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TECHNICAL SPECIFICATION
FOR
INERT GAS EXTINGUISHING SYSTEM

PROJECT : 2 x 660 MW UDANGUDI STPP

CUSTOMER : TANGEDCO

Revisions :	Prepared by:	Checked by:	Approved By:	Date
—	-SD-	-SD-	-SD-	29/04/2022
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.	<p>1. INTENT OF SPECIFICATION:</p> <p>The intent of this document is to establish the minimum requirement of design, engineering, supply, selection, selection, manufacture, assembly, inspection, shop testing, shop painting, transportation and delivery at Patratu site in proper condition and supervision of Erection & Commissioning at site for the Inert Gas Extinguishing System, which forms part of this 2 x 660 MW Udangudi project at Udangudi, Tamil Nadu.</p> <p>The equipment and supply shall conform to high standard of engineering and applicable codes/standards and shall be capable of performing intended operation in a manner acceptable to the Purchaser and end customer</p> <p>2. SPECIAL NOTES TO BIDDERS</p> <p>2.1. This specification shall be read in conjunction with all its annexures listed later in this specification. In case of any discrepancy arising between this specification & its annexures, the most stringent of all (as determined by purchaser) shall be followed. Further, if a requirement in this specification or any of the annexures, calls for a decision from the Purchaser, it shall be bidder’s sole responsibility to clearly bring out/highlight the same distinctively in his pre-bid queries (Annexure-7), so as to enable purchaser to furnish their decision/clarification. If such issues/requirements are not duly addressed by bidder during the pre-bid stage and if such issues/requirements are observed later during order execution stage, it shall be binding on the bidder to comply with the final decision made by the purchaser subsequently, without any cost, delivery, or any other commercial implications.</p> <p>2.2. All materials supplied under this contract shall be new and unused.</p> <p>2.3. All equipment/items applicable, shall be UL/FM/VDs/LPCB approved.</p> <p>2.4. Any additional equipment, material, services etc., which are not specifically mentioned in this specification, but required to make the IGES complete in all respects, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be covered under the scope of this specification.</p> <p>2.5. All mounting hardware/ accessories/fittings etc. required for the erection of Inert gas Extinguishing System shall be included in the scope of bidder and the same shall be included in the base price even if such items are not explicitly mentioned in this specification.</p> <p>2.6. The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipments and the IGES system as a whole.</p>			
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2.7. Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.

2.8. The design information, specifications and drawings indicate the "Minimum" requirements and are intended to enable Bidders to ascertain the extent of the work involved. Bidders are expected to supplement the information included in this specification as required and submit a comprehensive bid.

3. PROJECT DESCRIPTION

Owner	Tamil Nadu Generation & Distribution Corporation Ltd.
Project	2 x 660 MW Udangudi STPP
Location	Udangudi, Tamil Nadu

4. GENERAL SYSTEM REQUIREMENT

4.1. For the design of the plant, it is necessary not only to consider the requirements of operation, but also, by suitably planning the layout, the convenience of inspection, cleaning, maintenance and repair.

4.2. In order to achieve the reliability, high efficiency and safe operation of the plant, it is also necessary to consider various precautions to safeguard the operating and maintenance personnel.

4.3. After award of work, before finalizing especially the layout/Zones of system, pipe routes and other services, the bidder shall carry out a site survey to identify the location & details of existing facilities that may interfere with his proposed facilities. He shall suitably modify his layout/levels to prevent dislocation of existing facilities without any commercial implication to the purchaser.

4.4. The dimensions of the cylinder room is (11.8m x 11.3m) and cannot be changed now. Bidder to select the system (as per NFPA-2001 guidelines) to which while meeting the intended requirement as per the specification and shall be properly housed in the inert gas cylinder room. Adequate space for Operation & Maintenance of cylinder shall also be considered while selecting the inert gas system.

4.5. If during the execution of works it is found that there is interference with other facilities / structures, the Bidder shall revise his design/detailed drawings to clear the interference and shall provide all necessary measures for the safety of structures under construction. No claim in terms of cost or relaxation in time shall be entertained for any redesign, rework and for the safety measures provided.



4.6. Bidder is also required to provide on the job training to Purchaser /End Customer's operation personnel by associating them in all the day to day pre-commissioning, commissioning and maintenance activities and process operations. The cost of all such training shall be deemed to be included in the price quoted by the bidder. Bidder shall not be eligible to raise any extra claim in this regard.

5. APPLICABLE CODES & STANDARDS

5.1. The design, engineering, installation, testing, commissioning of the package shall be as per all relevant & applicable codes/standards, however specifically the following :

- NFPA 2001: National Fire Protection (Standard on Clean Agent Fire Extinguishing System)
- VDS – Flow calculations of the system
- UL/FM/LPCB/VdS approval for IGES equipment such as cylinders, contact gauges, pressure regulators etc.
- ASTM A 106 - Piping
- ASTM A 105, Grade WPB, ANSIB-16.9 for 65 NB & Above - Butt Weld Fittings
- ASTM A-105, ANSI B-16.11 for 50 NB & Below – Socket Weld Weld fittings
- ANSI B-16.5, Class 1500 # - Flanges
- IS 2932 : Enamel , synthetic , Exterior
- IS:1248(Part I)-1983 -Direct acting indicating analogue electrical measuring and their accessories: Part I General requirements(Second revision)
- IS:1248(Part II)-1983 -Direct acting indicating analogue electrical measuring instruments and their accessories: Part II Ammeters and Voltmeters (Second revision)
- IS:6236-1971-Direct recording electrical measuring instrument (Reaffirmed 1987)
- IS: 2419-1979 -Dimensions for Panel mounted indicating & recording electrical instruments (first revision) (with Amendment No.1.)
- IS:8573-1977 -Digital electronic DC voltmeters and DC electronic analogue-to-digital convertors(with Amendment No.1) (Reaffirmed1991)



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- ANSI B 16.5 - Pipe flanges and flanged fittings.
- SMPV rules , PESO Nagpur (For Storage Cylinders)
- Clean Agent Manufacturer's recommendations
- VDE: 0150, protection against corrosion due to stray currents from DC installations.
- Statutory Requirements

5.2. Requirements of the following local statutory authorities (as applicable) shall be taken into account for compliance:

- a. VDE : 0150, protection against corrosion due to stray currents from DC installations.
- b. DIN : 30676
- c. Requirement of Petroleum & Explosives Safety Organization (PESO), Nagpur, India.

5.3. Latest edition of applicable codes/Standards/Statutory Regulations referred to in the Bid Document shall correspond to the edition as on the date of issue of bid.

5.4. All addenda including the latest addenda to all the above codes and standards (latest editions) shall be followed by the bidder.

5.5. All the legal formalities including preparation of documents, furnishing clarifications, information etc. as and when required, for obtaining any of the permissions and approvals related to the IGES will have to be done by the bidder.

Note: Bidder to follow all other applicable statutory rules and regulations of India during manufacturing, procurement & transportation of the IGES components.

6. BIDDER'S SCOPE OF WORK

Inert Gas Extinguishing System shall be provided for the areas as mentioned below. Refer Annexure – 10 for areas to be protected and zoning details.

6.1. TG Building (El. 17.0 M)

- Control room Unit # 1
- Control room Unit # 2
- Misc Panel Room Unit # 1
- Misc Panel Room Unit # 2
- Central Equipment Room (CER) Unit # 1 & 2



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- PADO Room
- EDMS Room
- C&I Engg. Room
- Station Incharge Room
- Common Control Room
- Server / Network Room
- Conference Room
- UPS Panel & Charger Room

6.2. TG Building (El. 8.5 M)

- UPS Panel & Charger Room

6.3. Each IGES system should include the following minimum items:

- a) One (01) Inert Gas Release Panel.
- b) 1 lot of Inert Gas Cylinders required for the system along with same no. of spare cylinders. Including solenoid valves, directional valves, pilot manifold etc. and shall be FM/UL/Vds/LPCB approved.
- c) 1 Lot of Piping & fittings, pressure gauges, nozzles, threadolets, weldolets, socketolets & all other equipment/accessories required for completion of system.
- d) One lot of Armoured cables including interface cables with Fire Alarm panel and related erection hardware.
- e) One lot of Inert gas Discharge Warning Signs
- f) One lot of gas discharge EPB & inhibitor unit
- g) One lot of Pressure Operated Switches
- h) One lot of Pressure Relief Vents
- i) First Fill of consumables
- j) Erection & Commissioning spares
- k) One lot of erection hardware
- l) Special tools & tackles
- m) Mandatory spares



- n) Items like Trolleys, etc required for Refilling & Maintenance of Inert Gas cylinders.
- o) Other items not specified but required to complete the system in all respects.
- p) Engineering of Inert Gas Extinguishing System

NOTE:

- The offered IGES shall be in designed as per NFPA-2001.
- BOQ of inert gas pipes and cables shall be considered by considering welding allowances, cutting allowances etc. In addition to this, as inert gas extinguishing system is site intensive package, **a margin of 10% shall be considered over total BOQ of pipes and shall be reflected in each layout drawing.**
- **A margin of 10% shall be considered in addition to the total BOQ of erection hardware like structural steel, pipe fittings, brackets, U clamps, nuts & bolts, base plates, anchor fastners, cable clamps, conduits, cable ties etc. that are required for the erection of inert gas extinguishing system.**
- Cables shall be as per annexure – 14 attached to this specification.
- The input drawings are furnished along with the specification. The same may also be used for estimation of cables. Further, for quoting purpose bidder to consider a cable distance of 150 mtrs between Gas Release panel and Fire Alarm panel.

6.4. Special tools and tackles:

- a) The bidder shall furnish the following special tools required for operation and maintenance of the system supplied, as a part of scope of supply:

Sl. No.	Description	Quantity
1.	Multimeter	1 no.
2.	Hand drilling machine with complete set drill bit	1 set
3.	Hammer	1 no.
4.	Hexaframe	1 no.
5.	Instrument Box	1 no.
6.	Insulation Pliers	1 no.
7.	Nose Pliers	1 no.
8.	Screw Driver	1 no.
9.	First Aid Box	1 no.



Any other tools required for repairs and maintenance but not mentioned above shall be supplied by the bidder.

- b) All special tools and tackles which are necessary or convenient for erection and commissioning of the Inert Gas Extinguishing System shall be supplied at site by bidder. Price of these items shall be construed to be included in the main package price. No separate price for the same shall be offered
- c) All the special tools and tackles shall be shipped in separate heavily constructed wooden boxes.

Notes:

- All Tools and tackles required for dismantling, maintenance, adjustment, and calibration of the all the equipments that form part of Inert Gas Extinguishing System shall be supplied.
- Bidder shall provide all equipment like trolleys, etc. required for Refilling & Maintenance of Inert Gas cylinders.
- Bidder to note that if at a later stage the requirement of any other special tool & tackles is required for the Package, same has to be supplied by bidder without any delivery or commercial implication. Decision of the Purchaser regarding the requirement of any additional tools and tackles will be final and binding on the Purchaser.
- All special tools and tackles shall be handed over purchaser, prior to the issuance of the PROVISIONAL ACCEPTANCE CERTIFICATE for the IGES.

6.5. Mandatory Spares for IGES:

The following specified spare parts shall be supplied. The price for each listed special spare part shall be quoted individually in the Price Bid Format, the total price is included in the total contract price.


Sl. No.	Description	Quantity
1.	Not Applicable	
2.		
3.		
4.		
5.		


7. PRODUCT DESCRIPTION

7.1. Gas release panel:



- a) This Panel shall be designed and manufactured keeping in mind the ease of installation. Operating and maintenance of the panel and the associated system accessories. The design shall be totally modular in concept and in the unlikely even of any fault developing in the panel; the system can be brought back on line by simply replacing the faulty PCB module.
- b) Panel shall be located in inert gas cylinder room.
- c) The panel shall be provided with automatic Electronic battery charger unit, which will keep the backup batteries fully charged. The panel has various input/output modules. Each indication and control is labeled with easy to understand making it very simple to understand.
- d) 230V AC, 1 phase, 50Hz shall be provided at one point for Gas release panel. Further distribution if needed shall be in bidder's scope.
- e) Gas Release Panel shall be provided with battery backup of 24 hours in normal condition and 0.5 hours in alarm condition. The panel shall also have the capability for both trickle and boost charging of the batteries.
- f) The control panel consists of a lockable front door fitted with a 3 mm thick acrylic sheet, enabling visualizes the various indications and controls within the housing. The unit shall be designed in such a way so as to facilitate servicing. Cable entry shall from Bottom and removable plate shall be provided for cable entry.
- g) Panel shall be able to read the signals from conventional devices and potential free contact from other panels. It shall be capable of monitor each zone cable and DV, Cylinder solenoid valve.
- h) Suitable selector switches shall be provided for "Main/Standby" cylinder bank supply selection.
- i) Facility for manual release of gas/manual abort of gas release through push buttons shall be provided along with selection facility of "Auto/Manual" from the panel.
- j) Following are the minimum signals required through potential free contacts of gas release panel:
 - Pre-Discharge (one each for each zone)
 - Gas Discharged (one each for each zone)
 Any other signals for which potential free contacts are required shall be finalized during detailed engineering.

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		<p>a) 2 sets of inert gas cylinder (one working + one standby) banks for each of the IGES shall be provided in a separate Clean Agent Room and securely installed with a provision for convenient individual servicing.</p> <p>b) The design pressure for storage cylinders shall be suitable for the maximum pressure developed at 55 deg. C and shall be designed to meet the requirements in NFPA-2001.</p> <p>c) All cylinders shall bear the marking as detailed out in NFPA - 2001 and shall be duly listed by UL / FM / VDS / LPCB in addition to approval by CHIEF CONTROLLER OF EXPLOSIVES – INDIA (PESO).</p> <p>d) The storage cylinders shall have accessories such as contact gauges/pressure gauges/switches, liquid level indicators (if applicable), refilling connections, relief devices (if applicable) etc. A reliable means of indication shall be provided to determine the pressure in cylinders.</p> <p>e) All the contact gauges/pressure gauges/switches, manifold connections etc. shall be easily removable for servicing/maintenance without any loss of gas.</p> <p>f) Automatic means such as check valves shall be provided to prevent gas loss, if the system is operated, when any containers are removed for maintenance.</p> <p>g) The storage containers shall not be charged to a fill density or super pressurization level different from the manufacturer's listing.</p> <p>h) All the inert gas agent cylinders shall have a permanent nameplate or permanent marking to indicate details as mentoned in Cl. 4.1.4.2 of NFPA – 2001.</p> <p>7.3. Pipes, Fittings & other Operating devices:</p> <p>a) Piping shall be of noncombustible material. The selection of the pipe shall be as per NFPA-2001.</p> <p>b) Pipe joints other than threaded, welded, brazed, flared, compression, or flanged type shall be listed or approved.</p> <p>c) The fittings shall withstand a minimum rated working pressure as mentioned in NFPA-2001. The selection of the fittings shall also be inline with requirements of NFPA-2001.</p> <p>d) The pressure relieving device (if any) shall be designed for the maximum design pressure of the system and shall conform to the requirements of NFPA-2001 or as specified by listing authorities.</p>		
Ref. Doc	7.4. Valves:			

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		<p>a) All valves shall be listed or approved for the intended use.</p> <p>b) All gaskets, O-rings, sealants, and other valve components shall be constructed of materials that are compatible with the agent. Valves shall be protected against mechanical, chemical, or other damage.</p> <p>c) Special corrosion-resistant materials or coatings shall be used in severely corrosive atmospheres.</p> <p>d) Where directional valves are used for multihazard protection, the directional valves shall be listed or approved for use with the installed suppression system.</p> <p>e) Where directional valves are used for multihazard protection, the control equipment shall be specifically listed for the number, type, and operation of those valves.</p> <p>7.5. Nozzles:</p> <p>a) Discharge nozzles along with deflector shields shall be listed and quantity & design shall be such that complete quantity of gas is uniformly distributed throughout the hazard volume within the specified discharge time without disturbing the ceilings, lighting fixtures etc.</p> <p>b) Discharge nozzles shall conform to NFPA 2001 and shall be FM/UL/LCPB/Vds approved.</p> <p>c) Discharge nozzles used in the system shall be listed for the use intended for discharge characteristics.</p> <p>d) Listing criteria shall include flow characteristics, area coverage, height limits, and minimum pressures. Discharge orifices and discharge orifice plates and inserts shall be of a material that is corrosion resistant to the agent used and the atmosphere in the intended application.</p> <p>e) Special corrosion-resistant materials or coatings shall be required in severely corrosive atmospheres.</p> <p>f) The selection of nozzle orifice shall be such discharge time required to achieve 95% of the minimum design concentration for flame extinguishment based on 35% safety factor shall not exceed 120 seconds for the inert gas selected as per NFPA 2001.</p> <p>g) Each nozzle shall be permanently marked to identify the manufacturer as well as type and size of orifice.</p>		
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h) Where clogging by external foreign materials is likely, discharge nozzles shall be provided with frangible discs, blowoff caps, or other suitable devices. These devices shall provide an unobstructed opening upon system operation and shall be located so they will not injure personnel.

7.6. Warning Signs:

- a) Alarms or indicators or both shall be used to indicate the operation of the system, hazards to personnel, or failure of any supervised device.
- b) Audio and visual pre-discharge alarms shall be provided within the protected area to give positive warning of impending discharge.
- c) The operation of the warning devices shall continue after agent discharge until positive action has been taken to acknowledge the alarm.
- d) Alarms indicating failure of supervised devices or equipment shall give prompt and positive indication of any failure and shall be distinctive from alarms indicating operation or hazardous conditions.
- e) Warning and instruction signs shall be provided at the entrances to and inside the protected areas.
- f) The safety sign format and color and the letter style of the signal words shall be in accordance with ANSI Z535.
- g) Abort switches shall be located within the protected area and shall be located near the means of egress for the area. The abort switch shall be of a type that requires constant manual pressure to cause abort. In all cases, the normal manual control and the manual emergency control shall override the abort function. Operation of the abort function shall result in both audible and distinct visual indication of system impairment. The abort switch shall be clearly recognizable for the purpose intended.

7.7. Operating Devices:

- a) Operating devices shall include agent-releasing devices or valves, discharge controls, and shutdown equipment necessary for successful performance of the system.
- b) Operation shall be by listed mechanical, electrical, or pneumatic means. An adequate and reliable source of energy shall be used.
- c) All devices shall be designed for the service they will encounter and shall not readily be rendered inoperative or susceptible to accidental operation. Devices normally shall



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be designed to function properly from –20°F to 130°F (–29°C to 54°C) or marked to indicate temperature limitations.

- d) All devices shall be located, installed, or suitably protected so that they are not subject to mechanical, chemical, or other damage that would render them inoperative.
- e) A means of manual release of the system shall be provided. Manual release shall be accomplished by a mechanical manual release or by an electrical manual release when the control equipment monitors the battery voltage level of the standby battery supply and provides a low-battery signal. The release shall cause simultaneous operation of automatically operated valves controlling agent release and distribution.
- f) A discharge pressure switch shall be required where mechanical system actuation is possible.
- g) The discharge pressure switch shall provide an alarm initiating signal to the releasing panel.
- h) The normal manual control(s) for actuation shall be located for easy accessibility at all times, including at the time of a fire.
- i) The manual control(s) shall be of distinct appearance and clearly recognizable for the purpose intended.
- j) Operation of any manual control shall cause the complete system to operate as designed.
- k) Manual controls shall not require a pull of more than 40 lb (178 N) nor a movement of more than 14 in. (356 mm) to secure operation. At least one manual control for activation shall be located not more than 4 ft (1.2 m) above the floor.
- l) Where gas pressure from the system or pilot containers is used as a means for releasing the remaining containers, the supply and discharge rate shall be designed for releasing all the remaining containers.
- m) All devices for shutting down supplementary equipment shall be considered integral parts of the system and shall function with the system operation.
- n) All manual operating devices shall be identified as to the hazard they protect.

7.8. Pressure Relief Vents:



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- a) Pressure relief vent area, or equivalent leakage area, shall be calculated and provided for the protected enclosure to prevent development of pressure difference during discharge.

7.9. First Fill of Consumable:

- a) All the first fill consumables like gas etc. and replacements, if any, are in bidder scope till successful handing over of plant to BHEL after successful completion of erection and commissioning and /or site performance test.
- b) Price of these items shall be construed to be included in the main package price. No separate price for the same shall be offered.


7.10. Erection & Commissioning Spares


- a) All commissioning spares as required during erection and commissioning of the Inert Gas Extinguishing system is included in bidder's scope.
- b) Bidder to ensure that all the spares are procured from the original equipment manufacturers (as per their recommendation) and shall make them available at site well before the start of commissioning activities.
- c) Bidder shall also ensure supply of all erection & commissioning spares along with main equipment as per his experience, for replacement of damaged or unserviceable ones during the execution of the project by bidder at site, to avoid delay in the project schedule.
- d) Price of all the above items shall be construed to be included in the main package price. No separate price for the same shall be offered.


8. BIDDER'S SCOPE OF SERVICES

8.1. Supervision of erection & commissioning

- a) Supervision of erection, commissioning & performance testing at site for the supplied system shall be included in bidder's scope of service.
- b) Bidder to note that the supervision charges for erection & commissioning shall consists of the following:
- Per day supervision charges of an Engineer including all other expenses like boarding, lodging, local travel, insurance etc.

