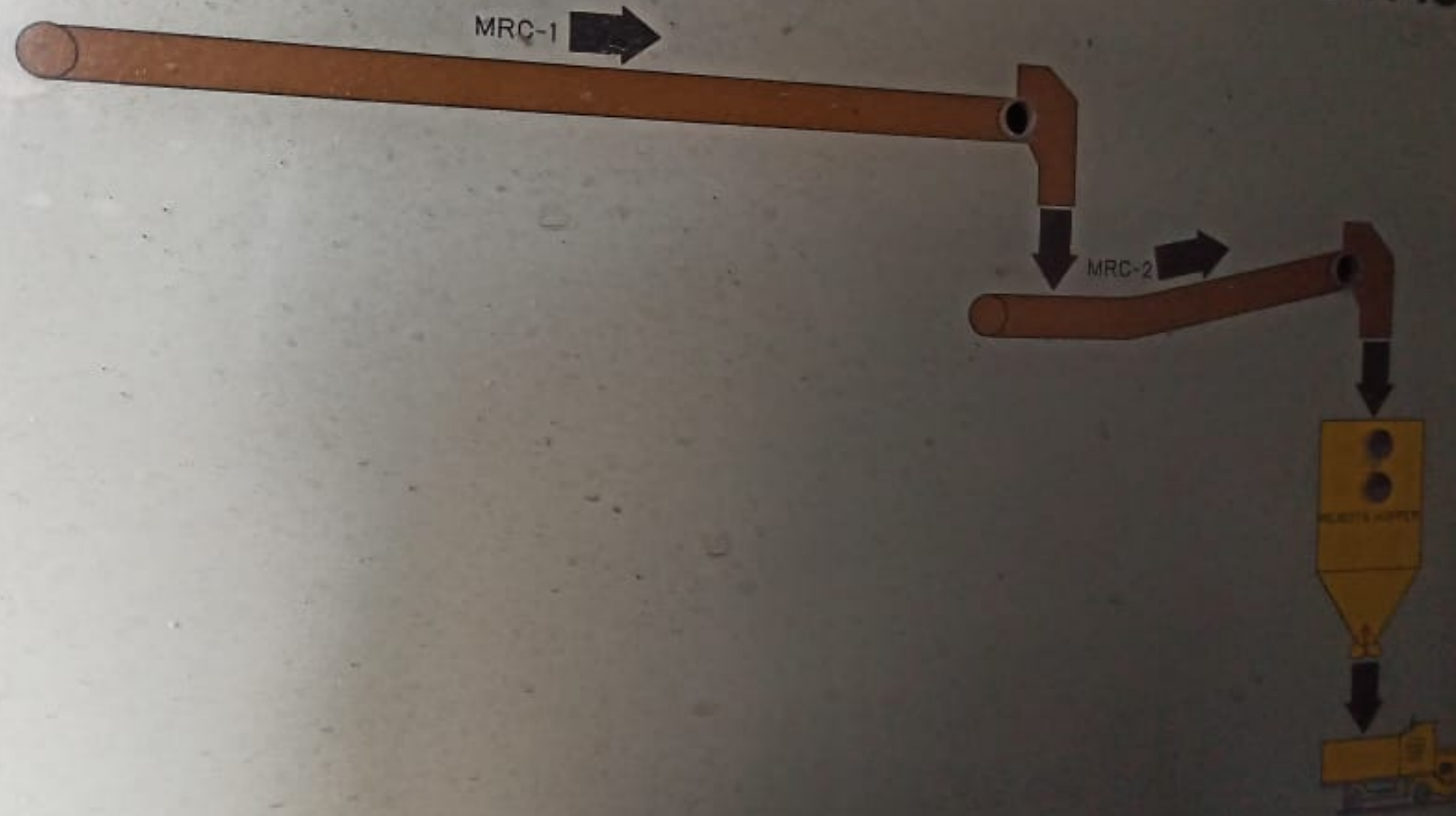
CONV. MRC-2
OVERLOAD TRIPPED

REJECTS BIN LEVEL
HIGH

REJECTS BIN LEVEL
HIGH HIGH

ANNUNCIATOR

MILL REJECTS HANDLING SYSTEM-STAGE I





QUALITY ASSURANCE

CLAUSE NO.	QUALITY ASSURANCE
1.01.00	GEAR BOX
1.01.01	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.
1.01.02	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.
1.01.03	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.
1.02.00	KNIFE GATE VALVE
1.02.01	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
1.03.00	STORAGE SILO/BIN
1.03.01	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.
1.04.00	FLUID COUPLING:
1.04.01	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
1.04.02	Functional test on fusible plug for each type of coupling shall be conducted at shop. All couplings to be run tested at shop.
1.04.03	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.
1.05.00	ELECTRIC HOIST & OVERHEAD TRAVELLING CRANE:
1.05.01	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
1.05.02	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.
1.05.03	All butt welds of rope drum shall be subjected to 100% RT. DP test shall be carried out after stress relieving of rope drums.
1.05.04	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.
1.05.05	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.
1.06.00	For items/components like pipes, valves, pumps, compressors, specialties etc. refer table below

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 joints 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
Page 4 of 5				

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-02

LT POWER CABLE

QUALITY ASSURANCE

LT Power 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	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

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	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.