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		<ul style="list-style-type: none"> • Travel expenses (inclusive of any clearance charges like Visa fee etc, insurance) from / to vendor works to site. c) Per diem charges shall be applicable from the day bidder’s person reaches site, up to the day he leaves the site. d) All payments towards supervision of E&C shall be made only after BHEL-site supervision. e) Bidder to mobilize concerned competent person for supervision of Erection & commissioning activities within a period of 7 days of receipt of intimation in this regard by BHEL. f) Bidder to quote supervision of erection and commissioning activities strictly as per BHEL’s price format (Annexure-1). g) Engineering of cables, cable routing and cable scheduling within Inert Gas extinguishing system. h) Engineering of cables, cable routing and cable scheduling between Gas release panel and Fire Alarm Panel. <p>9. DESIGN OF IGES SYSTEM</p> <p>9.1. General</p> <ul style="list-style-type: none"> a) Complete design and all the system components/equipment or major system components (as applicable for approving/listing agencies) shall be approved and listed by UL/FM/VdS/LPCB and shall also be approved by TAC/TAC accredited professional (s) before installation. b) The IGES shall be a total flooding centralized system with directional valves and have 100% standby cylinders. c) The system shall be centralized for all the rooms protected, and shall be designed as total flooding for the single largest room volume (ceiling void + room void + floor void) of control room. The areas to be protected by inert gas extinguishing system shall be divided into different zones as per attached drawings. d) The clean agent piping and nozzles shall have to planned clearing following facilities coming on its route , in the areas where protection is being envisaged: <ul style="list-style-type: none"> • The beam and ribs which criss-cross the ceiling • Path of AC ducts • Cabling in false flooring 		
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		<ul style="list-style-type: none"> • Lighting/Illumination fixtures, detectors etc. <p>e) System design, specifications, working plans, flow calculations etc. shall be prepared in line with NFPA-2001 or as specified by listing authorities and shall be approved by Owner.</p> <p>f) IGES system shall be interconnected with FDA system of the plant.</p> <p>9.2. Design Concentration, Quantity & Discharge Time</p> <p>a) Minimum design concentration of INERT gas fire extinguishing system shall be as per NFPA-2001. However higher concentration may be used, if it is specified by the agent manufacturer/system supplier (OEM) for the area protected.</p> <p>b) Bidder shall design the system to meet the minimum requirements of Clean Agent System as per NFPA-2001 and having design concentration as specified at 70 Deg. F (21 Deg. C) for the single largest risk zone to be protected.</p> <p>c) The complete volume of the rooms including the above false ceiling and below false flooring shall be considered for estimation of quantity of gas and containers.</p> <p>d) When determining the gas quantity, the minor leakage losses through window and door opening shall be considered. However, it is necessary that all the opening should be minimised in order to retain concentration of Inergen agent for 10 minutes after discharge to prevent reflash/reignition for effective extinguishment.</p> <p>e) Further volume of re-circulating type air conditioning system & its duct work (at least upto the automatic fire dampers of the ducts) shall be considered as a part of the total volume so that the design concentration is achieved throughout the hazard area. Further gas quantity will be adjusted for ambient pressure & temperature conditions.</p> <p>f) To provide primary supply of gas & its cylinders, along with 100% (one hundred percent) standby/reserve gas quantity and cylinders for single largest hazard being protected (as per NFPA 2001).</p> <p>g) The discharge time period shall be such that 95% of the minimum design concentration for flame extinguishment based on 35% safety factor is achieved within 120 seconds. The flow calculations shall establish this criterion.</p> <p>h) The quality of gas shall conform to relevant design standard such as NFPA-2001 or as specified by listing authorities.</p>		
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<p align="center">COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> <p>i) Calculation shall be provided by the designer to prove that the area is not pressurised and extinguishing capability is not affected due to provided ventilation of that area. Pressure vent shall be provided for each protected area as per system requirement.</p> <p>9.3. System Flow Calculation</p> <p>a) System flow calculation shall be performed using a calculation method listed or approved by the authority having jurisdiction (i.e. UL/FM/Vds/LPCB) and shall be approved by TAC accredited agency. The system design shall be within the manufacturers listed limitations.</p> <p>b) Approval certificate of software from UL/FM/Vds/LPCB etc. shall be submitted along with the offer.</p> <p>c) Bidder shall also provide sufficient safety facilities (like properly designed louvers etc.) in the risk areas to dissipate over pressurisation due to release of Clean Agent and also provide calculation in support of same for each protected area.</p> <p>9.4. Clean Agent Quantity</p> <p>a) Minimum design concentration of Clean Agent gas shall be as per NFPA-2001 at 70 deg F by volume for clean agent fire extinguishing system based on approved/listed flow calculation method.</p> <p>b) Clean agent concentration requirement shall be computed considering the volume of the hazard as specified. In addition to the concentration requirement as specified, 20% of the gas quantity as computed above, shall be added to compensate for leakages and extinguishing efficiency as per NFPA requirements. However, bidder drawing shall quote minimum quantity of agent for volume as given in the scope.</p> <p>9.5. The principle of operation shall be as follows</p> <p>a) Whenever there is a fire in any of the rooms protected, the same will be detected by the automatic fire detector. It will in turn annunciate a fire signal in the fire alarm panel (FAP). The first detection signal will actuate the hooters in the room and warning lights, so as to warn the people to evacuate and prevent people from entering the room. When, another automatic fire detector in the room registers a fire condition, the necessary fire dampers in the AC / Ventilation system will get closed (from their respective panel/s based upon confirmed fire signal from the FAP), the clean agent extinguishing system will get actuated and the time delay for the release starts (normally 10 seconds however shall be based on the recommendation of the bidder). After the time delay elapses, the clean agent is released. The release mechanism operates by opening the electrical actuator of the pilot cylinder, which then in turn open the quick opening valve of the designated slave cylinders, and thus</p>				
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releasing the gas in the manifold. The gas then is carried through piping to the room in fire and released through the nozzles located strategically in the room. The gas is maintained in the room for a specified period of time (about 10 min. however shall be based on the recommendation of the bidder), during which the fire is extinguished.


- b) In case, it gets known during the time delay period before release, that there is no fire but the alarm is false alarm, the gas release can be aborted by pressing the abort switch. Also, if due to any reason it is found that the gas is not getting released even after the time delay period, a manual release can be initiated by pressing the manual release button.
- c) The system shall be designed based on the single largest risk area to be protected. However, the grouping of cylinders shall be made in such a way that discharge takes place corresponding to the volume of the risk under fire.
- d) The system shall include electrically actuated automatic Clean Agent Fire Extinguishing System complete with filled up Clean Agent cylinders cylinder rack, manifolds, Pressure reducing devices, cylinder valves, pipes, discharge nozzles, bracket support, hangers, and such other fittings as necessary for complete installation of the system, including chipping of existing RCC/brick walls/cutting of steel plates etc. or removal & re-fixing of false ceiling and floor of risk areas, fixing fasteners and other activities required to install the system.
- e) The system shall also comprise of the different modes of operation, actuation and cancellation facility etc. with necessary local control panel mentioned elsewhere in this specification.
- f) Operating devices and Local control panels shall be provided for this system. The bidder shall have to offer 100% Clean Agent filled standby cylinders. (i.e. A reserve clean agent filled cylinders with manifold , directional valves and automatic change over to any of the two banks after actuation of main cylinders to be provided in each risk area i.e. 100% reserve).


9.6. System Operation


- a) System operation shall be possible by the following means:
 - Automatically due to fire detection in protected area
 - Operation of manual release push button located adjacent to protected area.
 - By operating manual lever provided on electrical/manual control head on pilot cylinder
 - By push button actuation at Clean Agent Control panel , in manual mode

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<p align="center">COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.</p>		<p>b) The clean agent shall be discharged /actuated automatically after an adjustable time delay based on the detection signal received. The delay shall be minimum 30 sec.; however it shall be adjustable from 30 to 120 sec. In the local control panel of clean agent system, there shall be one hooter, which shall operate once the gas is released. During time delay, there shall be a pre-discharge alarm (audio+visual). Hooter shall follow the alarm once the gas is discharged.</p> <p>9.7. Clean Agent Gas & Its Grouping/Distribution</p> <p>a) The quantity of clean agent gas provided shall be sufficient to protect the single largest risk with 100% standby. The system for every individual risk shall have its own distribution piping, nozzles, alarms and actuation system etc.</p> <p>b) Suitable combination of cylinders shall be made to cater to all the risk areas individually.</p> <p>c) Both primary and standby cylinders shall be permanently connected to distribution piping through manifold and arranged for easy and automatic changeover. Suitable selector switches be provided for "Normal/ Standby" supply selection.</p> <p>d) Since the system is designed for the largest risk and there are several risk areas varying in size in a particular building, the system shall permit the use of required no of cylinders for any individual risk involved so that the concentration of gas in that risk area does not exceed the NOAEL as per NFPA-2001.</p> <p>9.8. Gas properties and its discharge characteristics</p> <p>a) Physical properties of Inert gas agent shall be as per NFPA-2001 latest edition.</p> <p>b) The agent container pressure shall be as recommended in NFPA 2001.</p> <p>c) The agent discharge shall be substantially completed in a nominal 120 sec.</p> <p>d) For inert gases the measured discharge time is considered to be the time when the measuring device starts to record reduction of oxygen until the design oxygen reduction level is achieved.</p> <p>e) The min. O₂ concentration shall be as per NFPA-2001</p> <p>10. INSPECTION, TESTING, APPROVAL & COMMISSIONING</p>		
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.	<p>10.1. Final Inspection including document verification as per approved QAP shall be carried out by CUSTOMER /CONSULTANT/ CUSTOMER’s Third Inspection Agency & BHEL/BHEL’s Third Party Inspection Agency at vendor works.</p> <p>10.2. Inspection at Vendor works as per approved QAP.</p> <p>10.3. Site Acceptance Test at site as per approved testing procedure.</p> <p>10.4. Bidder after satisfying that all inspection requirements as per approved Inspection Testing Plan (ITP) and applicable specifications / documents have been taken care by Third Party Inspection Agency (TPIA), shall submit copy of the Inspection Certificate and all Quality control records to Purchaser in requisite copies along with Statutory Certificates if any, such as IBR, CCE, PESO etc. duly endorsed by their Quality Control Manager.</p> <p>10.5. Purchaser and / or End customer reserve the right to carry out surprise checks on all material either at manufacturer’s works or at site. In case of any rejection at site, the whole lot will be rejected and bidder shall get the entire lot replaced without any time or delivery implication to the purchaser.</p> <p>10.6. TPIA shall check the calibration status and traceability of all instruments used by the supplier, for testing. In case, TPIA uses their own instruments for testing purposes, similar certification shall be ensured.</p> <p>10.7. In case any non-conformity is noticed, 100% of the lot shall be checked by TPIA and all non-conforming material shall be replaced by the bidder.</p> <p>10.8. Testing</p> <p>a) After installation, the complete system shall be inspected and tested as per relevant clauses of NFPA-2001. Wherever testing is mentioned at a regular frequency in these chapters, the bidder shall carry out initial testing and records shall be presented to Owner for approval of the installation.</p> <p>b) Prior to handing over of the system to Employer, the supplier shall provide operational training to Employer’s operating personnel which shall consist of control system operation, trouble procedures, emergency procedures, safety requirements etc.</p> <p>11. MARKING, PACKING AND DISPATCH</p> <p>11.1. All items shall be marked (stamped/etched) in accordance with the applicable code/standard/specification. In addition, the item code, if available, shall also be marked.</p> <p>11.2. For ease of identification, the color of painted strip (wherever required) shall be as per the applicable standard.</p>			
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<p align="center">COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.</p>	<p>11.3. Part number/Dispatch link-up of all the equipment's/items supplied and also their correlation with system/drawing/approved BOQ.</p> <p>11.4. Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinarily or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.</p> <p>11.5. The equipment shall be transported to site by the vendor in fully assembled condition. However, in case some components are liable to be damaged during transit, the same shall be dismantled and supplied separately, to be reassembled at site the vendor. Assembly of the item supplied loose at site and repairing of any item damaged during transport shall be in the vendor's scope. The vendor shall send each consignment to site with a detailed packing list.</p> <p>11.6. All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to the finish. Crates/cases shall have skid bottom for handling.</p> <p>11.7. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchaser order.</p> <p>11.8. The equipment/items may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.</p> <p>11.9. All items shall be dry, clean and free from moisture, dirt and loose foreign material of all kinds.</p> <p>11.10. All items shall be protected from rust, corrosion, and mechanical damage during transportation and handling.</p> <p>11.11. Each variety and size of item shall be supplied in separate packaging marked with the purchase order no., item code (if available), and the salient specifications.</p> <p>11.12. All electrical, instrumentation etc., shall be properly packed to prevent damage during transport, storage, handling at site.</p> <p>11.13. All the items which the Bidders considered liable to be damaged during shipment or storage, shall be packaged for separate shipment. If instruments are removed from the panel, they and their connection shall be suitably tagged to ensure simple re installation</p>			
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		<p>at the job site. Each instrument shall be sealed in plastic bags containing moisture absorbing dessicants.</p> <p>11.14. It shall be bidder’s sole responsibility to protect all the material during period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and including delays in transit.</p> <p>11.15. Mandatory Spare parts (if applicable) shall be packaged separately and clearly marked as ‘Mandatory Spares ‘.</p> <p>11.16. Commissioning spares, Tools & tackles to be packed separately & suitably tagged.</p> <p>11.17. If mandatory spare items are ordered, same shall be sent in pre-decided lots in containers /secure boxes distinctly marked in GREEN color with boldly written "S “mark on each face of the containers /secure boxes</p> <p>11.18. Loose vendor items sent by vendor to sites shall be quantified/numbered/tagged and not merely mentioned as ONE lot of loose items.</p> <p>11.19. A packing list covering items having shelf life are to be intimated to site. Also, shelf life items shall be packed separately in BLACK color painted box for easy identification at site.</p> <p>11.20. Loose vendor items sent to sites shall be quantified/numbered/tagged and not merely mentioned as ONE lot of loose items.</p> <p>12. DOCUMENTATION</p> <p>12.1. Vendor shall make the offer in detail, with respect to every item of the Purchaser’s specifications. Any offer not conforming to the following requirements shall be summarily rejected.</p> <ul style="list-style-type: none"> a) Duly filled & Signed copy of Check list b) Deviation list, if any (as per “No deviation format” given in this specification). If there are no deviations, bidders shall submit “Deviation format” by mentioning deviations “Nil”. c) Unpriced price schedule (To be submitted compulsorily without fail) d) Bill of materials <p>12.2. Documentation after P.O. Placement</p>		
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		<p>a) Submission of documents as per “Master documents schedule” (which will be finalized in Kick-off meeting after award of the contract) within 2 weeks of placement of LOI (for approval by BHEL and / or BHEL’s customer in 4 sets)</p> <p>b) All vendor documents of Inert Gas Extinguishing System and its sub-items shall be submitted to End user for approval during order execution. Any comment furnished by End user / BHEL shall be taken care by vendor during ordering execution.</p> <p>c) Further BHEL will provide comments on vendor submitted document within 14 days for revision & resubmission. Vendor shall follow up with BHEL for non-receipt of comments/approvals.</p> <p>d) Revised drawings / Documents shall be submitted by Bidder in 07 days of receipt of comments / observations from BHEL. BHEL shall revert within 14 days on receipt of these revised documents / drawings from vendor for approvals.</p> <p>e) All the approvals required for manufacturing shall be completed with 3 months from P.O to meet the P.O delivery schedule. Accordingly vendor shall ensure the submission of approval category documents (which are required for manufacturing) and obtain their approvals.</p> <p>f) Vendor shall obtain final approvals on all technical + quality aspect documents before inspection dates.</p> <p>g) It is vendor’s responsibility to obtain approvals from BHEL as earliest as possible to meet PO delivery schedules. Accordingly vendor to plan and execute the supplies in time.</p> <p>12.3. Documents to be submitted during final shop testing and before equipment dispatch. (Note: submission of these documents are commercially linked) - all in 16 sets (2 sets to be included with item dispatch and balance to BHEL purchase department).</p> <p>a) Complete O&M manual.</p> <p>b) Approved Engg documents, As-Shipped documents, As-Built documents</p> <p>c) Guarantee and all test certificates for review and acceptance by BHEL and / or BHEL’s Customer</p> <p>d) 6 sets of CD-ROM – containing O&M manual and Engineering documents (1 set to be included with item dispatch and balance to BHEL purchase department).</p> <p>e) Following may be noted wrt the drawing submission schedule:</p>		
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SL NO.	DESCRIPTION	NUMBER OF COPIES TO BE SUBMITTED	WHEN TO SUBMIT
1.	Initial drawings / documents under approval and information category.	2	As per approved Master document list
2.	Revised drawings / documents incorporating BHEL's comments.	-	Within 1 weeks of receipt of commented drawings from BHEL
3.	Final Drawings / documents	6	Within 2 months of placement of order.
4.	Erection Documentation	8	1 Month before dispatch of equipment, The list of documents identified under master document list for erection to be furnished in 5 nos. of folders.
5.	Draft O & M Manuals with out test certificates	2	2 months before the delivery date of equipment
6.	Revised O & M Manuals with Test Certificates to be submitted to BHEL (Hyderabad)	8	Within one month after dispatch of equipment
7.	Final O&M Manuals in a CD	3	Within one month after dispatch of equipment

12.4. Input drawings

- a) List of inputs as envisaged by purchaser is attached in annexure-8.
- b) On receipt of order, it shall be solely the bidder's responsibility to spell out the requirement of the base engineering drawings/documents (required by him over and above the data furnished along with this specification) to go ahead with the engineering of the package within a week, and shall not expect the Purchaser to automatically supply the same after order placement. Any ultimate delay arising out of the delay by the successful bidder in putting up such a requisition shall solely be to the bidder's account.



c) **List of major inputs required for engineering of the system shall be prepared during kick off meeting or 15 days after the award of contract. It is bidder's responsibility to list out all the major inputs required for engineering. The required base drawings/documents shall be furnished to the Bidder within one week of receipt of such requisition from Bidder.**

d) Drawings attached with this specification are preliminary in nature & are not exhaustive. These drawings may get revised and /or new drawings will be furnished to bidder during detail engineering.

12.5. Review meetings & kick off meeting

a) As and when required, the bidder will be called upon to attend design co-ordination meeting / review meeting with the end customer/BHEL during the period of the Contract. The Contractor shall attend such meetings at his own cost at venues decided by BHEL.

b) A kick off meeting shall be held at Purchaser's office, preferably within 2 weeks of order.

c) An agenda shall be prepared for this meeting and would include the following points related to technical aspects.


- Any clarifications required by the Bidder on purchaser's order.
- Bidder Data Index & Schedule.
- Bidder Data Review/approval modalities.
- Sub-Bidder lists proposed by Bidder.
- Utility requirements.
- List of input drawings required from BHEL
- Preliminary General Arrangement & layout drawings

13. PRICE BID FORMAT

13.1. Price bid format is enclosed as Annexure-1, bidder to furnish the offer in line with the same.

13.2. Inert Gas Extinguishing System as envisaged in this bid document shall be quoted by the bidder on Lump sum Turnkeybasis.

13.3. All the items included in the price bid format shall be quoted as per tender specification and pre-bid clarifications, if any. Responsibility of ensuring correctness & completeness of scope of supply as per specification requirement solely lies with bidder.

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		<p>13.4. Prices quoted by the bidder shall remain firm till the successful handing over of the Fire Protection plant to end customer. Any request for upward revision of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL.</p> <p>13.5. Bidder to quote only base rates for all the items, Applicable taxes and duties shall be indicated separately.</p> <p>13.6. The Priced Bid shall be submitted in Original (without any copy) duly signed and stamped on each page in a separate sealed envelope super scribing “Price Bid –Do not Open” This shall not contain any condition whatsoever failing which the Bids shall be liable to be rejected. In case of any correction, the bidder shall put its signature and its stamp. Eraser fluid will not be allowed for making any correction.</p> <p>13.7. Bidder shall confirm to the unpriced bid as part of their offer.</p> <p>13.8. Information like Bill of materials (BOM), Instrument list, datasheets, and typical specifications enclosed by the bidder as a part of their bid, shall be retained for information only and shall not be referred by contractor as contractual agreement. No implication shall be admissible on the basis of these documents during any stage of contract execution.</p> <p>14. SUB VENDOR LIST</p> <p>14.1. All the equipment shall be sourced from recommended Bidders only as specified Annexure-12.</p> <p>14.2. Further the supplied model shall be under regular manufacturing range and have Proven Track Record (PTR). (Bidder / sub-Bidder shall have supplied minimum 2 no. in last 7 years, out of which at least one shall be in satisfactory operation for minimum 8000 hours).</p> <p>14.3. Bidder to comply with sub-vendor list enclosed with the specification. The sub-vendors for any item that is not appearing in the sub-vendor list (annexure-12) may be proposed for BHEL’s approval. Non-acceptance of any sub-vendor by BHEL / customer shall not have any commercial & delivery implication. While submitting sub-vendors for approval of BHEL, bidder shall furnish following documents :</p> <p>a) ISO certificate of Sub-vendors</p> <p>b) Proven track record & references for makes and models supplied earlier.</p> <p>Note:</p>		
	Ref. Doc			



Bidder to note that all IGES equipment such as cylinders, contact gauges, pressure regulators, Gas release Panel etc. shall be UL/FM/LPCB/VdS approved. Cylinders shall also have PESO , Nagpur approval certificate.

15. DOCUMENTS ALONG WITH BID

15.1. The following documents shall be submitted by bidder and the bidder's offer shall be evaluated on the following:

- a) Duly filled & Signed copy of Check list
- b) No Deviation Format
- c) Unpriced price schedule (To be submitted compulsorily without fail)

Note:

Evaluation shall be done on No Deviation schedule. Even if no deviations are there, bidder shall submit, signed copy of No deviation format. Technical evaluation of offer shall be done based on no deviation schedule only. Any other document submitted along with the offer shall be retained for information only.

16. LIST OF ANNEXURES

LIST OF ANNEXURES		
Sl. No	Drawings/Documents	Drg/Doc no
1.	Price Bid Format	Annexure – 1
2.	Master Document List	Annexure – 2
3.	Standard Manufacturing Quality Plan (for reference)	Annexure – 3
4.	Guidelines for QA QC plan	Annexure – 4
5.	Format for Despatch details	Annexure – 5
6.	Typical BBU for IGES system	Annexure – 6
7.	Pre Bid Query Format	Annexure – 7
8.	Input Doc. List	Annexure – 8
9.	Deviation Format	Annexure – 9
10.	Tender purpose Drawings	Annexure – 10
11.	Check List	Annexure – 11
12.	Sub-Vendor List	Annexure – 12
13.	Typical BOQ Format	Annexure – 13
14.	Specification for Cables	Annexure – 14
15.	Painting Specification	Annexure – 15

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NOTE:

Bidder to note that the above annexures are preliminary in nature .These annexures may get revised and /or new annexures will be furnished to bidder. Bidder to however note that they will not be eligible to raise any extra charges on account of this.

ANNEXURE – 1 for PY51833

**PRICE BID FORMAT FOR
IGES – LUMP SUM TURNKEY
PROJECT- 2 x 660 MW UDANGUDI SUPER THERMAL POWER PROJECT**

Sl. No.	Description	Qty.	Unit	PRICE in INR (Refer notes below)		Weightage
				Unit Price (INR)	Total Price (INR)	
1.	Supply of Inert Gas Extinguishing System	1	Lot			98.18%
2.	Supervision of erection, testing, commissioning & performance testing for Inert Gas Extinguishing System	36	Days			1.72%
3.	Travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc.) from / to vendor works to site for Engineer per visit for erection & commissioning of Inert Gas Extinguishing System	3	Visits			0.10%
	Grand Total					100.00%

Notes:

1. This document details the price schedule format for the enquiry. No other format will be entertained. Applicable taxes and duties shall be indicated separately in commercial offer.
2. Duly signed & stamped un-priced price schedule format shall be submitted by vendor in the technical offer as a token of concurrence that price schedule would be submitted in this format. Any tampering / modification / additions, etc. are NOT allowed and not considered binding and is liable for rejection of the offer.
3. Unit rates of components (Annexure –1A) would be used for effecting required additions/deletions of main equipment during order execution. These would include the cost up to engineering, installation of the item, wiring up in the panel and seamless integration with main system at works/site without any cost implications. All accessories required for this purpose shall be included in the price quoted.
4. As the dimensions of the room are not finalized, for addition/reduction of quantity, unit rate quoted in the present offer shall be considered during ordering and shall be valid up to execution of the contract to the extent of (-)20% to (+)10% of order Value. These would include the cost up to engineering, installation of the item, wiring up in the panel and seamless integration with main system at works/site without any cost implications. All accessories required for this purpose shall be included in the price quoted.
5. In case of deletion of specific zone, unit rates as indicated in (Annexure –1A) shall be used for deletion.
6. All the inert gas cylinders shall be supplied in filled condition to site.

ANNEXURE – 1 for PY51833

7. For the purpose of tender total no of 50 man days to be covered in 3 visits have been considered. However, either or both of the number of man days or number of visits may change on either side based on the actual site requirement. Bidder to note that payment against Sl. No. 2 & 3 above shall be made as per the total number of visits and man days required for the supervision of the complete E&C activities.
8. Offer will be evaluated based on total price for Sl. No. 1, 2 & 3 of price format.
9. Bidder to quote the base rates only. Applicable taxes and duties to be indicated separately.

BIDDER'S SIGNATURE
NAME:
DATE
COMPANY SEAL

ANNEXURE – 1A for PY51833

UNIT PRICES

S. No	Item Description	Unit Rate (Rs.)	REMARKS
1.	Supply of IGES package for TG Building Unit - 1		Note-3, 4 & 5 of Annexure – 1
2.	Supply of IGES package for TG Building Unit – 2&3		
3.	Supply of IGES package for IT Building		
4.	Supply of IGES package for Admin Building		
5.	1 no. of Inert Gas Cylinder and hooking up to Manifold		
6.	Electromagnetic release device for Master cylinder		
7.	Discharge Nozzles		
8.	Additional cost of selector valve, pilot manifold with fittings like SOV, pressure switch, etc. for addition of 1 no. of zone		
9.	Pressure relief vent		
10.	Gas inhibitor switch		
11.	Manual release switch		
12.	Discharge indicator		
13.	Pre-discharge indicator		
14.	Warning sign		
15.	10 metres of pipe(downstream of direction valve) along with associated fittings like elbows, tees, etc.		
16.	Pilot Manifold		
17.	Gas Release Panel		
18.	Selector Valve		
19.	SS Flexible Hose 100NB x 25 M Long		
20.	SS Flexible Hose 25NB x 25 M Long		
21.	SS Flexible Hose 150NB x 25 M Long		

ANNEXURE - 2

2 x 660 MW SUPER THERMAL POWER PROJECT, UDANGUDI - INERT GAS EXTINGUISHING SYSTEM - BIDDER DWGS/DOCS SCHEDULE												
1	LIST OF SUPERCIDED DRAWINGS / DOCUMENTS				S	TO INDEX PAGE		NO COMMENTS			1	
2	LIST OF ACTIVE DRAWINGS / DOCUMENTS				A	TODAY'S DATE		COMMENTS AS MARKED CLEARED FOR MANUFACTURE			2	
3	LIST OF DRAWINGS/DOCUMENTS UNDER PREPARATION				UP	17-May-22		NOT APPROVED & COMMENTS AS MARKED			3	
4	LIST OF BHEL APPROVED DRAWINGS				ADS			RETAINED FOR INFORMATION			4	
1	Drawings & Documents Pending with BIDDER							A			1	
2	Drawings & Documents Pending with BHEL							A	P-BIDDER		2	
3	Drawings & Documents Approved by BHEL							A	P-BHEL		3	
4	Supercided Drawings.							A	ADS		4	
4	Supercided Drawings.							A	S			
S. NO	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY BIDDER (SOFT COPY)	HARD COPY RECEIVED FROM BIDDER	COMMENTS SEND TO BIDDER	STS	PEND	BHEL APP STATU S	REMARKS
A) MECHANICAL												
A.01	P&I Diagram for IGES for TG Building		A	14 days from P.O Placement	0				UP	P-BIDDER		
A.02	Design Philosphy & Write-up		A	14 days from P.O Placement	0				UP	P-BIDDER		
A.03	Layout of IGES for TG Building		A	30 days from P.O Placement	0				UP	P-BIDDER		
A.04	Isometric View of IGES Piping system for TG Building		A	30 days from P.O Placement	0				UP	P-BIDDER		
A.05	Equipment Layout of Inert Gas Cylinder Room		A	30 days from P.O Placement	0				UP	P-BIDDER		
A.06	Clamping Arrangement of Inert Gas Cylinders		A	30 days from P.O Placement	0				UP	P-BIDDER		
A.07	GA of Cylinder Manifold		A	30 days from P.O Placement	0				UP	P-BIDDER		
A.08	GA of DV Pilot Manifold		A	30 days from P.O Placement	0				UP	P-BIDDER		
A.09	Control Logic Diagram		A	30 days from P.O Placement	0				UP	P-BIDDER		
A.10	Pressure Relief Vents G.A & location layout		A	30 days from P.O Placement	0				UP	P-BIDDER		
B) ELECTRICAL												
B.01	GA & Data Sheet of EPB Inhibitor Unit		A	14 days from placement of P.O	0				UP	P-BIDDER		
B.02	GA & Data Sheet of Gas Release Panel		A	14 days from placement of P.O	0				UP	P-BIDDER		
B.03	Circuit Diagrams		A	14 days from placement of P.O	0				UP	P-BIDDER		

2 x 660 MW SUPER THERMAL POWER PROJECT, UDANGUDI - INERT GAS EXTINGUISHING SYSTEM - BIDDER DWGS/DOCS SCHEDULE												
1	LIST OF SUPERCIDED DRAWINGS / DOCUMENTS			S	TO INDEX PAGE		NO COMMENTS			1		
2	LIST OF ACTIVE DRAWINGS / DOCUMENTS			A	TODAY'S DATE		COMMENTS AS MARKED CLEARED FOR MANUFACTURE			2		
3	LIST OF DRAWINGS/DOCUMENTS UNDER PREPARATION			UP	17-May-22		NOT APPROVED & COMMENTS AS MARKED			3		
4	LIST OF BHEL APPROVED DRAWINGS			ADS	RETAINED FOR INFORMATION			4				
								A		1		
1	Drawings & Documents Pending with BIDDER							A	P-BIDDER	2		
2	Drawings & Documents Pending with BHEL							A	P-BHEL	3		
3	Drawings & Documents Approved by BHEL							A	ADS	4		
4	Supercided Drawings.							A	S			
S. NO	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY BIDDER (SOFT COPY)	HARD COPY RECEIVED FROM BIDDER	COMMENTS SEND TO BIDDER	STS	PEND	BHEL APP STATUS	REMARKS
B.04	G.A of Junction Box		A	14 days from placement of P.O	0				UP	P-BIDDER		
B.05	Cable Schedule		A	14 days from placement of P.O	0				UP	P-BIDDER		
C) QUALITY												
C.01	Quality Assurance Plan		A	14 days from placement of P.O	0				UP	P-BIDDER		
D) PROCEDURE												
D.01	System Write-Up		I	14 days from placement of P.O	0				UP	P-BIDDER		
D.02	Bill of Materials		A	30 days from placement of P.O	0				UP	P-BIDDER		
D.03	Testing & Commissioning Procedure		A	14 days from placement of P.O	0				UP	P-BIDDER		
D.04	Pre-Commissioning Procedure		I	14 days from placement of P.O	0				UP	P-BIDDER		
D.05	Job Procedure / Installation Procedure		I	14 days from placement of P.O	0				UP	P-BIDDER		
E) OTHERS												
E.01	Flow calculations		I	30 days from placement of P.O	0				UP	P-BIDDER		
F) APPROVALS												
F.01	UL/FM/Vds/LPCB Approvals of IGES Components		I	14 days from placement of P.O	0				UP	P-BIDDER		
F.02	PESO Certificate for IGES Cylinders & Valves		I	14 days from placement of P.O	0				UP	P-BIDDER		

2 x 660 MW SUPER THERMAL POWER PROJECT, UDANGUDI - INERT GAS EXTINGUISHING SYSTEM - BIDDER DWGS/DOCS SCHEDULE												
1	LIST OF SUPERCIDED DRAWINGS / DOCUMENTS			S	TO INDEX PAGE		NO COMMENTS					1
2	LIST OF ACTIVE DRAWINGS / DOCUMENTS			A	TODAY'S DATE		COMMENTS AS MARKED CLEARED FOR MANUFACTURE					2
3	LIST OF DRAWINGS/DOCUMENTS UNDER PREPARATION			UP	17-May-22		NOT APPROVED & COMMENTS AS MARKED					3
4	LIST OF BHEL APPROVED DRAWINGS			ADS			RETAINED FOR INFORMATION					4
								A				1
1	Drawings & Documents Pending with BIDDER							A		P-BIDDER		2
2	Drawings & Documents Pending with BHEL							A		P-BHEL		3
3	Drawings & Documents Approved by BHEL							A		ADS		4
4	Supercided Drawings.							A		S		
S. NO	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY BIDDER (SOFT COPY)	HARD COPY RECEIVED FROM BIDDER	COMMENTS SEND TO BIDDER	STS	PEND	BHEL APP STATU S	REMARKS
F.03	PESO Certificate for Refilling of IGES Cylinders		I	14 days from placement of P.O	0				UP	P-BIDDER		
G) DATA SHEETS												
G.01	Inert Gas Cylinder		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.02	Pneumatic IGES Valve		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.03	Release Unit With Solenoid		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.04	Contact Guage Unit		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.05	Discharge Hose		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.06	Check Valve		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.07	Leak / Bleeder Unit		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.08	Hi- Flex Hose		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.09	Pressure Relief Device		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.10	Non Return Valve for Pilot Line		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.11	Nozzle Assembly		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.12	Pressure Regulator		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.13	Ball Valve WITH Pneumatic Actuator		A	14 days from placement of P.O	0				UP	P-BIDDER		

2 x 660 MW SUPER THERMAL POWER PROJECT, UDANGUDI - INERT GAS EXTINGUISHING SYSTEM - BIDDER DWGS/DOCS SCHEDULE												
1	LIST OF SUPERCIDED DRAWINGS / DOCUMENTS				S	TO INDEX PAGE		NO COMMENTS				1
2	LIST OF ACTIVE DRAWINGS / DOCUMENTS				A	TODAY'S DATE		COMMENTS AS MARKED CLEARED FOR MANUFACTURE				2
3	LIST OF DRAWINGS/DOCUMENTS UNDER PREPARATION				UP	17-May-22		NOT APPROVED & COMMENTS AS MARKED				3
4	LIST OF BHEL APPROVED DRAWINGS				ADS			RETAINED FOR INFORMATION				4
									A			1
1	Drawings & Documents Pending with BIDDER								A	P-BIDDER		2
2	Drawings & Documents Pending with BHEL								A	P-BHEL		3
3	Drawings & Documents Approved by BHEL								A	ADS		4
4	Supercided Drawings.								A	S		
S. NO	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY BIDDER (SOFT COPY)	HARD COPY RECEIVED FROM BIDDER	COMMENTS SEND TO BIDDER	STS	PEND	BHEL APP STATU S	REMARKS
G.14	Pressure Guage		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.15	Restrictor		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.16	Solenoid Valves		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.17	Warning Signs		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.18	Pressure Operated Switch		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.19	Pipes & Fittings		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.20	Cables		A	14 days from placement of P.O	0				UP	P-BIDDER		
G.21	Camcoupler & Hoses		A	14 days from placement of P.O	0				UP	P-BIDDER		
H) CALCULATIONS & OTHER GENERAL ITEMS												
H.01	Battery Sizing Calculations		I	30 days from P.O Placement	0				UP	P-BIDDER		
H.02	Electrical Load List		I	14 days from P.O Placement	0				UP	P-BIDDER		
H.03	List of Bought out Items		I	14 days from P.O Placement	0				UP	P-BIDDER		
H.04	Storage Procedures		I	14 days from placement of P.O	0				UP	P-BIDDER		
H.05	List of Tag Numbers		I	14 days from placement of P.O	0				UP	P-BIDDER		
H.06	O & M Manuals / Procedure		I	30 days from P.O Placement	0				UP	P-BIDDER		

2 x 660 MW SUPER THERMAL POWER PROJECT, UDANGUDI - INERT GAS EXTINGUISHING SYSTEM - BIDDER DWGS/DOCS SCHEDULE												
1	LIST OF SUPERCIDED DRAWINGS / DOCUMENTS					S	TO INDEX PAGE		NO COMMENTS			1
2	LIST OF ACTIVE DRAWINGS / DOCUMENTS					A	TODAY'S DATE		COMMENTS AS MARKED CLEARED FOR MANUFACTURE			2
3	LIST OF DRAWINGS/DOCUMENTS UNDER PREPARATION					UP	17-May-22		NOT APPROVED & COMMENTS AS MARKED			3
4	LIST OF BHEL APPROVED DRAWINGS					ADS			RETAINED FOR INFORMATION			4
									A		1	
1	Drawings & Documents Pending with BIDDER								A	P-BIDDER	2	
2	Drawings & Documents Pending with BHEL								A	P-BHEL	3	
3	Drawings & Documents Approved by BHEL								A	ADS	4	
4	Supercided Drawings.								A	S		
S. NO	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY BIDDER (SOFT COPY)	HARD COPY RECEIVED FROM BIDDER	COMMENTS SEND TO BIDDER	STS	PEND	BHEL APP STATU S	REMARKS
H.07	Field Quality Plan		I	30 days from P.O Placement	0				UP	P-BIDDER		
G) INTERFACE DRAWINGS												
G.01	Interface between Fire Alarm Panel & Gas Release Panel		I	14 days from P.O Placement	0				UP	P-BIDDER		

ANNEXURE – 4

GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

PAGE 1 OF 2

1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.
2. Each page of QAP shall contain the following information.
 - a) Vendor's name & address.
 - b) Customer: BHEL, Hyderabad.
 - c) Project.
 - d) BHEL Product Standard Number/revision number as referred in P.O.
 - e) BHEL Purchase Order Number & Date.
 - f) Product as per P.O. description.
 - g) QAP Number (unique and shall not repeat)/revision number/date.
 - h) Page number and number of pages
3. QAP shall contain four parts / stages as follows.
 - A) Raw materials and bought out items.
 - B) Inprocess Control / Inspection.
 - C) Final assembly, Inspection & Testing.
 - D) Painting, preservation & packing.
4. Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc).
5. Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc), Hydrostatic test, calibration check etc.)
6. Under 'Class', indicate minor, major or critical depending on the importance of characteristic.
7. Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.)
8. Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)
9. Under 'Reference document' and 'Acceptance norms', appropriate National & International standards, BHEL standards, approved drg references etc should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practise etc". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.
10. Under 'Format of record', indicate appropriately supplier's Test certificate, calibration certificate, lab report, inspection report etc.
11. Please refer 'Agency' in QAP format.

"Under P: Perform, W: Witness, V: Verify
Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR
2: (Vendor / Sub vendor)
Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, under Witness (W) column use 1. Under 'Verify' column, use code 1
12. Under 'D' please put (4 Tick) against each characteristic where vendor proposes to submit test certificate/report etc OR as required as per BHEL Spec.
13. Vendor's signature & stamp should be available on each page of QAP.
14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drgs.

GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

15. The following operations/characteristics/check points may be included (**AS APPROPRIATE**)

- a) Visual check
- b) Dimensional check
- c) Mechanical and Chemical properties.
- d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc as the case may be.)
- e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peeloff test etc.
- f) Check for correctness for all components mounted as per General arrangement Drg, Bill Of Materials (BOM), etc for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.
- g) Verification of test certificate for protection class for the enclosures.
- h) Mechanical functioning of switches.
- i) Continuity of earthing and provision of earth points.
- j) Colour coding of wiring, size, tightness & dressing of wiring.
- k) Review of test certificates of assembled items, raw materials, internal test reports etc.
- l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.
- m) PQR, WPS, Welder Qualification Record, welding records (fitup, DP) etc.
- n) Material identification (for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc)
- o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non Destructive Tests.
- p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Preece Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)
- q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole.
- r) Packing and Preservation.