QUALITY ASSURANCE

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-06

LT SWITCHGEAR & BUS DUCT

LT SWITCHGEAR

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERIS-TICS	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY														
Sheet Steel (IS : 513)	Y	Y		Y	Y		Y							
Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
Support Insulator	Y	Y	Y	Y			Y							
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y			Y
Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y			Y				Y
Power & Aux. Contactors (IS : 13947)	Y	Y				Y	Y			Y				
Protection & Aux. Relays (IS : 3231) (IEC 60255 / IEC 61850)	Y	Y				Y	Y			Y				Y
Control & Selector Switches (IS : 13947)	Y	Y				Y	Y			Y				
CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
MCCB (IS : 13947)	Y	Y					Y			Y				
Indicating Meters (IS : 1248)	Y	Y				Y	Y			Y				Y
Indicating Lamps (IS : 13947)	Y	Y				Y	Y			Y				
Air Break Switches (IS : 13947)	Y	Y				Y	Y			Y				
Control Terminal Blocks	Y	Y				Y	Y							

LT SWITCHGEAR

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERISTICS → ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y				Y	Y							
Control Transformer (IS : 12021)	Y	Y				Y	Y			Y				Y
Push Buttons (IS : 4794)	Y	Y				Y	Y			Y				
Transducer (IEC : 60688)	Y	Y				Y	Y			Y				Y
MCB (IS : 8828)	Y	Y				Y	Y			Y				
Breaker Handling Trolley	Y	Y				Y			Y	Y				Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y							
LT SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y		Y	Y	Y

Notes:

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

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												

QUALITY ASSURANCE

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-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-QI-03

PROCESS CONNECTION & PIPING

QUALITY ASSURANCE

PROCESS CONNECTION & PIPING

TESTS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening,flaring,hydrotest,hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydraulic impulse and vibration test (R)	Tests as per standards & specification
ITEMS																	
Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y	Y	Y*		Y		Y	Y								
Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	Y			
Impulse pipes and tubes	Y		Y		Y			Y							Y		
Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
Compression fittings	Y		Y					Y						Y	Y	Y	
Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
Copper tubings ASTM B75	Y							Y									Y
*-applicable for painted junction boxes. Note: R-Routine Test A- Acceptance Test Y – Test applicable Note: 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-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

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	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

CLAUSE NO.	QUALITY ASSURANCE			
	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/			
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 4 of 17

CLAUSE NO.	QUALITY ASSURANCE			
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			
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 5 of 17

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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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2.3.0	Acceptance criteria shall be			
	a) When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation			
	b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation.			
	c) Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement			
	MASONRY AND ALLIED WORKS			
	The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable.			
	All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpend properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below:			
	Sl. No.	Type of Check	Tolerance	
		Deviation in verticality in total height of any wall of a building	Shall not exceed ± 12.5mm (more than one storey) ± 6mm per 3m height (within a storey)	
		Deviation from the position shown on the plan of any brickwork	Shall not exceed 12.5mm (more than one storey)	
	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	Shall not exceed 6mm		
	Deviation of bed joint from horizontal in any length, and it	Shall not exceed 6mm (upto 12m) Shall not exceed 12.5mm total (in any length over 12m)		
	Deviation from the specified thickness of bed-joints, cross-joints or perpend	Shall not exceed ± 3mm		
	Finished plastered surface	Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface		
	The average thickness of plaster	Not be less than the specified thickness		
	The minimum thickness over any portion of the surface	Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster		
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2.4.0	CONCRETE WORKS For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted. The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement, compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance. The equipment, deployment of manpower and machinery shall arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works. Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of engineer-in-charge. Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars. Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494. All the materials, equipment, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete. If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45μ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production. The acceptance criteria of concrete shall be in accordance with clause no.16 of IS 456. However in exceptional circumstances and that too in non-critical areas, the engineer may accept concrete work which is marginally unacceptable as per the criteria laid down in IS 456. For such accepted work, payment shall be made at a reduced rate pro rata to the concrete cube strength obtained, against that stipulated.			
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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.																							
TOLERANCES <table><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>				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><th>Thickness of thickest part at the area of welding / heat affected zone</th><th>Welding using other than low hydrogen welding electrodes IS 2062</th><th>Welding using low hydrogen welding electrodes or submerged arc welding IS 2062</th></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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2.9.0 2.10.0 2.11.0	tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832, part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness. FIRE PROOF DOORS Fire Proof doors shall be tested for the requirements mentioned in the Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system WATER PROOFING The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the NTPC approved brand / source and the works shall be executed by the authorized applicator of the supplier Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried electrometric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel/ drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course. WATER SUPPLY, DRAINAGE & SANITATION. Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in NTPC technical specification. The obstructions in sewer lines shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight. The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under test / working condition of pressure and flow, when all draw-off taps are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost.			
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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.			
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 15 of 17

CLAUSE NO.	QUALITY ASSURANCE		एनटीपीसी NTPC	
	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.		
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