ANNEXURE-5

BILL OF MATERIALS

(SUB-VENDOR PACKAGES)

(NOTE: ASSEMBLED UNITS AND ALL LOOSE DESPATCHABLE ITEMS IDENTIFIED IN THIS BOM)

System Name		Supplier:	Project:			Supplier Doc. No.			
			Supplied Job No.	BHEL P.O.No.	Rev. No.		sh.	of	
				Date	Date		1		
Item Despatch Tag-No.	Ref. Drg. No.	Item No.	Item Description	Qty. (Nos./mts)	Wt (Kg)	Despatch Details			Remarks
						Packing box	LR No.	Date	
	Rev.	Rev.	Prepared By:		Approved By:		Supplier Doc. No.:		
					(xxx)				
			Sign :		Sign :				
			Date :		Date :				

ANNEXURE-6


Client: Bharat Heavy Electricals Limited

System: INERT GAS EXTINGUISHUING SYSTEM

TYPICAL BILLING BREAK UP SCHEDULE

Sl. No.	Item Description	Unit	Total Qty.	Supply		Freight & Insurance	
				Rate Rs	Amount Rs.	Rate Rs	Amount Rs.
(A)	(B)	(C)	(D)	(E)	(F)	(E)	(F)
1.0	Argonite Cylinder,with Pneumatic valve	Nos.					
2.0	Discharge Hose	Nos.					
3.0	Check Valve	Nos.					
4.0	Contact Pressure Gauge Unit	Nos.					
5.0	Release Unit with Solenoid, CPG & Actuator	Nos.					
6.0	Leak / Bleeder unit	Nos.					
7.0	Non Return Valve	Nos.					
8.0	Hi-flex hoses	Nos.					
9.0	Ball Valve with dual action pneumatic actuator	Nos.					
10.0	Pressure Relief device	Nos.					
11.0	Pressure Gauge	Nos.					
12.0	Argonite Discharge Nozzles						
13.0	Pressure Regulator	Nos.					
14.0	Solenoid valve	Nos.					
15.0	Restrictor	Nos.					
16.0	T-Piece for Pilot Line	Nos.					
17.0	Cros for Pilot Line	Nos.					
18.0	Pipes & Fittings	Lot					
19.0	Manifolds	Lot					
20.0	Pilot Line Manifold	No.					
21.0	Structural Steel for Cyl. Mounting Frame Bracket	Lot					
22.0	Gas Release Panel with Nicd Batteries	Set					
23.0	Pressure Operated Switch	Nos.					
24.0	Pressure Relief Vent	Nos.					
25.0	Gas Discharge EPB & Inhibitor unit	Nos.					
26.0	Argonite Warning sign	Nos.					
27.0	Junction box	Nos.					
28.0	Flame Retardent Cu. Conductor Control Flexible Wire, Cable and Conduit	Lot					
	Total						

ANNEXURE-7

TD-106-2	Rev.No. 5 Form No.		<p align="center">PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, HYDERABAD –32.</p>	PESD/HYD-776								
				Rev No.: 00								
				Page 1 of 1								
<p align="center"><u>PRE-BID QUERRIES FROM SPECIFICATION</u></p>												
<p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.</p>												
<p>If the proposal submitted has got any Queries from the technical stipulations in the bidding document, the Bidder shall tabulate below the full particulars of such Queries and shall sign below. Additional sheets may be enclosed, if necessary. Queries are to be furnished with mention of specific clause numbers. Technical and commercial Queries to scope of supply and services shall be indicated separately.</p>												
<table border="1"> <thead> <tr> <th data-bbox="289 787 527 829">SL.No.</th> <th data-bbox="527 787 852 829">Clause No.</th> <th data-bbox="852 787 1226 829">Description as per specification</th> <th data-bbox="1226 787 1477 829">Queries by Bidder</th> </tr> </thead> <tbody> <tr> <td data-bbox="289 829 527 1396" style="height: 200px;"></td> <td data-bbox="527 829 852 1396"></td> <td data-bbox="852 829 1226 1396"></td> <td data-bbox="1226 829 1477 1396"></td> </tr> </tbody> </table>					SL.No.	Clause No.	Description as per specification	Queries by Bidder				
SL.No.	Clause No.	Description as per specification	Queries by Bidder									
<p>We confirm that all the Pre-Bid Queries to the Technical Specification, Job Specification and enclosures including reference documents attached are listed in this Annexure only. No other Pre-Bid Queries even if mentioned elsewhere shall be considered for any technical/ commercial evaluation or for ordering.</p>												
<p>Bidder's Signature.....</p>												
<p>Date:.....</p>												
Doc												

ANNEXURE - 8

Package Name : Inert Gas Extinguishing system
 Project : 2 x 660 MW UDANGUDI STPP

INPUT DRAWING LIST

SL NO.	Title of the Drawing (to be filled by Bidder)	INPUT DRG. NO. (to be filled by BHEL)	Rev. no.	DATE OF FURNISHING BY BHEL	Reference E Mail (to be filled by BHEL)	Drawing Type (to be filled by BHEL)	Remarks
1	Power House Building Arch Plan at El. 0.0 M (Unit#1)	PE-DG-435-611-C035	03	along with tender spec.			
2	Power House Building Arch Plan at El. 0.0 M (CCR)	PE-DG-435-611-C036	03	along with tender spec.			
3	Power House Building Arch Plan at El. 0.0 M (Unit#2)	PE-DG-435-611-C037	03	along with tender spec.			
4	Power House Building Arch Plan at El. 3.5 M & Misc. Platforms (Unit#1&2)	PE-DG-435-611-C039	03	along with tender spec.			
5	Power House Building Arch Plan at El. 8.5 M (Unit#1)	PE-DG-435-611-C040	03	along with tender spec.			
6	Power House Building Arch Plan at El. 8.5 M (CCR)	PE-DG-435-611-C041	03	along with tender spec.			
7	Power House Building Arch Plan at El. 8.5 M (Unit#2)	PE-DG-435-611-C042	03	along with tender spec.			
8	Power House Building Arch Plan at El. 12.0 M & 13.5 M	PE-DG-435-611-C043	03	along with tender spec.			
9	Power House Building Arch Plan at El. 17.0 M (Unit#1)	PE-DG-435-611-C044	03	along with tender spec.			
10	Power House Building Arch Plan at El. 17.0 M (CCR)	PE-DG-435-611-C045	03	along with tender spec.			
11	Power House Building Arch Plan at El. 17.0 M (Unit#2)	PE-DG-435-611-C046	03	along with tender spec.			
12	Power House Building Arch Plan at El. 24.0 M & 25.5 M (Unit#1&2)	PE-DG-435-611-C048	03	along with tender spec.			
13	Power House Building Arch Plan at El. 24.0 M	PE-DG-435-611-C049	03	along with tender spec.			
14	Power House Building Elevation Along Grid - A	PE-DG-435-611-C032	02	along with tender spec.			
15	Power House Building Elevation Along Grid - C & H	PE-DG-435-611-C033	01	along with tender spec.			
16	CCR / CER / Computer Room Layout	PE-DG-435-145-I401	02	along with tender spec.			
17	UPS Room Layout	PE-DG-435-145-I405	04	along with tender spec.			
18							
19							
20							

ANNEXURE - 9

LIST OF DEVIATIONS

Project: IGES SYSTEM FOR 2 x 660 MW UDANGUDI STPP

Sl. No.	Part No./ Volume	Page no.	Clause No.	Subject	Deviation/Clarification	Reason for Deviation
1						
2						
3						
4						
5						
6						

NOTES:

1. Deviations, if any, shall be clearly brought out only in this format. Deviations mentioned / taken elsewhere or in any other format will be ignored.
2. Additional sheets in the same format can be attached by the vendor, if necessary.
3. Nature of Deviations shall only be of Design / Manufacturing constraints and non-availability of items / components / makes in market.
4. No price implications shall be entertained for deviations withdrawn during the technical scrutiny. If any deviations are accepted by BHEL during technical scrutiny then also there will be no price implication. Hence, in no case there will be consideration of Price implications.
5. Reasons for the deviations shall be specified in the Remarks column.
6. If there are no deviations from the specifications, bidder still has to submit the signed copy of this format by writing "NO Deviations" on this format.
7. If the "Deviation Schedule" is not submitted along with the offer, the bidder's offer is likely to be rejected without any further interaction with the bidder. Only the accepted deviations in conjunction with the original tender shall constitute the contract document for the award of job to the bidder

ANNEXURE - 11**CHECK LIST FOR OFFER SUBMISSION**

SL No	Description	Bidder's Confirmation
1	Bidder to confirm to the scope of supply and scope of services as per BHEL spec: PY51833, Rev-00	
2	Bidder to submit the No Deviation letter w.r.t. BHEL spec: PY51833, Rev-00 along with offer.	
3	Bidder to quote as per BHEL price format only. Bidder to attached unpriced bid format along with Annexure-1A by indicating "QUOTED" against each item in the technical offer.	
4	For addition/reduction of quantity, unit rate quoted in the present offer shall be considered during ordering and shall be valid up to execution of the contract to the extent of (-)20% to (+) 10% of order Value.	
5	In case of deviation, vendor to confirm that these are technically not feasible deviations and same are submitted in BHEL format. In case technically feasible deviations are proposed by the bidder and subsequently withdrawn, no commercial implications can be claimed by the bidder	
6	It shall be bidder's responsibility to get all his queries and deviations addressed by the purchaser during the pre-bid stage itself. No queries / deviations shall be accepted by purchaser from the bidder after the closure of pre-bid.	
7	Bidder to agree that Bill of materials / list of equipment furnished in the offer is only for information; Vendor shall supply all the material to meet the performance, sizing & technical requirement as per specification & its Annexures, scope matrix etc.	
8	Confirm that the quote includes training, commissioning spares, special tool & tackles, mounting hardware/ accessories, terminations, etc. as required for commissioning activities.	
9	All the equipments / items supplied by bidder are having valid statutory approval certificates and same will be produced at any stage of contract execution to BHEL. The same were eligible to take local statutory regulatory body approval during commissioning of the system	

BIDDER'S SIGNATURE:

NAME:

DATE:

COMPANY SEAL:

ANNEXURE – 12

Project: - 2 x 660 MW Udangudi STPP

Package: - Inert Gas Extinguishing System

Sl. No.	Item Description	Name of the Vendor	Remarks on Vendor Approval
1	ERW PIPES AND GI PIPES	UTKARSH INDIA LIMITED	APPROVED
		NEZONE TUBES LIMITED	APPROVED
		APL APOLLO TUBES LIMITED	APPROVED
		DADU PIPES PVT. LTD.	APPROVED
		BHARAT TUBES CORPORATION	APPROVED
		STEEL AUTHORITY OF INDIA LIMITED	APPROVED
		MADRAS STEEL AND TUBES	APPROVED
		BHAWANI INDUSTRIES LTD	APPROVED
		TUBES INDIA	APPROVED
		MOKSHI INDUSTRIES PVT. LTD.	APPROVED
		MAHARASHTRA SEAMLESS LTD.	APPROVED
		SURYA ROSHNI LIMITED	APPROVED
		JINDAL PIPES LIMITED	APPROVED
		SWASTIK PIPE LIMITED	APPROVED
		NAVRATAN PIPE AND PROFILE LIMITED	APPROVED
		INDUS TUBES LIMITED	APPROVED
FUTNANI STEELS PVT LTD.	APPROVED		
2	VALVES	MICON VALVES (I) PVT. LTD.	APPROVED
		NSSL LIMITED	APPROVED
		WEIR BDK VALVES	APPROVED

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Sl. No.	Item Description	Name of the Vendor	Remarks on Vendor Approval
	VALVES	B.F.E.SRL BONNEY FORGE	APPROVED
		VALVITALIA S.P.A	APPROVED
		FLOSTEER ENGINEERS PVT. LTD.	APPROVED
		OSWAL INDUSTRIES LTD.	APPROVED
		L & T VALVES LIMITED	APPROVED
		FOURESS ENGINEERING (I)PVT.LTD	APPROVED
3	FITTINGS	ENGINEERING SERVICE ENTERPRISE	APPROVED
		N L HAZRA AND SON	APPROVED
		M.S. FITTINGS MANUFACTURING CO. PVT	APPROVED
		POONAM ENTERPRISE	APPROVED
		NAV DURGA FORGING AND FITTINGS	APPROVED
		TUBE TURN (INDIA) P. LTD.	APPROVED
		UNITECH MACHINES LIMITED	APPROVED
		K. S. PIPE FITTINGS PVT. LTD.	APPROVED
		P.K. TUBES & FITTINGS PVT. LTD.	APPROVED
		TRUE FAB ENGINEER (P) LTD.	APPROVED
		DEE DEVELOPMENT ENGINEERS LTD.	APPROVED
		TRUE FORGE PVT.LTD.,	APPROVED
		PIPEFIT ENGINEERS PVT. LTD.	APPROVED
		PETRO CHEM INDUSTRIES	APPROVED
		SAWAN ENGINEERS PVT. LTD.	APPROVED
		GUJARAT INFRAPIPES PVT.LTD.	APPROVED
		TUBE PRODUCTS INCORPORATE	APPROVED
		WEIFANG HUODA PIPE FITTINGS	APPROVED
		U I PIPE FITTINGS PVT. LTD.	APPROVED
		4	FLANGES
C.D.ENGINEERING CO.	APPROVED		
KISAAN STEELS (PVT) LTD.	APPROVED		
CHW FORGE PRIVATE LIMITED	APPROVED		
C.D. INDUSTRIES,	APPROVED		
NAV DURGA FORGING AND FITTINGS	APPROVED		
TRUE FORGE PVT.LTD.	APPROVED		
PIPEFIT ENGINEERS PVT. LTD.	APPROVED		
TUBE PRODUCTS INCORPORATE	APPROVED		
METAL FORGINGS P. LTD.	APPROVED		
THE PUNJAB STEEL WORKS,	APPROVED		
PRESHZINGER ENGINEERING	APPROVED		
KIRLOSKAR BROTHERS LTD	APPROVED		
KSB PUMPS LIMITED,	APPROVED		
SULZER PUMPS INDIA PRIVATE LIMITED.	APPROVED		
WILO MATHER AND PLATT PUMPS	APPROVED		
FLOWMORE LIMITED	APPROVED		

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Sl. No.	Item Description	Name of the Vendor	Remarks on Vendor Approval
5	BOLTING MATERIAL (U Bolt, Nuts & Clamps)	SREE PAVITHRA INDUSTRIES,	APPROVED
		UDEHRA FASTENERS LIMITED	APPROVED
		MORNING STAR INDUSTRIES,	APPROVED
		PIONEER NUTS AND BOLTS PVT.LTD	APPROVED
		MEGA ENGINEERING PVT. LTD.	APPROVED
		PRESIDENT ENGINEERING WORKS	APPROVED
		BOLTMASER (INDIA)PVT.LTD.	APPROVED
		MULTI FASTNERS PVT. LTD.	APPROVED
		ATLAS FASTENERS	APPROVED
6	POWER CABLES	SUNGOV ENGINEERING PVT LTD.	APPROVED
		ASIAN INDUSTRIAL VALVES AND	APPROVED
		NISAN SCIENTIFIC PROCESS	APPROVED
		SKILT FABRICATORS PVT.LTD.	APPROVED
		FILTRATION ENGINEERS INDIA PVT LTD.	APPROVED
		JAY-EESH ENGINEERING COMPANY	APPROVED
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT	APPROVED
		GRAND PRIX ENGINEERING PVT. LTD.	APPROVED
		TRIVENI EQUIPMENTS PVT LTD.	APPROVED
7	CONTROL CABLES	GUJARAT OTOFILT	APPROVED
		H K ENTERPRISES	APPROVED
		SPIRAX MARSHALL LIMITED	APPROVED
		GUPTA POWER INFRASTRUCTURE LTD.	APPROVED
		PAGODA CABLES PVT. LTD.	APPROVED
		ASSOCIATED CABLES PVT LTD.	APPROVED
		RAVIN CABLES LTD	APPROVED
		SBEE CABLES (INDIA) LIMITED	APPROVED
		ELKAY TELELINKS LIMITED	APPROVED
		SUYOG ELECTRICALS LTD.	APPROVED
		POLYCAB WIRES PVT.LTD.	APPROVED
		GEMSCAB INDUSTRIES LTD.	APPROVED
		SRIRAM CABLES PVT. LTD.	APPROVED
		SPECIAL CABLES PVT. LTD.	APPROVED
		PARAMOUNT COMMUNICATIONS LTD.	APPROVED
		DELTON CABLES LIMITED	APPROVED
		KEI INDUSTRIES LIMITED	APPROVED
		CMI LIMITED	APPROVED
		CORDS CABLE INDUSTRIES LTD.	APPROVED
		KEC INTERNATIONAL LIMITED	APPROVED
THERMO CABLES LIMITED	APPROVED		
UNIVERSAL CABLES LTD.	APPROVED		
NICCO CORPORATION LTD HYD	APPROVED		

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Sl. No.	Item Description	Name of the Vendor	Remarks on Vendor Approval
8	GASKETS	GOODRICH GASKET PVT. LTD.	APPROVED
		MADRAS INDUSTRIAL PRODUCTS	APPROVED
		I G P ENGINEERS LIMITED	APPROVED
		TEEKAY FLOWFLEX PVT. LTD.	APPROVED
		UNI KLINGER LTD.	APPROVED
		UNIQUE INDUSTRIAL PACKINGS PVT. LTD.	APPROVED
		JAMES WALKER INMARCO INDS PVT LTD.	APPROVED
		STARFLEX SEALING INDIA PVT. LTD.	APPROVED
		JYOTHI INDUSTRIES	APPROVED
13	PRESSURE GAUGE	PROTECH CONTROL INSTRUMENTS	Not Approved, since no Experience with vendor
		A.N. INSTRUMENTS PVT. LTD.,	Approved
		GAUGES BOURDON INDIA PVT. LTD.	Approved
		BAUMER TECHNOLOGIES	Approved
		SCIENTIFIC DEVICES (BOMBAY) PVT. LTD	Not Approved, since no Experience with vendor
		WALCHANDNAGAR INDUSTRIES LIMITED	Not Approved, since no Experience with vendor
		H.GURU INSTRUMENTS(S.I)PVT.LTD	Approved
		PRECISION MASS PRODUCTS PVT LTD	Approved
		GOA INSTRUMENTS INDUSTRIES PVT. LTD.	Approved
18	PRESSURE SWITCHES	SWITZER PROCESS INSTRUMENTS	Approved
		GAUGES BOURDON INDIA PVT. LTD.	Approved
		KAUSTUBHA UDYOG	Not Approved, since no Experience with vendor
		HIRLEKAR PRECISION ENGG. PVT. LTD.	Not Approved, since no Experience with vendor
		BAUMER TECHNOLOGIES	Approved
		TRAFAG CONTROLS INDIA PVT LTD.	Approved
		PRECISION MASS PRODUCTS PVT LTD.	Approved

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30	FITTINGS	TRIOMECH ENGINEERING PVT. LTD.	Approved
		JINDAL FORGING PVT LTD.	Approved
		REAL FORGE	Approved
		SUPER FORGE	Approved
		PRESHZINGER ENGINEERING	Approved
31	SOCKET WELDED / SCREWED WELDED PIPE FITTINGS	JINDAL FORGING PVT LTD.	Approved
		REAL FORGE	Approved
		SUPER FORGE	Approved
		BHARAT FORGE	Approved
		DYNAMIC FORGE	Approved
		FLOWTECH	Approved
		ENGINEERING SERVICE ENTERPRISE	Approved
		N L HAZRA AND SON	Approved
		M.S. FITTINGS MANUFACTURING CO. PVT	Approved
LEADER VALVES LIMITED	Approved		
NAV DURGA FORGING AND FITTINGS	Approved		

SI No	Items Description	Name of Vendor	Remarks on Vendor Approval
	SOCKET WELDED / SCREWED WELDED PIPE FITTINGS	FITTECH INDUSTRIES PVT. LTD.	Approved
		PRECISION ENGINEERING INDS.	Approved
		SKY FORGE PRIVATE LIMITED	Approved
		K. S. PIPE FITTINGS PVT. LTD.	Approved
		P.K. TUBES & FITTINGS PVT. LTD.	Approved
		TRUE FORGE PVT.LTD.	Approved
		PIPEFIT ENGINEERS PVT. LTD.	Approved
		U I PIPE FITTINGS PVT. LTD.	Approved
		CARLO DYNATECH INDUSTRIES,	Approved
		FLASH FORGE PVT LTD.	Approved
		PRESHZINGER ENGINEERING	Approved
		UNIQUE ENGINEERING ENTPS. PVT. LTD.	Approved
		S.S.PIPE FITTINGS & FORGINGS	Approved
33	BOLTING MATERIAL	HARYANA FASTNERS	Approved
		KWALITY FORGE	Approved
35	CONTROL CABLES	UDEY PYROCABLES PVT. LTD.	Approved
		LEONI CABLE SOLUTIONS (INDIA)	Not Approved, since no Experience with vendor
		ADVANCE CABLE TECHNOLOGIES PVT LTD.	Approved
		LAPP INDIA PVT. LTD.	Approved
		T C COMMUNICATION PVT. LTD.	Approved
		MIDDLE EAST SPECIALIZED CABLES CO.	Not Approved, since no Experience with vendor

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37	CABLE TRAY	ADVANCE POWER PRODUCTS	Not Approved, since no Experience with vendor
		INDUSTRIAL PERFORATION (I) PVT. LTD.	Approved
		UNITECH FABRICATORS & ENGINEERS PVT	Not Approved, since no Experience with vendor
		RUKMANI ELECTRICAL & COMPONENTS	Approved
		RABI ENGINEERING WORKS PVT. LTD	Approved
		RATAN PROJECTS & ENGG. CO. PVT. LTD.	Approved
		INDIA ELECTRICALS SYNDICATE	Not Approved, since no Experience with vendor
		PREMIER POWER PRODUCTS	Approved
		EROS METAL WORKS (P) LTD.	Approved
		VINFAB ENGINEERS INDIA PRIVATE	Not Approved, since no Experience with vendor
		INDIANA GRATINGS PVT. LTD.	Not Approved, since no Experience with vendor
		PASSIVE INFRA PROJECTS (P) LTD.	Not Approved, since no Experience with vendor

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Sl No	Items Description	Name of Vendor	Remarks on Vendor Approval
		ANIL STEELS PVT LTD.	Not Approved, since no Experience with vendor
		M J ENGINEERING WORKS (P) LIMITED	Not Approved, since no Experience with vendor
		PATNY SYSTEMS PVT. LTD	Approved
38	PAINTS AND PRIMER	KANSAI NEROLAC PAINTS LTD.	Approved
		ASIAN PAINTS INDIA) LTD.	Approved
		SHALIMAR PAINTS LTD.	Approved
		BERGER PAINTS INDIA LTD.,	Approved
		COROMANDEL PAINTS LIMITED	Approved
		GRAUER & WEIL (INDIA) LIMITED	Not Approved, since no Experience with vendor
		SYNORGANIC PAINTS PVT. LTD.	Not Approved, since no Experience with vendor
		GRAND POLYCOATS CO. PVT.LTD.	Not Approved, since no Experience with vendor
		ADVANCE PAINTS LTD.	Not Approved, since no Experience with vendor
		HEMPEL PAINTS (INDIA) PVT. LTD.	Approved
		CIPY POLYURETHANES PVT. LTD.	Not Approved, since no Experience with vendor
		KORROCOAT POLYMERS PVT. LTD.	Not Approved, since no Experience with vendor
		CARBOLINE (INDIA) PRIVATE LIMITED	Approved
39	ERW PIPES and GI Pipes	GAJANAN TUBES PRIVATE LIMITED	Approved
		JINDAL INDIA	Approved
		M K K METAL SECTIONS PVT. LTD.	Not Approved, since no Experience with vendor
40	GATE VALVE	A.V.VALVES LIMITED	Approved
		AMPO VALVES INDIA PRIVATE LIMITED	Not Approved, since no Experience with vendor
		LEADER VALVES LIMITED	Approved
		VALVE TECH INDUSTRIES	Not Approved, since no Experience with vendor
		STEEL STRONG VALVES (I) PVT. LTD.	Not Approved, since no Experience with vendor
		SHALIMAR VALVES PVT. LTD.	Approved
		SKILT FABRICATORS PVT.LTD.	Not Approved, since no Experience with vendor
		NITON VALVE INDUSTRIES LTD.	Approved
41	SOLENOID VALVE	ROTEX MANUFACTURERS & ENGINEERS	Approved
		ASCO PVT. LTD.	Approved
		IMI PRECISION ENGG	Not Approved, since no Experience with vendor
		AVCON CONTROLS PVT LTD.	Approved
42	FLANGES	TESHI ENGINEERS	Approved
		DYNAMIC FORGE & FITTINGS PVT. LTD.	Approved

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Sl No	Items Description	Name of Vendor	Remarks on Vendor Approval
		ENGINEERING SERVICE ENTERPRISE	Approved
		JINDAL FORGINGS	Approved

ANNEXURE-13

BOQ FOR INERT GAS EXTINGUISHING SYSTEM										
Sl.No.	Drawing Title	Unit	P&ID of IGES	Piping Layout of IGES	Isometric View of IGES	GA of Inergen cylinder storage room & supporting arrangement	GA of Cylinder Manifold	Pressure Vent Location Location Layout	Electrical Cabling Layout	TOTAL BOQ
	Vendor Documet No.									
	Drawing Approval status (By BHEL)									
	Remarks									
1.0	Inergen CYLINDER -300 BAR, CAPACITY. 140 LTRS.	Nos.								
2.0	LABEL FOR140 LTRS CYLINDER	Nos.								0
3.0	PNEUMATIC VALVE (INCLUDED IN CYLN. ASSEMBLY)	Nos.								0
4.0	CHECK VALVE 3/4"NPT X 1/2"BSP	Nos.								0
5.0	CONTACT GAUGE UNIT	Nos.								0
6.0	DISCHARGE HOSE 1/2" X 400 LG.	Nos.								0
7.0	NON RETURN VALVE 1/4 inch	Nos.								0
8.0	1/4 INCH CROSS FOR ACTUATION LINE	Nos.								0
9.0	HI-FLEX. HOSE FOR PILOT 1/4" X 365 Length.	Nos.								0
10.0	HI FLEX HOSE 1/4" X 500MM	Nos.								0
11.0	HI FLEX HOSE 1/4" X 400MM (1X90°)	Nos.								0
12.0	HI FLEX HOSE 1/4" X 700MM (1X90°)	Nos.								0
13.0	PRESSURE GAUGE 1/2 NPT-300 Bar	Nos.								0
14.0	PRESSURE RELIEF DEVICE 300 BAR, BSP	Nos.								0
15.0	RELEASE UNIT 300 BAR(Automatic & Manual Release)	Nos.								0
16.0	1/4 Inch TEE PIECE FOR ACTUATOR LINE	Nos.								0
17.0	BALL VALVE, 1 1/2 INCH (DIVERter VALVE) FE - NPT	Nos.								0
18.0	HANDLE FOR 1 1/2 INCH BALL VALVE	Nos.								0
19.0	BALL VALVE, 1 INCH (DIVERter VALVE) FE - NPT	Nos.								0
20.0	HANDLE FOR 1 INCH BALL VALVE	Nos.								0



SECTION - 3.24: CABLES

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of cables.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following:

- a) 19/33 kV grade XLPE insulated armoured FRLS power cables
- b) 11/11 kV grade XLPE insulated armoured FRLS power cables
- c) 6.6/6.6 kV grade XLPE insulated armoured FRLS cables
- d) 1.1 kV grade XLPE insulated armoured FRLS cables
- e) 1.1 kV grade XLPE insulated armoured FRLS control cables
- f) Trailing cables
- g) Shielded cables
- h) Telephone cables
- i) Fiber optic cables

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and / or supplemented by this specification.

- a) IS: 3975 Mild steel wires formed wires and tapes for armouring of cables.
- b) IS: 4905 Methods for random sampling.
- c) IS: 5831 PVC insulation and sheath of electric cables.
- d) IS: 7098 Part-I Cross-linked polyethylene insulated PVC sheathed cables (LV)
- e) IS: 7098 Part-II Cross-linked polyethylene insulated PVC sheathed cables (HV)
- f) IS: 8130 Conductors for insulated electric cables and flexible cords.
- g) IS: 10418 Drums for electric cables.
- h) IS: 10810 Methods of tests for cables.
- i) IS: 3961 Recommended current ratings for cables

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Power cables shall be provided for the following systems:

- 33 kV earthed system having phase fault current and earth fault current of 25 kA.
- 11 kV unearthed system having phase fault current of 50 kA and earth fault current of 300 A.
- 6.6 kV unearthed system having phase fault current of 31.5 kA and earth fault current of 300 A.
- 415 V earthed system having phase fault current and earth fault current of 65/50 kA.
- 220 V DC unearthed system having fault current of not less than 25 kA.

4.2.0 Power cables shall be sized to withstand the system fault current for the fault clearing time indicated below:

- Breaker operated Motor feeders and transformer feeders: 0.16 second.
- Breaker operated outgoing feeders: 0.5 second.
- Tie between two switchgear: 0.5 second.
- Incomers: 1 second.



- 4.3.0 Power cables shall be sized to satisfy the following Criteria:
- To withstand specified system short circuit current for the specified fault clearing time.
 - To carry full load current under applicable installation conditions considering Site ambient temperature & site installation (Grouping) conditions based on Manufacturer's recommendation.
 - To limit the voltage drop under steady state/transient state conditions to permissible values.
- 4.4.0 Cables shall be armoured type only.
- 4.5.0 Power cables shall be XLPE insulated. Control cables shall be PVC / XLPE insulated.
- 4.6.0 PVC insulation shall be suitable for continuous conductor temperature of 70°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90 °C and short circuit conductor temperature of 250 °C.
- 4.7.0 Cables for 33 kV system shall be rated for 19/33 kV earthed grade, cables for 11 kV system shall be rated for 11/11 kV unearthed grade and Cables for 6.6 kV system shall be rated for 6.6/6.6 kV unearthed grade. Cables for 415/230 V AC and 220 V DC shall be rated for 1.1 kV grade.
- 4.8.0 To minimize the damage that can be caused by a fire, conductors installed in electrical cable tray systems shall have jackets which have non-propagating, and self-extinguishing flame retardant, low smoke (FRLS) characteristics. Outer sheath shall be of PVC black in colour. These cables shall meet the following test requirements.
- Oxygen index of minimum 29 when tested as per IS 10810 Part-58
 - Temperature index of minimum 250°C when tested as per IS 10810 Part-64
 - Acid gas emission of maximum 20% when tested as per IS 10810 Part-59 Average light transmission of 40% minimum when tested as per IS 10810 Part-63 (average smoke density is maximum 60%)
 - Flame test requirements as per IS 10810 Parts-53 and 62
 - Flame retardant test requirements as per IS 10810 Part-61
- 4.9.0 For power cables, copper conductor shall be used for current rating of up to 10 A. For higher current rating, conductor can be aluminium/copper. Minimum size of copper conductor shall be 2.5 sq.mm and aluminium conductor shall be 6 sq.mm.
- 4.10.0 Conductor of control cables shall have plain annealed copper. The minimum size of control cable shall be of 1.5 sq.mm. For CT circuit minimum size shall be 2.5 sq.mm copper. Control cables shall have 20% spare cores.
- 4.11.0 Current transformers leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity and knee point voltage. Minimum 2.5 sq.mm copper cables shall be used for connection of CT to load. In case 2.5 sq.mm size impose unacceptably high burden on CTs, 4 sq.mm copper shall be used. Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq.mm copper conductor exceeds this value, higher conductor sizes shall be used.
- 4.12.0 Power cables shall carry the full load current of the circuit continuously under site conditions considering the various derating factors like thermal resistivity of soil, ambient air/ground temperature, grouping, method of laying, etc.
- 4.13.0 Design ambient air temperature and ground temperature shall be considered at 50°C and 40 °C respectively for cable sizing.
- 4.14.0 For 11 kV & 6.6 kV cables, screen of each core shall be sized to withstand 300 A for 1 sec. For 33 kV cables, screen of each core shall be sized to withstand system earth fault current for 0.16 sec.



- 4.15.0 For HT motors the voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 2.5% of the rated voltage. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5% of rated voltage
- 4.16.0 For LT motors the voltage drop in the cable, during motor starting condition, shall be limited to 15% and during full load running condition, shall be limited to 3% of the rated voltage. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 6% of rated voltage.
- 4.17.0 Cables for the following systems shall be fire survival type.
- DC emergency lube oil pumps
 - DC seal oil pump
 - DC emergency lighting cables for main building.
 - Batteries to chargers and DC distribution boards
 - Turbine lub oil pumps
 - Jacking oil pumps
 - Emergency turbine trip by push button in control room
 - Inter trip cables between Boiler master fuel trip and turbine trip relays
 - Inter trip cables between Generator trip relays and turbine trip relays/400 kV circuit breaker/generator field breaker/UT breakers
- 4.18.0 Method of curing for HT XLPE insulation shall be **gas/steam curing**.
- 4.19.0 Conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied with XLPE insulation in one operation through triple extrusion.
- 4.20.0 For armoured cables, armouring shall be of aluminium for single core cables. For multicore armoured cables, armouring shall be of galvanised steel.
- 4.21.0 All the cables shall be protected against rodent and termite attack. Necessary chemicals shall be added into the PVC compound of the outer sheath. The sheath shall be resistant to water, UV radiation, fungus, etc.
- 4.22.0 Multi-core cable color coding shall be as follows:
- Red, yellow, blue, black and gray for five core cables
 - Outer sheath shall be of black in colour.
 - For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.
- 4.23.0 Three core 19/33 kV earthed grade, 11/11 kV unearthed grade, 6.6/6.6 kV unearthed grade cables shall constitute the following:
- Circular stranded and compacted aluminium conductor
 - Extruded semi conducting compound as conductor screen
 - Extruded XLPE insulation
 - Extruded semi conducting compound as insulation screen
 - Copper tape as metallic screen for each core
 - Extruded PVC inner sheath
 - Galvanised steel formed wire/strip
 - Extruded FRLS PVC outer sheath
- 4.24.0 Single core 19/33 kV earthed grade, 11/11 kV unearthed grade, 6.6/6.6 kV unearthed grade cables shall constitute the following:
- Circular stranded and compacted aluminium conductor
 - Extruded Semi conducting compound as conductor screen
 - Extruded XLPE insulation
 - Extruded Semi conducting compound as insulation screen
 - Copper tape as metallic screen
 - Hard drawn aluminium wire armour
 - Extruded FRLS PVC outer sheath



- 4.25.0 Multicore 1.1 kV earthed grade cables shall constitute the following:
- Circular / shaped, stranded aluminium conductor (compacted for >10 sq.mm)
 - Extruded XLPE insulation
 - Extruded PVC inner sheath
 - Galvanised steel formed wire/strip
 - Extruded FRLS PVC outer sheath
- 4.26.0 Single core 1.1 kV earthed grade cables shall constitute the following:
- Circular stranded and compacted aluminium conductor
 - Extruded XLPE insulation
 - Hard drawn aluminium wire armour
 - Extruded FRLS PVC outer sheath
- 4.27.0 **Trailing power and control cables for mobile equipment shall constitute the following:**
- Unearthed grade HT power cables, earthed grade LV power cables and control cables shall be flexible trailing with annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed. For HT cables, insulation screen shall be provided. Cables shall conform to applicable IS/IEC standard requirements.
- 4.28.0 **Fire survival cables**
- Fire survival cable shall be of copper conductor and comply with IEC-60331 (withstanding 750 degree C temperature for 3 hours). Also the halogen acid contents in outer sheath shall not be more than 2% when tested as per IEC-60754 and the smoke density in percent light absorption shall not exceed 20% when tested as per ASTM-D-2843. 1.1 kV earthed grade fire survival cables shall constitute the following:
- Circular/shaped stranded and compacted annealed copper conductor
 - Elastomeric materials (XLPE, EPR, SR, or LSOH) insulated
 - Glass mica tapped
 - Extruded FRLS compound or LSOH material as inner sheath
 - Galvanised steel formed wire/strip
 - Extruded FRLS compound or LSOH material as inner sheath
- 4.29.0 Multicore 1.1 kV earthed grade control cables shall constitute the following as per IS:1554-1 / 7098-1:
- Multi stranded annealed copper conductor
 - Extruded PVC / XLPE insulation
 - Extruded PVC inner sheath
 - Galvanised steel formed wire/strip
 - Extruded FRLS PVC outer sheath
- 4.30.0 Multi pair 1.1 kV earthed grade, overall screened signal cables shall constitute the following as per BS EN 50288-7:
- Multi stranded annealed copper conductor
 - Extruded PVC insulation
 - Twisted pair
 - Overall polyester taped, Al-mylar screened with ATC drain wire
 - Extruded PVC inner sheath
 - Galvanised steel formed wire/strip
 - Extruded FRLS PVC outer sheath
- 4.31.0 Multi pair 1.1 kV earthed grade, individual and overall screened signal cables shall constitute the following as per BS EN 50288-7:
- Multi stranded annealed copper conductor
 - Extruded PVC insulation
 - Twisted pair



- Individual polyester taped, Al-mylar screened with ATC drain wire
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.32.0 Cable drums

Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. All wooden parts shall be manufactured from durable quality wood duly seasoned and treated with copper naphthenates or zinc naphthenates for preserving the wood. The surface of the drum and the outer most cable layer shall be covered with waterproof layer. 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.

4.33.0 Cable identification system

- a) In addition to manufacturer's identification on cables as per IS, following marking shall also be embossed/printed on the outer sheath at an interval of one metre throughout the length of cables.
 - BIS mark
 - Manufacturer's name and or trade mark.
 - Year of manufacture
 - Cable code
 - Type of cable and voltage class.
 - Nominal cross section area of conductor and no.of cores.
 - Progressive sequential length making.
- b) Cables shall be marked as having FRLS outer sheath at every 5 meters.
- c) The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible.
- d) Multi-core cable color coding shall be as follows:
 - Red, yellow and blue for three core cables
 - Outer sheath shall be of black in colour.
 - For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.
 - For multi pair cables, each pair shall be coloured and numbered.

5.0.0 TESTS

Cables offered shall be type tested and proven type. Routine tests shall be carried out on 100% drums. Type tests, special tests and acceptance tests shall be carried out on 1 drum selected on random basis, out of every 10 or less number of drums of each type and size of cable of each lot. Size shall mean area of cross section in sq.mm read in conjunction with the number of cores. Type shall mean type of insulation, sheath, volt grade FRLS/FS etc.

5.1.0 Type Test

- a) Tests on conductor



- i) Annealing Test (for copper)
- ii) Tensile test (for aluminium)
- iii) Wrapping test (for aluminium)
- iv) Resistance test

- b) Tests for armour wires/strips
- c) Tests for thickness of insulation and sheath
- d) Physical tests for insulation
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Shrinkage test
 - iv) Hot test
 - v) Water absorption (gravimetric)

- e) Physical test for outer sheath
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Shrinkage test
 - iv) Hot deformation
 - v) Heat shock test
 - vi) Loss of mass test in air oven
 - vii) Thermal heat stability test (as per IS : 5831)
 - viii) Bleeding and blooming test

- f) Anti-termite and anti-rodent test (on outer sheath).
- g) Partial discharge test
- h) Bending test
- i) Dielectric power factor test
 - i) As a function of voltage
 - ii) As a function of temperature

- j) Insulation resistance (volume resistivity) test
- k) Heating cycle test
- l) Impulse withstand test
- m) High voltage test
- n) Flammability test
- o) Cold impact test

5.2.0 Acceptance Test

- a) Annealing test (for copper)
- b) Tensile test (for aluminium)
- c) Wrapping test (for aluminium)
- d) Conductor resistance test
- e) Test for thickness of insulation and sheath
- f) Hot set test for insulation
- g) Tensile strength and elongation at break test for insulation and outer sheath
- h) Partial discharge test (for screened cables)
- i) High voltage test
- j) Insulation resistance (volume resistivity) test

5.3.0 Routine Test

- a) Conductor resistance test
- b) Partial discharge test



- c) High voltage test

5.4.0 Special Test

- a) Oxygen index test as per IS 10810 Part-58
- b) Temperature index test as per IS 10810 Part-64
- c) Acid gas generation test as per IS 10810 Part-59
- d) Smoke generation test as per IS 10810 Part-63
- e) Flammability tests as per IS 10810 Parts-53 and 62
- f) Flame retardant test as per IS 10810 Part-61

5.5.0 Site Test

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.

- a) Insulation resistance test
- b) High voltage test

6.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



VOLUME II
SUB-SECTION 4.20
INSTRUMENTATION & CONTROL CABLES

1.0.0 GENERAL

All Instrumentation Cables shall be of 600V grades and Control cables shall be of 1100V FRLS, PVC insulated, armoured 7-stranded copper conductor cable to be provided as per the latest IS/IEC standards.

Signal cable	:	600V, 0.5 Sq.mm for single pair, screened 600V, 0.5 Sq mm for multipair, individual pair and overall shielded.
Control Cable	:	1100V Screened with overall screen 1100V 1.0 Sq mm for 2 Cores 1100V 1.0 Sq mm for multi core
Power cable	:	2.5 Sq.mm for 2/3 Cores

Wiring within desks and panels shall be supported on trays and shall be segregated according to voltage level. Wire carrying AC and DC voltage shall also be segregated.

All desks, panels, cubicles and racks shall be factory-wired. Where desks or panels shall be supplied in more than one section, electrical connections between the sections shall be via terminal strips provided for this purpose.

Spare cores shall be terminated at terminal strips and shall be ferruled in such a way as to indicate that they are spare cores.

After commissioning 20% of the conductors of multi core cables shall be available as spare.

All instrument cables shall be laid on cable trays. Cable trays shall be sized to have 20% spare space as a minimum.

Junction boxes for alarm, signal, T/C, interlocks etc shall be separate. All the shield wires shall be terminated in the JB as per Cable Schedule. Separate JB shall be used for inputs and outputs. JB shall be earthed through GI flat. Separate JB shall be provided for intrinsic safe circuits. Fiber optic cables shall be routed in GI conduits.

All panel wiring shall have sufficient spares for future expandability.

Individual pair shielded & overall shield twisted pair copper cables shall be used for analog signals & overall shielded cables shall be used for digital signals. All these cables shall be armoured. The insulation of outer sheath shall be FRLS quality. The wire size shall be 0.5 sq.mm. Ferruling indicating terminal numbers on termination side shall be followed. Colour coding shall be as per Purchaser's standard.

2.0.0 INSTRUMENTATION CABLES

Instrumentation cables shall be 600VAC grade, stranded high conductivity annealed, tinned copper, twisted pair (with min. 20 twists for meter) extruded PVC insulated with overall and / or individual screening, extruded PVC inner sheathed, galvanized steel wire armoured, only extruded outer sheathed with FRLS PVC compound. The conductor size shall be 0.5 sq.mm. Pair cables can be used for RTDs. Instrumentation cables carrying digital signals shall have



overall screening along with drain wire and analogue signal carrying cables shall have each pair screening and overall screening along with each pair drain wire and overall drain wire. Colour coding for the identification of pairs shall be as per BS-5308 Part-2.

3.0.0 CONTROL CABLES

Control cables shall be 1100V AC grade, multicore, minimum 1.0 sq.mm cross section, stranded copper conductor having 7 strands, PVC insulated, inner PVC sheathed of type ST-1, galvanized steel wire armoured and outer sheath made of FRLS PVC compound of type ST-1. In situations where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required shall be used. Colour coding for the identification of pairs shall be as per BS-5308 Part-2.

4.0.0 FIBRE OPTIC CABLES

Mono mode type fibre optic cable with following parameters shall be provided.

- Cable Type: Mono-mode with minimum 4 fibres
- Wavelength band optimized : 850nm / 1300nm / 1550nm
- Mode field diameter : 9-10 μ m \pm 10% of nominal value
- Cladding diameter : 125 μ m \pm 3
- Non-concentricity core/cladding : not more than 2 μ m
- Non-circularity of cladding : not more than 3 μ m
- Cut-off wavelength : 1200nm
- Attenuation : less than 0.3-0.4 dB/km at 1300nm
less than 0.15-0.25 dB/km at 1550nm

Multi mode type fibre optic cable with following parameters shall be provided.

- Cable Type: Multi-mode with minimum 4 fibres
- Core / cladding diameter: 62.5 / 125 μ m
- Jacketing Material: Halogen Free, Flame Retardant, Low Toxicity
- Attenuation @ 850 nm: Length (m) x 0.0035 db/m+2db maximum
- Outside Diameter: 8.10 mm (0.324 in)
- Minimum Bend Radius: 12.5 cm (5 in)
- Minimum Bend Radius (Long term): 7.5 cm (3 in)
- Cable Assembly: Tensile Load for attenuation increase <0.5 db: 300 N (66 lb) maximum
- Tensile Load at Installation: 1776 N (400 lb) max.
- Connector Tensile Load MIC : 133 N (30lb)
- Minimum Crush Resistance: 46 N /cm (250 lb /in)
- Maximum Cable Weight : 46 kg/1 km (31 lb/1000ft)
- Maximum Cable length: 2 km (6560 ft)

HDPE insulation shall be suitable for continuous conductor temperature of 85°C. The insulation material shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

The cables shall have HDPE primary insulation suitable for FRLS. Inner and outer jacket shall be made of extruded flame retardant HDPE.

The cables shall be armoured. Armour shall be of galvanised steel wire / flat as per IS 3975.

The cables shall be protected against termite and rodent attack. Necessary chemicals shall be added into the compound of the outer sheath.



The material used in the construction of fibre optic cables shall be compatible with the properties of the cables and shall be in accordance with the relevant IS and IEC standards as stated above.

5.0.0 Design requirements

All cables shall be suitable for laying on racks, in ducts, trenches with chances of flooding by water and shall also be suitable for directly buried installation. All the cables shall be FRLS type designed to withstand mechanical, electrical and thermal stresses developed under steady state and transient operating conditions.

The cables shall be capable of operating satisfactorily under the power supply and frequency variations, high ambient, high humid tropical climatic conditions as specified in project information.

The cables are proposed to be laid in multi-tier overhead cable racks, in concrete cable trenches. Derating factors for grouping and ambient temperature shall be furnished by successful bidder along with filled up datasheets during contract engineering stage.

PVC insulation shall be suitable for continuous conductor temperature of 85°C and short circuit conductor temperature of 160 °C. The insulation material shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

All the cables shall be protected against termite and rodent attack. Necessary chemicals shall be added into the PVC compound of the outer sheath.

All cables shall have PVC primary insulation as per IS 5831 Type C / IEC 502 suitable for FRLS. Inner and outer jacket shall be made of extruded flame retardant 90°C PVC to IS 5831 Type ST2 / IEC 502. Oxygen Index of PVC shall be over 29% and temperature index shall be over 250°C.

The cable cores shall be laid up with fillers between the cores wherever necessary. All the cables shall have distinct extruded PVC inner sheath.

The cables shall be armoured. Armour over inner jacket shall be of galvanised steel wire / flat as per IS 3975.

All the cores of single pair or multipair shall be twisted and twists shall not be less than 20 per metre.

The outer sheath for analog and digital cables the colour shall be light blue and black respectively.

Running length of cable shall be printed atleast every 5m interval. For multipair cables, pair identification shall be provided with numbers at interval of not more than 250mm or as per vendor's standard.

6.0.0 Construction

The insulation shall be applied directly over the conductor by extrusion method. in such a way that it fits closely on the conductor and it shall be possible to remove it easily without damage to the conductor. Two cores shall be twisted to form a pair and four such pairs shall be twisted together to form a unit.

Every pair shall be twisted with a lay of 40 to 50 mm and to be wrapped with polyester tape. Individual pair screening with edges frees poly aluminium tape with continuous drain wire of minimum overlap of 30%.



Required number of pairs to be laid up to form the cable and overall shielded with edge free Poly- aluminium tape with continuous drain wire of minimum overlap of 30%.

The cable shall be then sheathed with FRLS PVC by extrusion method. The shielding and sheathing shall be so done that it fits firmly on to the cable and are easily removable without damage to the cores.

7.0.0 Packing and Marking

Packing

The tolerance on the dispatched cable length on each drum verified and accepted by Inspector shall be limited to +/-5% of standard drum length. However the overall tolerance of the total dispatched quantity of each size shall be +2%. Short lengths of individual length not less than 200m shall be acceptable only in the final drum lengths to meet the overall tolerance limits stipulated above. Cable consumed for testing and inspection will be to bidder's account.

Cable Reeling Drums

The Cable drums shall be non returnable wooden or steel drums of sturdy construction

The wood used for the construction of the drums shall be of durable quality, properly seasoned and treated with Copper Nephthenates or Zinc Nephthenates for preserving the wood (Refer IS 401). Wood preservatives anti-termites treatment shall be applied to the entire drum. Wooden drums shall comply with IS 10418. All ferrous parts shall be treated with suitable rust preventive coating to avoid rusting during transit and storage.

The surface of the drum and the outermost cable shall be covered with waterproof layer. Both the ends of the cable shall be properly secured with heat shrinkable PVC / Rubber caps, secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection.

Each drum shall carry the manufacturer's name, purchaser's name, address and contract no., item no. and type, size and length of the cable and net and gross weight stenciled on both sides of the drum. A tag containing the same information shall be attached to the leading end of the cable.

An arrow accompanied by suitable wording shall be stenciled on the ends of the drums of indicate which way it should be rolled. The number of each drum shall be either branded at the end of the drum or stamped on the metal disc attached to one end of the drum.

Marking

Marking on outer sheath:

In addition to manufacturer's identification on cables as per IS, the following shall be embossed on the outer sheath at every 1m throughout the length of the cable:

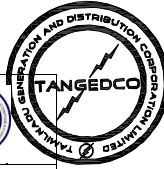
- (i) Manufacturer's Name & Trade Name :
- (ii) Year of Manufacture :
- (iii) User's Name :
- (iv) Voltage grade :
- (v) Type of outer sheath :
- (vi) Type of inner sheath :

The label which is securely attached to the reel or drum or coil shall have the following information:



Purchaser's name and address :
Purchase Order No. and item no. :
Manufacturer's /Supplier Name :
Length in meters :
Gross Weight :
Item code number and cable drum number :
Direction of rotation of drum for unwinding by means of an arrow

**TAMIL NADU GENERATION AND DISTRIBUTION
CORPORATION LTD.**



 TATA CONSULTING ENGINEERS LIMITED		UDANGUDI SUPER CRITICAL THERMAL POWER PROJECT (2 X 660 MW)	
<input checked="" type="checkbox"/>	CAT-1	Drawing/documents approved for final distribution. BHEL will proceed with manufacturing/ fabrication/construction.	
<input type="checkbox"/>	CAT-2	Drawing/documents cleared for manufacturing/ fabrication/construction subject to incorporating the comments given. BHEL to resubmit the drawing for Approval in Category – 1. Comments will be marked on the drawing documents.	
<input type="checkbox"/>	CAT-4	Drawing document of this category are for information only and not for approval. Information furnished on the document is noted.	
Approval conveyed herein neither relieves the Vendor/Contractor of his contractual obligations and his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits conforming to the relevant codes and standards as per the specification and performance requirements nor does it limit the purchaser's rights under the contract.			
NOTE:			
1.	It is mandatory to close documents with Code 2 / 3 to Code 1 in agreed contract period or 2 weeks, whichever is earlier		
2.	Any design changes / modification required to be carried out in Code 4 Drawings / Documents shall be the responsibility of BHEL. BHEL to resubmit reflecting the Design Changes for information.		
 ENGINEER. TATA Consulting Engineers Ltd. Date Jul 19, 2021	 PROJECT MANAGER. TATA Consulting Engineers Ltd. Date Jul 19, 2021	 CHIEF ENGINEER /PROJECTS-II, TANGEDCO, CHENNAI-02 Date	

03	11.06.21	REVISED AS PER CUSTOMER COMMENTS								
02	02.06.21	REVISED AS PER CUSTOMER COMMENTS								
01	20.11.20	REVISED AS PER CUSTOMER COMMENTS								
00	10.02.20	INITIAL SUBMISSION								
REV	DATE	DESCRIPTION								
PROJECT:		2 X 660 MW UDANGUDI STPP STAGE - I								
CUSTOMER:			TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, TANGEDCO HEAD QUARTERS, 1ST FLOOR, NEW EB QTRS., 144,ANNASALAI, CHENNAI 600002.							
CONSULTANT:			TATA CONSULTING ENGINEERS LIMITED BENGALURU							
EPC CONTRACTOR:			BHARAT HEAVY ELECTRICALS LTD. PE & SD, HYDERABAD							
ADDITIONAL INFORMATION		COPY RIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED it must not be used directly or indirectly in any way detrimental to the interest of the company.								
STATUS OF DRAWING						DRN.	SUMANT	SIGN. –sd–	DATE 10.02.20	NO.OF VAR.
DISTRIBUTION OF PRINTS						CHD.	AMIT KUMAR	SIGN. –sd–	DATE 10.02.20	
MANUFACTURER :		APPD.	C. SEKHAR	SIGN. –sd–	DATE 10.02.20					
		DEPT. PESD	UNTOL. DIM. GR. C/M/F		SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS	
		CODE 450					DOCUMENT NO	REV.		
						PY-AQ-4-M109-8315-01		03		
						SHT No. 01	NO OF SHT. 02			
						TITLE:				
						PAINTING SCHEDULE				
DRN.	NAME	SIGN.	DATE							
CHD.										
APPD.										



PAINTING SCHEDULE FOR 2X660 MW UDANGUDI STPP

(As per Contract Specification , Volume -II , Sub-Section 2.25 : CLEANING, PROTECTIVE COATING AND PAINTING)

SL No	Application	Location	Process	Paint Type	Number of coats	DFT of each layer in micron	Remarks
1	Above ground Fire water Piping (Carbon Steel / Mild steel)	Indoor and outdoor	Surface Preparation	Blast clean to SA 2 1/2			
			Primer	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1	1	75	
			Touch up	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	1	(75)	** Touch up is applicable in case the coat is peeled off.
			Intermediate Coat	2 pack High build High Solid Lamellar MIO based Epoxy Mid coat.	1	200	Note : In case 1 coat of 200 micron is not feasible, 2 coats of 100 microns shall be applied.
			Final Paint	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUUVB exposure of minimum 1000 hrs.	1	75	Shade : FIRE RED (Color No. 536 as per IS: 5)
						Total DFT in micron	
2	Above ground Fire water Piping (Galvanised Iron: pipes normally empty but periodically charged with water) *** (See Note-2)	Indoor and outdoor	Surface Preparation	Manual cleaning or any approved method			
			Primer	Etch Primer	2	6	
			Intermediate Coat	MIO Paint	1	50	
			Final Paint	Synthetic Enamel paint (Long Oil Alkyd) to IS2932.	1	50	Shade : FIRE RED (Color No. 536 as per IS: 5)
						Total DFT in micron	
3	Structural steel (Carbon steel /Mild Steel)	Indoor and outdoor	Surface Preparation	Blast clean to SA 2 1/2			
			Primer	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1	1	75	
			Intermediate Coat	2 pack High build High Solid Lamellar MIO based Epoxy Mid coat.	1	200	Note : In case 1 coat of 200 micron is not feasible, 2 coats of 100 microns shall be applied.
			Final Paint	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUUVB exposure of minimum 1000 hrs.	1	75	Shade : DARK ADMIRALTY GREY (Color No. 632 as per IS: 5)
			Total DFT in micron		350		
4	Fire water Pumps & Motors	Indoor	Surface Preparation	Blast clean to SA 2 1/2			
			Primer	Catalysed Zn rich Primer with a VS of 60% min, complying to SSPC Paint 20 level 2.	1	75	
			Final Paint	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	2	100	Shade : FIRE RED (Color No. 536 as per IS: 5)
						Total DFT in micron	
5	Miscellaneous Fire Fighting components like Deluge valve,Hydrant Valve , Hose Box , Foam monitor, Foam proportioning equipments and foam maker etc.	Indoor and outdoor	Surface Preparation	As per Manufacturer			
			Primer	Zinc filled epoxy Primer **	1	35	These are OEM Specific items . Hence, Painting shall be as per OEM Standards. **Painting details for these items are indicative only as these are OEM Specific Items. Accordingly, OEM may adopt their standard Painting procedure maintaining the total DFT as min. 170 Microns and Final Shade : FIRE RED (Color No. 536 as per IS: 5) Exact Painting Details shall be mentioned in individual datasheets.
			Intermediate Coat	Epoxy resin with MIO**	1	100	
			Final Paint	Aliphatic acrylic polyurethane finish paint **	1	35	
			Total DFT in micron		170		
Notes:							
1	Painting not required on a. Uninsulated austenitic stainless steel, b. Plastic and/or plastic coated materials and c. Non-ferrous materials like aluminum/PVC/GRP.						
2	***Painting requirements for Galvanized Pipes is not specifically mentioned in Contract Specification. Accordingly, same has been considered inline with OEM Recommendations implemented in various projects.						
3	For buried Piping , Painting is not applicable. Wrapping & coating shall be provided as per approved datasheet. (Ref Document :PY-VD-4-M109-8315-24)						

**VOLUME II****SUB-SECTION 2.25****CLEANING, PROTECTIVE COATING AND PAINTING****1.0.0 GENERAL**

This specification covers the general requirements related to the cleaning protective coating and painting of equipment, components and systems that are covered under main equipment / system specifications for 2x660 MW Supercritical Thermal Power Plant. The components and/or equipment shall be mechanically and /or chemically cleaned during the following stages of the Contract.

- Cleaning in workshop
- Cleaning before painting and/or corrosion protection (application of prime coat)
- Cleaning before erection and during installation.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturer's works or at site, as appropriate. No paint shall be applied surfaces within 75 mm of field welded connections. These surfaces shall be coated with a consumable preservative and marked.

For cleaning in workshop and before painting, mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, hand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the Owner / Engineer.

Machined surfaces shall be protected during the cleaning operations.

In the event of the surfaces not being cleaned to the Owner's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the supplier's sole expense.

For reclining small areas, hand cleaning by wire brushing may be permitted.

2.0.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the Codes indicated below and shall conform to the relevant IS Code for the material and workmanship.

The following codes and standards shall be followed for the surface preparation, surface protection and painting works.

IS: 5	Colors for ready mixed paints and enamels.
IS: 101	Methods of test for ready mixed paints and enamels.
IS: 104	Ready mixed paint, brushing, Zinc Chrome, priming.
IS: 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS: 161	Heat resistant paints
IS: 1303	Glossary of terms relating to paints.
IS: 1477	Code of practice for painting of ferrous metals in buildings (Parts I & II).
IS: 2074	Specifications for ready mixed paint, Air drying, red oxide zinc chrome priming.
IS: 2338	Code of practice for finishing of wood and wood based materials: Parts 2 schedules.



IS: 2339	Aluminum paint for general purposes, in dual container.
IS: 2395	Code of practice for painting of concrete, masonry and plaster surfaces: Part 2 schedules.
IS: 2524	Code of practice for painting of non-ferrous metals in buildings (Parts I & II).
IS: 2932	Specification for enamel, synthetic, exterior (a) undercoating, (b) Finishing
IS: 3140	Code of practice for painting asbestos cement building products.
IS: 6158	Recommended practice for design safeguarding against Embrittlement of hot dip Galvanized Iron & steel products.
IS: 6159	Recommended practice for design & fabrication of Iron & steel products prior to Galvanizing & metal spraying.
IS: 6278	Code of practice for white washing and Color - Washing.
IS: 10221	Code of practice for coating & wrapping of underground mild steel pipelines.
IS: 33	Inorganic pigments and extenders for paints –Methods of sampling & test.
IS: 13183	Aluminum paint, Heat resistant - specifications.
IS: 144	Specification for ready mixed paint brushing, petrol resisting, Air drying for Interior paints of tanks and containers, Red oxide.
IS: 9954	Pictorial surface preparation standards for painting of steel surfaces.
IS: 11883	Specification for Ready Mixed Paint, Air Drying, Red Oxide Priming for metals.
IS: 9404	Color code for identification of pipelines used in the Thermal Power Plants.
IS: 12744	Specification for Ready Mixed Paint, Air Drying, Red Oxide-Zinc Phosphate Priming.
BS: 2015	Glossary of paint selected terms.
BS: 5252	Final coat color.
BS: 7079A1/S1	Specification for rust grades and preparation grades of uncoated substrates after overall removal of previous coating.
BS: 7079A2	Preparations grades of previously coated steel substrates.
BS: 7079GrC	Surface roughness characteristics of blast cleaned steel substrates.
BS: 7079GrD	Methods for surface preparation.
BS-4232	Surface Finish of Blast cleaned steel for painting.
ASTM	American Standard for Testing Material.
ASTM A 780	Standard practice for repair of damaged galvanized coatings.
AWWA	American Water Works Association.
ASA-A-13.1-1981	Scheme for identification of piping system (American National Standard Institution).
DIN	Deutsehes Institute for Normung
SIS-055900-1967	Surface preparation standards for painting steel surfaces. (Swedish standard Institution)
SSPC-SP	Preparation Specifications (Steel structures painting council, U.S.A.). National Association of Corrosion Engineers, U.S.A. (NACE).



3.0.0 SCOPE OF WORK AND GENERAL REQUIREMENTS

This specification covers the surface preparation, method of application and material to be used for all coating of equipment, steel structures and piping. Steel material subjected to surface preparation on shop/site shall have minimum requirements in accordance with Rust Grade B (SSPC/SSPM Volume-2).

Coating materials according to SSPC, EN ISO, ASTM, BIS or DIN standards, shall be used. The paint shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval.

Standards of surface preparation and painting shall give a time to first maintenance of minimum 10 years.

The paint to be applied shall be approved by Owner.

All paints & paint material used shall be procured from approved manufacturers. Paint shall be supplied in manufacturers original containers with the description of content, specification No., colour, ref no, date of manufacture, shelf life expiry date & pot life.

The paint manufacturers shall provide coating system data sheet for each coating system to be used containing the following information

- a. Surface preparations
- b. Film thickness (min and max)
- c. Min and max recoating intervals at relevant temperatures
- d. Mixing ratio, thinner details and coating repair systems

The sample for testing the paint being used may be taken by the Owner at any time.

In general Shop fabricated equipment will be delivered to the site coated with a shop applied system or the manufacturer's standard finish in accordance with the requirements of this specification.

For equipment that has received shop prime coat, all touch-up prime coat and additional coats shall be applied in accordance with the coating schedule. It is responsibility of the vendor to ensure compatibility between shop and field applied paint systems.

Necessary precautions shall be provided to all equipment, structures to protect other surfaces from abrasive blasting, coating over spray and spatter. Damage to other surfaces or equipment shall be repaired by the vendor.

The Contractor shall submit the following for review and approval by the Owner:

- a. Manufacturer's recommended paint scheme for the project
- b. Latest published product & instructions for application data,
- c. Procedures for surface preparation and application.
- d. Pre qualification for equipments and blasting materials, product, procedure and personnel qualifications for the paint and painting systems.
- e. Painting repair procedures

Painting records shall contain:

- Equipment/components/location painted
- Date of painting
- Paint details such as specification No, colour, date of manufacture, shelf life, expiry date
- Application equipments



- Ambient conditions at the time of painting
- Surface temperature
- Drying time between coating, DFT and number of coatings
- Appropriate work plan for painting.

The supply of all necessary equipments, weather protection, and scaffolding for painting to ensure work is carried out in accordance with the specification and agreed programme.

Maintenance of the paint work until completion of the contract, this shall include repair of any damaged areas caused by third party.

Disposal of painting waste resulting from painting, shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work and coating materials.

It is a mandatory requirement that all operatives working to this procedure take full cognizance and implement necessary safety precautions.

4.0.0 CLEANING AT MANUFACTURER'S WORKS

Mechanical cleaning shall preferably be carried out by abrasive blasting. The Owner is prepared to consider alternative methods such as chemical cleaning provided they achieve the necessary surface condition.

In case of chemical cleaning, the detailed procedure for chemical cleaning as well as the system for which chemical cleaning is required shall be submitted by the contractor for Owner's approval. The procedure shall comprise of pre-treatment and acid treatment to achieve cleanliness equivalent to that specified for mechanical cleaning.

Surface condition:

The Metal surfaces shall be clean and free of mil scale, rust, dirt, grease and any other deleterious matter.

Where metal surfaces are to be painted the surface profiles shall conform to the painting specification requirements.

Where this does not apply, surfaces shall have a surface texture not coarser than Grade 80 abrasive paper.

Abrasives:

Abrasives containing silica, silicates or slag residues shall not be used for water/steam side surfaces of plant except for cleaning sand castings, where hydro blasting may be employed.

For austenitic materials only, abrasives containing 98% or more of alumina, Al_2O_3 , shall be used.

Removal of abrasive and debris:

After cleaning, abrasive and debris shall be thoroughly removed for components.

5.0.0 PROTECTION AT MANUFACTURER'S WORKS

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.



All water, air and steam side surfaces shall be protected by the application of approved water soluble corrosion inhibitors, or vapor phase inhibitors that can be subsequently removed by site water washing or steam blowing.

The gas side of steam generating plant items shall be protected by the application of temporary protective that do not require to be removed before commissioning, but which are removed during initial firing.

The rate of application of volatile corrosion inhibitors shall be at least 10 grams per square meter or 35 grams per cubic metre, whichever is the greater, except for pipes up to 300 mm diameter for which the minimum application rates shall be 5 grams per square metre.

Immediately after the protective treatment has been applied all vessels and pipes shall be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surroundings. Cylindrical plugs shall not be driven into the ends of pipes. These protective covers shall not be removed until immediately before final connection is made to the associated equipment.

6.0.0 WEATHER CONDITIONS

Painting shall be done only when the surface temperature is above 5°C. Surface temperature must be at least 3°C above dew point to ensure that condensation does not occur on the surface.

Reasonable protection against precipitation and seawater spray shall be exercised for the painting of outdoor parts.

Precautions shall also be taken against solar radiation to ensure that the specified dry film thickness of priming or finish coats is obtained.

Any prime coat exposed to excess humidity, rain, dust etc., before drying, shall be permitted to dry and the damaged area of primer shall be removed and the surface prepared and primed again.

Sheltered or unventilated horizontal surfaces on which dew may collect require more protection, and to achieve this additional top coat of paint shall be applied.

The temperature quoted as “normal” in the “Paint System Tables” refers to the average local climatic conditions.

7.0.0 SURFACE PREPARATION

In preparing any surface to be coated, all loose paint, dirt, grease, rust, scale, weld slag or spatter or any other extraneous material shall be removed and defects repaired, so as to obtain a clean, dry, even surface to receive the priming or finishing coat (s) as called for in the painting schedules. Sharp edges should be rounded, especially when tank linings have to be applied.

All machined surfaces, including flange faces, shall be suitably covered to prevent damage during surface preparation.

All surfaces should be blast cleaned whenever possible.

**Surface preparation methods:**

Bare steel surfaces should be prepared by one of the methods described below in order of preference and in accordance with Swedish Standard SIS 05 59 00 or Steel Structures Painting Council, SSPC, Vis 1, or DIN 55928, section 4.

The relative humidity level should not be more than 60% & the steel surface temperature at least 3° C above the dew point during dry blast cleaning operations.

a. White metal blast cleaning Sa 3 or SSPC - SP 5

Sa 3 Blast cleaning to bare metal. Mill scale, rust and foreign matter must be removed completely. Subsequently, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. It must then have a uniform metallic color and correspond in appearance to the prints designated Sa 3.

b. Near white metal blast cleaning Sa 2 1/2 or SSPC - SP 10

Sa 2 1/2. very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are slight imperfections in the form of spots or stripes. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It must then correspond in appearance to the prints designated Sa 2 1/2.

Mechanical cleaning should only be used when procedures (a) and (b) are not practicable.

c. Near white metal blast cleaning P Sa 2 1/2 DIN 55928

Very thorough blast cleaning. Very adhesive coatings remain. From all other surface mill scale and rust are to be removed to such an extent that the only traces remaining are slight imperfections in the form of spots or stripes. Further treatments see Sub b).

The adhesivity of residual coatings in the transition zone has to be tested even after the application of the primer.

d. Very thorough mechanical scraping and wire brushing St 3

St 3 very thorough scraping and wire-brushing - machine brushing - grinding - etc. are to be preferred. Surface preparation as for St 2. But much more thoroughly. After the removal of dust, the surface must have a pronounced metallic sheen and correspond to the prints designated St. 3.

e. Thorough scraping and wire brushing St 2

St 2 Thorough scraping and wire-brushing - machine brushing - grinding - etc. The treatment shall remove loose mill scale, rust and foreign matter. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It should then have a faint metallic sheen. The appearance must correspond to the prints designated St 2.

f. Air Blasting with Non-Metallic Abrasives Powder

Whenever the "Duplex"-process is to be applied (hot dip galvanising followed by painting), prepare the hot dip galvanised surface by water washing to remove flux residues and careful air blasting with non-metallic abrasive powder. Use an abrasive with grain size from 0.1 to 0.5 mm, at a greatly reduced air pressure, max. 2 bar (g) (28 psig).

This procedure also applies to stainless steel and aluminium surfaces to be coated.



Surface preparation methods	SIS 055900	DIN 55928 Part-4	BS 4232 only for blasting	SSPC-Vis
Blasting acc to item (a),(b),(c),	Sa 3		First quality	White metal SP 5
Blasting acc to item (b)	Sa 2 1/2		Second quality	near White SP 10
Blasting acc to item (c)	Sa 2		Third quality	Commercial blast SP 6
Hand/or power tool derusting acc to item (e)	St 2		--	Hand tool cleaning SP 2
acc to items (d) and (e)	St 3		--	Power tool cleaning SP 3
Flame jet cleaning		F1	--	Flame cleaning SP 4
Pickling		Be	--	Pickling

Steel structures to be blast cleaned have to be free of pitting and other severely corroded places in accordance with B.S. 4232 and SIS 055900.

The abrasives used for blast-cleaning shall be graded flint, grit, shot or silica sand and shall be such that they will produce an average keying profile on the blast-cleaned surface of not more than 40 microns.

An air pressure of 7 bar g at the nozzle shall be used.

After blast-cleaning, all accumulated grit, dust, etc., must be removed leaving the surface clean, dry and free of mill scale, rust grease and other foreign matter.

In the event of rusting after completion of the surface preparation, the surface must be cleaned again in the manner specified.

Oil, grease, soil, cement, salts, acids or other corrosive chemicals shall be cleaned from steel surfaces, by the use of solvents, emulsions or cleaning compounds. The final wiping shall be with clean solvent and clean rags or brushes. There shall be no detrimental residue left on the surface.

Primed areas which suffer damage must be spot blasted on site to a degree of cleanliness Sa 2 1/2 before, touching up.

Protective coating must be applied as quickly as possible after the completion of surface preparation no matter what cleaning method has been used.

No blast-cleaned surface shall be allowed to remain uncoated overnight.

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil etc. Before the first coat of paint is applied on site. Shop primer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming.

Concrete: If a protective coating is required, concrete shall be allowed to cure before painting.



8.0.0 PREPARATION OF COATING MATERIALS

All containers shall remain un-opened until required for use.

Primers and paints which have livered, gelled or otherwise deteriorated shall not be used.

The oldest primer or paint of each kind shall be used first.

All ingredients in any container shall be thoroughly mixed before use, and shall be agitated frequently during application to keep the primer in suspension.

Primer or paint mixed in the original container shall not be transferred until all settled pigment is incorporated into the body of liquid.

Mixing in open containers shall be done in a well ventilated area.

Primer or paint shall be mixed in a manner ensuring the breakdown of all lumps, complete dispersion of pigment and uniform composition.

Two-component primers shall be mixed in accordance with the manufacturer's instructions. Thinners shall not be added to primers or paints unless necessary for proper application according to the manufacturer's instructions. When use of thinners is permitted, it must be added to the primer or paint during mixing.

8.1.0 Primer Paint

After the surface is prepared, one coat of suitable primer shall be applied. After this first coat is dried up completely, second coat of primer shall be applied.

Primer shall be applied by brushing to ensure a continuous film without 'holidays'. The dry film thickness of each coat shall be as specified in the Annex- ANNEX 25.1.2 -Paint System of this specification.

The primer should be worked by brush application to cover the crevices, corners, sharp edges etc. in the presence of inspector.

The shades of successive coats should be slightly different in color in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per specification approved by Engineer before application of successive coats.

The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Elko meter for measuring the Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detectors for checking the painted surface discontinuities should be provided by the contractor.

The contractor shall make arrangements for paint manufacturer to provide expert technical service at site as and when required free of cost and without any obligation to the Owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations.

Final inspection shall include measurement of paint dry film thickness, check of finish and workmanship.

8.2.0 Rub down and Touch Up of Primer

The shop coated surfaces shall be rubbed down thoroughly with emery paper to remove all dust, rust and other foreign matters, washed, degreased, then cleaned with warm fresh water and air dried.



The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry before applying a coat of primer.

The compatibility between shop coat and field primer shall be ascertained from the paint manufacturer. In case degreasing with white spirit is not effective, the surface shall be finally wiped clean with aromatic solvent like xylol or light naphtha.

8.3.0 Non Compatible Shop Coat Primer

- a) The compatibility of finishing coat shall be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc., the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer. Shop coated (coated with primer & finishing coat) equipment shall not be repainted unless paint is damaged.
- b) Shop primed equipment and surfaces shall only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer shall be completely removed before application of selected paint system for particular environment. For package units/equipment, shop primer shall be as per the paint system given for particular environment.
- c) In case of existing paint, compatibility between finishing coat and new selected finish coat shall be ascertained before application of finish coat. In case, the coat is selected for upgrading existing alkyd coating to high performance coating then, surface preparation shall be by manual/mechanical means to remove loose rust, peeled off/damaged paint, but sound old coating need not be removed. It shall be touched with suitable primer wherever it has peeled of before application of tie coat. The tie coat shall be applied after 7 days of curing of the primer. If, new paint system is not suitable to upgrade existing coating then complete paint shall be removed by mechanical or blast cleaning before application of new coating system.

8.4.0 Finish Paint

Suitable Finish paints as per the schedule shall be applied for the jobs. The color/shade shall be as approved by the Owner. After cleaning the dust on the dried up primer, first coat of finished paint shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After applying second coat, allowing the water to get evaporated completely, third finish coat of finish paint may be applied(if applicable).

9.0.0 STEEL STRUCTURES PAINTING

Generally, all steel structures shall receive two primer coats and two finish coats of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied (if required) after erection and final alignment of the erected structures. Two finish coats shall also be applied after erection.

Steel surface which is to painted shall be cleaned off dust and grease and the heavier layers of rust shall be removed by chipping to grade ST-2 as per SIS05-5900 or as per IS: 1477 (part -I) prior to actual surface preparation. Suitable primer of required DFT shall be applied as specified in the Paint system of this document- Annex-25.1.1.

Suitable finish paint of required DFT shall be applied as specified in the Paint system of this document- Annex-25.1.1. The undercoat and finish coat shall be of different tint to distinguish



the same from finish paint. All paints shall be of approved brand and shade as per the Owner's requirement.

Joints to be site welded shall have no paint applied within 100 mm of welding zone. Similarly where Friction grip fasteners are to be used no painting shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams supporting gratings or chequered plate shall receive one additional coat of finish paint over and above number of coats specified before erection. Portion of steel member embedded / to be encased in concrete shall not be painted.

10.0.0 PAINT MATERIALS

The paints shall conform to the specifications given in this Annex and class - 1 quality in the products range of any of the following manufacturers:

- a. Asian Paints (India) Ltd.
- b. Bombay Paints
- c. Berger Paints India Ltd.,
- d. Good lass Nerolac Paints Ltd.,
- e. Garware Paints
- f. Jenson & Nicholson
- g. Shalimar Paints
- h. Equivalent other country manufacturer after prior approval of Owner.

11.0.0 STORAGE

All paints and painting material shall be stored only in rooms to Engineer's approval. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separated from adjacent buildings. A signboard bearing the words "PAINT STORAGE - NO NAKED LIGHT - HIGHLY INFLAMMABLE - DANGER - NO SMOKING" shall be clearly displayed outside. All paints shall be stored in the safest manner so that no container rolls down and causes accidents. The shelf life of the paints shall be ensured so that the paint materials are not in storage and use after the date of expiry.

12.0.0 APPLICATION

Health and safety of work

The supplier has to check all painting work to be carried out according to the specification of the paint supplier further to all relevant prescriptions and regulations concerning the health and safety of work.

The paint supplier has to present a written specification including at least the flash point of the paints, ventilation requirements, handling precautions such as inhalation, eye and skin protection, and first aid procedure, storage requirements, spill or leak procedure, fire precaution, waste disposal.

Methods

Quality of the surface to be painted or coated has to be tested acc. to DIN 55928 and DIN 8202.

Temporary corrosion protections are to be completely removed prior to applying the definite one, in acc. with DIN 55928.



All prime coatings shall be applied by brush or airless spray or a combination of these methods, as approved by the coating manufacturer.

All doors, windows, stairways, handrails (if painted), bolts, flanges and equipment supports shall be finish painted by brush.

Spray guns should not be used outside in windy weather or near surfaces of a contrasting colour unless the latter is properly protected.

All cold-spray painting shall be done using standard equipment in accordance with accepted standards and methods.

Care has to be taken not to connect spraying devices for nitro and bakelite paints simultaneously to oil based paints.

Paint applied to items that are not being painted shall be removed at the supplier's expense, leaving the surface clean, unstained and undamaged.

Dry film thickness (DFT)

To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats shall not be of the same colour.

For a composite paint or coating system consisting of several coats, the total DFT must be at least equal to the sum of the minimal DFT's for the individual coats. If, the paint system does not have the required minimum DFT those areas should be marked & repainted. If the occurrence of those areas is high, the complete surface must be repainted. It is also critically important to check the DFT of primers and intermediate coats and to correct them where necessary.

For paintings based on Zinc silicate the DFT is limited as well on minimum DFT as on maximum (150µm) because of the risk of mud cracking.

Consumption of paints

Has to be evaluated according to DIN 53220. The paints shall be tested as per IS - 101.

Each coat of paint shall be allowed to harden before the next is applied. For epoxy paint the hardening time normally is 12-14 hours. Suppliers' recommendations regarding hardening time of epoxy paints must be followed.

Particular attention must be paid to full film thickness at edges.

The minimum total dry film thickness of the paint systems shall be as recommended in the **Annex 25.1.2**. The DFT is given in microns (millionths of a metre).

13.0.0 PROTECTIVE COATINGS AND PAINT SYSTEMS

The colour coding for identification of pipelines should comply with IS-2379 & IS -9404.

The type and number of protective coats for any item requiring painting are to be in accordance with DIN 55928 and are to be at least of a quality as shown in the attached Annex-25.1.1- Paint System.

Alternative to the Annex-25.1.1- Paint System specified, are to be presented on the schedule Departure from Specification, as indicated elsewhere.



Generally, all parts shall receive the specified prime coat (s) at the supplier's works to ensure that no corrosion occurs during transport to the site and storage at the site.

Parts which cannot be damaged during transport shall receive the full number of coats.

Types of Substrate, Base metal:

- Ferrous (Surface Temperature during operation < 120° C, EN ISO 12944:1998)

To this group belongs carbon steel, low alloyed steel & high alloyed steel. All paint systems are inevitable for corrosion protection.

- Hot dip galvanized surfaces.

Hot dip galvanized surfaces do require painting in a wet, industrial, chemicals and/or marine environment

- SS (EN ISO 12944:1998 conditionally applicable)

In general, SS surfaces do not require painting unless in a chemical and/or marine environment. In case of chemical and/or marine environments determination of whether or not the surface requires painting depends on the chemical content of the base metal.

The following formula applies:

$$W = Cr + 3.3 \times Mo + 22.45 N_2$$

If $W < 23$, then the surface has to be painted.

If $W < 28$ & $W > 23$, then the surface to be painted if splash contact with the media (i.e. sea) is possible. This may also occur if there is a strong wind carrying drops to the surface.

If $W > 28$, then the surface need not be painted.

- Aluminium

By default such surfaces/components will not be painted. Exceptions are architectural/aesthetic reasons and high corrosive conditions, which shall be evaluated separately depending on aluminum alloys.

14.0.0 GALVANIZING

Galvanizing works shall conform in all respect to B.S. 729, B.S. 3083 and B.S.C.P. 2008 and to DIN 50976 whatever requires the higher quality and shall be performed by the hot dip process, unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed in accordance with B.S 4479.

Vent-holes and drain-holes should be provided to avoid high internal pressures and air-locks during immersion, which may cause explosions, and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. The welds and the surrounding metal should be cleaned separately, preferably be blast-cleaning, because the usual preliminary pickling cannot be relied on to remove the welding slag.

All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with B.S. 4360. All drilling, cutting, welding, forming and final



fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from paint, oil, grease and similar contaminants in accordance with DIN 55928, part 4 and DIN 50976. The weight of zinc coating per unit area has to be noted in the manufacturing documents in accordance with DIN 50976.

The minimum average coating weight shall be as specified in Table 1 of B.S. 729 or Table 2, DIN 50976, whatever requires higher quality.

Structural steel items shall be initially grit-blasted to B.S. 4232, second quality, (Sa 21/2) or by pickling in a bath and the minimum average coating weight on steel sections 5 mm thick and over shall be 610 g/m² (DFT = 85μ) .

On removal from the galvanizing bath, the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross.

Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor (defined in B.S. 3294, part 1 and B.S. 4604, part 1) is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Bolts, nuts and washers, including general grade high-tensile friction grip bolts (referred to in B.S. 3139, and B.S.4395 part 1) shall be hot dip galvanized and subsequently centrifuged (according to B.S. 729). Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger-turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of galvanized high-tensile friction-grip bolt after the bolt has been inserted through the steelwork, must be allowed to come into contact with the mating faces of the steelwork,. A local remelting of the galvanized parts to achieve the nuts to be finger turned on the bolt is possible in accordance with DIN 50976.

Protected slings must be used for offloading and erection. Galvanized work which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored in accordance with DIN 55928, part A and DIN 50976 by:

- Cleaning the area of any weld slag rust and other impurities and by thorough wire brushing to give a metallic clean surface.
- Application of suitable number of coats of zinc-rich paint containing more than 90 % w/w of zinc in dried film. The dry film thickness shall exceed at least 50 % the thickness of the desired galvanization. In case of application of a low melting point zinc alloy repair rod, the rods shall be in accordance with DIN1707, the thickness of the alloy shall be at least as of the desired galvanization.

The restored area is not to exceed 1 % of the galvanized surface.

Surface restoration of parts in contact with drinking water is not allowed and the quality of the galvanization is to be in accordance with DIN 2444.

After fixing, bolt heads, washers and nuts shall receive two coats of zinc-rich paint. Connections between galvanized surfaces and copper, copper alloy or aluminum surfaces shall be protected by suitable preferably hydrophobe tape wrappings to the owner's approval.



15.0.0 SPRAYED METAL COATINGS

Corrosion protection may be also achieved by spraying of suitable metals as zinc and/or aluminum on the surfaces of structures. For special cases tin, copper, lead can be used as well. Methods of surface preparation have to conform to B.S. 2569 or to DIN 8567. A proper treatment of the surface followed by an immediate spraying is to apply to ensure adhesion of the sprayed metal. The surface has to be clean, free of impurities, rust, mill scale and rough enough to have binding properties to ensure good enticulation with the sprayed layer. Suitable roughness can be achieved by blast cleaning acc. to BS 4232 or DIN 8567. Welds are to be cleaned and prepared with special care. All surfaces to be treated have to be dry and accessible.

Application of coatings, requirements for thickness, adhesion, composition of coating metals, and subsequent treatment have to conform to BS 2569, DIN 8565 and 8567.

Testing of the spray coated layers are to be carried out in accordance with DIN 8565.

The contractor has to specify the type, composition and thickness of the sprayed metal and of the sealing coating according to DIN 8565 including the corresponding warranties and tests if, sprayed metal coating will be applied.

Safety of work:

All precautions connected with this type of application of corrosion protection have to be in accordance with German regulation DVS 2307, page 1. 2.

Sprayed, unfused coating of metals and metallic compounds applied by combustion gas flame, plasma arc, detonation and similar processes, and the preparation of components, spraying techniques, sealing, finishing and inspection shall be according to B.S. 4761.

The hot galvanized surface has to be cleaned before the application of the coats to remove corrosion products, dirt, dust, grease.

The cleaning can be achieved by

- brush off
- washing with 1 - 1.5 % ammonia water with up to 0.1 % detergent added and followed by wet grinding to turn the foam to grey color,
- steam blasting.

16.0.0 WARNING NOTES / SIGNALS

This Instruction serves the identification of the coated surfaces that are received from shop in assembled condition / module wise.

The warning note shall prevent any possible damage to the coated surfaces during transportation / assembly at site.

Eg.: Welding work OR Heat treatment work on the outside of coated or lined surfaces is prohibited.

17.0.0 COLOUR CODE FOR PIPING

- a. The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it. The colour coding for the identification of pipelines shall comply with **Annex – 25.1.1** of this specification.



Ground Colour shall be applied throughout the entire length for un insulated pipes. For insulated pipes, on the metal cladding or on the pipes of material such as non-ferrous metals, austenitic stainless steel etc., ground colour coating of minimum 2m length or of adequate length not to be mistaken as colour band shall be applied at places requiring colour bands. Colour band(s) shall be applied at the following location.

- i. At battery limit points
 - ii. Intersection points & change of direction points in piping ways.
 - iii. Other points, such as midway of each piping way, near valves, junction joints of service appliances, walls, on either side of pipe culverts.
 - iv. For long stretch/yard piping at 50 M interval.
 - v. At start and terminating points.
- b. Flow direction shall be indicated by an arrow in the location stated above and as directed by Engineer. Colors of arrows shall be black or white and in contrast to the color on which they are superimposed. The size of the arrows shall conform to IS:2379. Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by Engineer. As a rule minimum width of color band shall conform to 75 mm up to 300 NB and to 100 mm over 350 NB. Whenever it is required by the Engineer to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of red and golden yellow as per IS:2379 shall be painted on the ground color.
- c. All uninsulated piping systems, hangers and supports shall have two coats of suitable primer coats and with suitable finish paints as per Annex 25.1.2 Painting system. Shades shall be as per IS 5 or as indicated by Owner /Engineer. Service of the pipe/line designations shall be painted on all pipes at visible locations.

18.0.0 IDENTIFICATION OF VESSELS, PIPING ETC.

Equipment number shall be stenciled in black or white on each vessel, column, equipment and machinery after painting.

Line number in black or white shall be stenciled on all the pipelines of more than one location as directed by Engineer; size of letters printed shall be 150 mm (high) for column & vessels. 50 mm (high) for pump compressor and other machinery and shall be as per IS: 9404 for piping. The storage tanks shall be marked as detailed in the respective drawing.

19.0.0 INSPECTION AND TESTING

- a) All painting materials including primers and thinners brought to site for application shall be procured directly from manufacturer as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable. Engineer at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch wise test of wet paints for physical & chemical analysis. All costs thereof shall be borne by the contractor. The paints shall be tested as per IS: 101 / equivalent international standard and approved by the Owner.
- b) The painting work shall be subject to inspection by Engineer at all times. In particular, following stage wise inspection shall be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection shall be surface preparation, primer application and each coat of paint. In addition to above, record shall include type of shop primer already applied on equipment e.g. red oxide zinc chromate or zinc phosphate or Silicate primer etc.



- c) Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good of any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint shall be applied to make-up the DFT specified without any extra coat to the Owner.

20.0.0 GUARANTEE

The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work. The contractor shall produce test reports from the manufacturer regarding the quality of the particular batch of paint supplied. The Engineer shall have the right to test wet samples of paint at random for quality of the same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.



ANNEX-25.1.1

STANDARD FINAL COLOUR OF EQUIPMENT AND PIPING

1.0.0 STANDARD COLOUR CODE FOR MECHANICAL EQUIPMENT

Sl. No.	Description	Ground Colour
A	CLOSED COOLING WATER SYSTEM	
1	Closed cooling water pumps	Sea Green
2	Plate heat exchanger	Sea Green
3	Closed Cycle cooling Water (CCCW) pumps	Sea Green
4	CCCW Expansion tank	Sea Green
5	CCCW chemical dosing tank	Sea Green
B	WATER TREATMENT PLANT	
1	Raw water	
a	Raw water pump	Sea Green
b	Clarifier	Sea Green
c	- Raw / Fire water storage tank	Sea Green
d	DM plant supply pump	Sea Green
e	Filter air blower	Sea Green
f	Filter back wash pump	Sea Green
g	Lime slaking tank & agitator	Sea Green
h	Lime slurry transfer pump	Sea Green
l	Lime solution tank	Sea Green
j	Lime solution dosing pump	Sea Green
k	Alum solution tank	Sea Green
l	Alum solution metering pump	Sea Green
m	Polyelectrolyte solution tank	Sea Green
n	Polyelectrolyte solution metering pump	Sea Green
o	Sludge feed pump	Sea Green
p	Filter press	Sea Green
q	Service water tank for DM building	Sea Green
r	Service water tank for control annex	Sea Green
2	Demineralization system	
a	Activated carbon filter	Sea Green
b	Cation exchanger	Sea Green
c	Anion exchanger	Sea Green
d	Degasser tower	Sea Green
e	Air blower for degasser tower	Sea Green
f	Strong base anion exchanger	Sea Green
g	Degassed water transfer pump	Sea Green
h	Strong base anion exchanger	Sea Green
l	Mixed bed polisher	Sea Green
j	Air blower for mixed bed polisher	Sea Green
k	DM Water Storage tank	Sea Green
l	DM water transfer pump	Sea Green
m	Acid unloading cum transfer pump	Dark Admiralty Grey
n	Bulk acid storage tank	Dark Admiralty Grey
o	Acid measuring tank for SAC	Dark Admiralty Grey
p	Acid measuring tank for MB	Dark Admiralty Grey
q	Regeneration water pump	Dark Admiralty Grey
r	Caustic Lye unloading cum transfer pump	Dark Violet
s	Bulk caustic storage tank	Dark Violet
t	Caustic regeneration tank & agitator	Dark Violet



Sl. No.	Description	Ground Colour
u	Caustic solution filter	Dark Violet
v	Caustic dilution tank for SBA/WBA	Dark Violet
w	Caustic dilution tank for MB	Dark Violet
x	Caustic pump for regeneration for WBA/SBA	Dark Violet
y	Waste water recirculation cum disposal pump	Sea Green
C	CRANE & HOIST	
1	Power house EOT crane	Canary Yellow
2	CW pump house EOT crane	Canary Yellow
D	COMPRESSED AIR PLANT	
1	Air compressor	Sky Blue
2	Compressed air dryer	Sky Blue
3	Air receiver	Sky Blue
E	Chemical Dosing	
1	Hydrazine preparation tank	Dark Admiralty Grey
2	Ammonia preparation tank	Dark Admiralty Grey
3	Hydrazine & ammonia dosing tank	Dark Admiralty Grey
4	Hydrazine & ammonia dosing pump	Dark Admiralty Grey
5	Phosphate preparation tank	Dark Admiralty Grey
6	Phosphate dosing tank	Dark Admiralty Grey
7	Phosphate dosing pump	Dark Admiralty Grey
8	Sampling system	Dark Admiralty Grey
F	FIRE PROTECTION SYSTEM	
1	Diesel engine driven pump	Fire Red
2	Fuel tank for diesel engine driven pump	Fire Red
3	Main hydrant pump (Electrical)	Fire Red
4	Jockey pump	Fire Red
5	Fire Water Storage tank	Fire Red
6	CO2 cylinder	Fire Red
G	FUEL OIL SYSTEM	
1	Fuel oil pumps skid	Light Brown
2	Fuel oil Storage tank	Light Brown
3	Fuel oil strainer	Light Brown
H	ASH DISPOSAL SYSTEM	
1	Ash transmitting vessel	Aluminium
I	AIR CONDITIONING AND VENTILATION SYSTEM	
1	Refrigerant compressor	Sky Blue
2	Chilled / condenser pumps	Sea Green
3	Condenser water pipe	Sea Green
4	Fans	Grey

Notes:

1. This color code basically refers to IS:2379 for piping with necessary modifications
2. For any item left out, color coding will be decided after Owner's approval.

**2.0.0 STANDARD COLOUR CODE FOR ELECTRICAL EQUIPMENT**

	Description	Colour	Colour No.
1	Generator	Two undercoats of high quality epoxy based primer followed by two coats of epoxy painting	
2	Generator circuit breaker	-	RAL 7032
	a) Outdoor		
	b) Indoor	Glossy white	-
3	Transformers	Pebble grey	RAL 7032
4	Bus ducts	Pebble grey	RAL 7032
5	Junction boxes.	Pebble grey	RAL 7032
6	HT/LT Switchboards, Distribution boards, Control & Relay panels		
	a) Indoor	Pebble grey	RAL 7032
	b) Outdoor	Pebble grey	RAL 7032
7	UPS Panel, charger panels	Pebble grey	RAL 7032
8	DG Alternator	Onan Green	-
9	NGR	Pebble grey	RAL 7032
10	Motor	Pebble grey	RAL 7032
11	Lighting fittings	As per manufacturer's standard	As per manufacturer's standard
12	Cable trays	Galvanized	
13	Elevator	Red oxide primer paint	

1. For interior coating, manufacturer's standard can be adopted subject to Owner's approval.
2. All panels that are to be erected at CCR floor shall be painted using RAL 7032 (exterior colour). All Electrical, C&I, Fire alarm or any other panel shall have this colour.



3.0.0 COLOUR CODING FOR IDENTIFICATION OF PIPELINES USED IN THERMAL POWER PLANTS

Sl.No	Medium	Ground Shade		Band Shade		Remarks
		Color	Color No. as per IS:5	Color	Color No. as per IS:5	
1	Water system					
a)	Untreated or raw / service	Sea green	217	White	-	White is not included in IS - 5-2007
b)	Treated/dematerialized	Sea green	217	Light orange	557	
c)	Condensate	Sea green	217	Light brown	410	
d)	Potable water	Sea green	217	French blue	166	
e)	RO water	Sea green	217	Light orange	557	
f)	Service & clarified water	Sea green	217	French blue	166	
2	Steam system					
a)	Auxiliary steam	Aluminum	-	Signal red	537	with aluminum
3	Air system					
a)	Instrument	Sky Blue	101	White	-	White not included in IS-5 - 2007
b)	Service/Plant	Sky Blue	101	White	-	
c)	Vacuum pipes	Sky Blue	101	Black	-	
4	Gas system					
a)	Hydrogen	Canary yellow	309	Signal red	537	White is not included in
b)	Chlorine	Canary yellow	309	Dark violet	796	
c)	Carbon dioxide	Canary yellow	309	Light grey	631	
d)	Oxygen	Canary yellow	309	White	218	
5	Oils					



Sl.No	Medium	Ground Shade		Band Shade		Remarks
		Color	Color No. as per IS:5	Color	Color No. as per IS:5	
a)	LDO/HFO	Light brown	410	Brilliant green	221	
b)	Transformer oil	Light brown	410	Light orange	557	
6	Chemical feed					
a)	Acid piping (in water treatment plant)	Dark admiralty grey	632	Signal red	537	Hazard mark is given
b)	Alkali Piping (in water treatment plant)	Dark violet	796	Golden yellow	356	Hazard mark is given
7	Fire services	Fire red	536	-	-	-
8	Effluent pipes	Black	-	-	-	-

4.0.0 COLOUR CODE FOR STRUCTURAL STEEL

SL. NO	ITEAM/SERVICE	COLOR	COLOR No. as per IS:5
1	Gantry girder & monorail	Brilliant green	221
2	Gantry girder & monorail stopper	Signal red	537
3	Building structural steel columns brackets, beams bracings, roof truss, purloin, side grit, louvers, stringers	Dark admiralty grey	632
4	Pipe rack structure & trestle	Dark admiralty grey	632
5	Chequered plate (Plain Face)	Black	-
6	Grating	Black	-
7	Ladder	Dark admiralty grey	632
8	Hand railing Hand rail	Signal red	537
9	Middle rail	Signal red	537
10	Toe Plate	Signal red	537
11	Vertical post	Black	-
12	Structural steel for Silo	Smoke grey	692



Notes

1. Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT shall be maintained.
2. All primers and finish coats shall be cold cured and air dried unless otherwise specified.
3. All paints shall conform to relevant Indian Standard and shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship shall be ensured.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. In case of use of epoxy tie coat, manufacturer shall demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat, alternate system may be used taking into consideration the service requirement of the system.
6. Contractor will submit the final colour shade for all equipments & piping under his scope for final approval by client / consultant.



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
Structural Steel work, piping (Oil + Water), tanks outside surface, transmission towers cranes, steel floors, galleries, stairways, Outdoor.	< 130 Deg	SA 2 1/2	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1	75
			Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Mid coat	1	2 pack High build High Solid Lamellar MIO based Epoxy Mid coat.	200
			Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUUV exposure of minimum 1000 hrs.	75
					Total	350
Structural Steelwork, piping, indoor and outdoor	130 to 200 Deg	SA 2 1/2	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Sealer	1	Single pack Heat Resistant Silicon Acrylic Finish paint.	25
			Finish	2	Single pack Heat Resistant Silicon Acrylic Finish paint.	25
					Total	150
Alternative -2		SA 2 1/2	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
				1	Single pack Moisture Cured, Inorganic Silicate based heat resisting finish up to 400 Deg - Grey shade./ white/ Aluminium.	50
			Finish	1		50
					Total	175
Alternative-3			Finish	1	Single pack Heat Resistant Silicon Acrylic Finish paint. - either Aviation White/ Aviation Orange.	80
					Total	155
Structural Steel work Piping, Un-insulated	200 to 400	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs	75



ANNEX 25.1.2 PAINTING SYSTEMS							
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.							
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat	
Carbon Steel Indoor and Outdoor	Deg C.			1	/ 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	(75)	
					Touch up		Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level 2.
					Finish		Heat Resisting Silicon Aluminium Paint. VS to be min 28%.
Total						115	
Carbon steel surfaces subjected to temperature up to 400 °C. But Under Thermal Insulation.	< 400 °C	Power tool cleaning to St 2 /3		2	Red-oxide Zinc phosphate primer to IS 12744	30	
Components coming in the gas path (other than Coils), including water walls, SH panels, SH Headers, Hot air ducts etc.		Power tool cleaning		2	Red-oxide Zinc phosphate primer to IS 12744	60	
						30	
Structural Steel work, Piping (Oil + water) , Tanks Indoor.	<130 Deg.C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75	
			Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)	
			Mid coat	2	2 pack High build High Solid Lamellar MIO based Epoxy Mid coat.	100	
			Finish	2	Two component Polyamide Cured Epoxy Coating.	25	
Total						325	
Structural Steel work in the battery rooms, chlorination plant and	Ambient	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance	75	



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
water treatment plant, (extremely aggressive atmosphere)			Touch up		specifications for SSPC Paint 20 , Level 1	(75)
			Mid coat	1	Two component, high build rust encapsulating, aluminium pigmented modified epoxy coating.	125
			Finish	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	150
					Total	350
Steel Tanks inside Surface (Total) for Oil Storage	Normal	SA 2.5	Primer	1	Two component high build amine cured epoxy Primer with zinc phosphate pigment.	75
			Finish	2	Two component Self priming High Build Polyamine adduct cured epoxy coating.	125
					Total	325
Alternative-1			Finish	3	Two component Self priming High Build Polyamine adduct cured epoxy coating. (No primer required. Self priming coating post blasting)	125
					Total	375
Alternative-2			Finish	2	Two component High build high solid Solvent free epoxy coating - certified by CFTRI for Potable water usage. (Primer same as above)	150
					Total	300
Steel Tanks inside Surface (Total) for Water Storage (Potable and Distilled Water)	Ambient	SA 3	Primer	1	Two component high build polyamide cured zinc phosphate Primer	75
			Finish	2	Two component Self priming High Build Polyamine adduct cured epoxy coating - certified by CFTRI for Potable water usage.	125
					Total	325
Alternative 1			Finish	2	Two component High build high solid Solvent free epoxy coating - certified by CFTRI for Potable water usage. (No primer required. Self priming coating post blasting)	200
					Total	400
Steelwork immersed in	< 60	SA 3	Primer	1	Two component High Build High Solid Rapid Curing Epoxy	75



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
seawater such as inlet/ outlet structures, dolphins, sheet piling	Deg C				Zinc Phosphate Primer.	
			Finish	1	Two component High build High Solid Modified Epoxy coating.	500
					Total	575
					Wherever TAR based product is not to be recommended.	
			Finish	1	Two component High build High Solid Modified Epoxy coating	500
					Total	500
			Finish	1	Two component High build High Solid Modified Epoxy coating with Glass Flake.	500
					Total	500
Alternative 1						
Cast Iron Water pipelines - Outside surface, buried in Soil	< 60 Deg C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1	75
			Finish	2	Polyamide Cured Coal Tar Epoxy, Vs min 65% black.	200
					Total	475
Alternate-1			Finish	1	Two component High build High Solid Modified Epoxy coating	500
Alternate -2			Finish	1	Two component High build High Solid Modified Epoxy coating with Glass Flake	500
Steel Pipes - Inside surfaces such as cooling water lines.	< 60 Deg C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Finish	2	Coal Tar Epoxy, Vs min 65% black.	225
					Total	525
Water Pipelines - Outside Surface, Indoor	< 60 Deg C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Touch	1	Two component Zinc rich Primer meeting performance and	(75)



ANNEX 25.1.2 PAINTING SYSTEMS							
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.							
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat	
			up Finish	2	compositional specifications of SSPC Paint 20 Level2 Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	100	
					Total	275	
Oil pipelines - Outside surface, above ground	< 100 Deg C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75	
			Touch up			Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Mid coat	2	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	100	
			Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75	
					Total	350	
Pumps, Motors, Turbine, Claddings, Steam Turbine Condenser, Indoor	Up to 90 Deg	SA 2.5	Primer	1	Catalysed Zn rich Primer with a VS of 60% min, complying to SSPC Paint 20 level 2.	75	
			Finish	2	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100	
					Total	275	
Alternative 1		SA 2.5	Primer	1	Catalysed Zn rich Primer with a VS of 60% min, complying to SSPC Paint 20 level 2.	75	
			Mid coat	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100	
			Finish	2	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75	
					Total	250	
Heat Exchangers - Inside Surface.	Up to 60 Deg	SA 2.5	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75	
			Finish	2	Coal Tar Epoxy, Vs min 65% black.	200	



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
					Total	475
Heat exchanger Coils coming in the gas path . (Eco, SH, RH coils & Loose tubes etc.)		Power tool cleaning			One coat of dip-coat paint -Red-oxide Zinc phosphate primer	35
Instrument panels, Electrical cubicles and similar steel sheet – indoor (Can be used on Aluminium, steel, stainless steel and galvanized substrates.)	Ambient	Oil grease and contaminants must be removed	Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	75
			Mid coat	1	Two component High Build Surface Tolerant Epoxy coating pigmented with Aluminium and Lamellar Micaceous iron oxide	100
			Top coat	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	100
					Total	275
Instrument panels, Electrical cubicles and similar steel sheet – outdoor (Can be used on Aluminium, steel, stainless steel and galvanized substrates.)	Ambient	Oil grease and contaminants must be removed	Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	100
			Mid coat	1	Two component High Build Surface Tolerant Epoxy coating pigmented with Aluminium and Lamellar Micaceous iron oxide.	150
			Top coat	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of atleast 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	325
Substrate, base metal: Carbon steel, HDG acc ISO 1461 Or. Equiv. Non Insulated. - Outdoor	<120 Deg	Air blasting with Nonmetallic abrasive Powder	Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	50
			Mid coat	1	Two component High Build Surface Tolerant Epoxy coating pigmented with Aluminium and Lamellar Micaceous iron oxide	150



ANNEX 25.1.2 PAINTING SYSTEMS								
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.								
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat		
			Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of atleast 90% on QUVB exposure of minimum 1000 hrs.	75		
					Total	275		
Substrate, base metal: Carbon steel, HDG acc ISO 1461 Or. Equiv. Non Insulated.- Indoor	<120 Deg	Air blasting with Nonmetallic abrasive Powder	Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level 2.	75		
			Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125		
			Finish	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100		
						Total	225	
						For Outdoor Application		
					Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
					Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125
					Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75
							Total	200
							For Indoor Application	
Substrate, Stainless Steel - Non insulated.	< 120 Deg	Air blasting with Nonmetallic abrasive Powder	Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125		
			Finish	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	100		
						Total	225	
						For Outdoor Application		
					Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125
					Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of atleast 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	200		
Applicable for Water -					For Indoor Application			



ANNEX 25.1.2 PAINTING SYSTEMS							
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.							
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat	
Water Cooled heat Exchangers like Condensers, Flash box, Water - Water coolers etc.	< 120 Deg	Air blasting with Nonmetallic abrasive Powder	Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	75	
			Top coat	2	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100	
Total					275		
For Outdoor Application							
For Outdoor installations in corrosive atmosphere - like Chemical/ Marine.			Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125	
		Mid coat	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100		
		Top coat	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75		
Total					300		

**PAINTING SPECIFICATION FOR CIVIL BUILDINGS – COASTAL**

S.No.	Location	Description
1	Metal and Timber Joinery	Two component high build, self priming, rust encapsulating, modified epoxy coating. Min VS 80%.
2	All Ceiling	Oil bound distemper (Office rooms) White Washing - all areas.
3	Internal wall surfaces	Oil Bound distemper
4	Control room/office	Acrylic Emulsion.
5	External faces of walls	Cement based Water proof paint
6	Walls of battery room and other acid/alkali spillage areas	1. Primer -1 coat of 50 microns - Two pack Polyamide Epoxy Primer with Zinc phosphate Pigment for concrete application. Min VS 48%. 2. Top coat - 1 coat of 125 microns - Two component self priming, high build polyamine adduct cured epoxy coating having excellent chemical resistance. Min VS 60%.
7	Cooling Tower External	
	a. Steel sections	i) Blasting to SA 2.5 ii) 1 x 75 microns - Inorganic Zinc Silicate as per SSPC Paint 20 Level 2. iii) 1 x 150 microns –Two components high build epoxy intermediate pigmented with lamellar micaceous iron oxide. Min VS 65%. iv) 1 x 75 microns - Two component high solids, Glossy, Acrylic Aliphatic Polyurethane paint, Min VS of 57%, Gloss retention of 90% after exposure to 2000 hrs under QUV B 313 lamp
	b. Concrete sections	1. 1 x 50 microns - Epoxy Polyamide Primer 2. 1x 500 microns-Two components high build high solid, engineered epoxy coating. Min VS 87%. - Typical dft - 500 microns per coat. Condensation as per IS 101 - 9000 hrs, Salt spray as per ASTM G 85 - 8000 hrs.
8	Chimney external	i) 1 x 50 microns Concrete Epoxy Polyamide primer followed by ii) 2 Coats of 50 microns of Acrylic Aliphatic Polyurethane paint