

TTTD-106-1 Rev No. 5	Form No.	 HYDERABAD	PROJECT ENGINEERING & SYSTEM DIVISION BHEL, HYDERABAD -32.	PEMC 03842
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TECHNICAL SPECIFICATION
FOR
INERT GAS EXTINGUISHING SYSTEM

PROJECT : 2 x 250 MW UNIT # 8 & 9, BARAUNI-TPS, BEGUSARAI

CUSTOMER : BIHAR STATE ELECTRICITY BOARD (BSEB)

CONSULTANT : M/S STEAG ENERGY SERVICES (INDIA) PVT. LTD.

		Revisions :	Prepared by:	Checked by:	Approved By:	Date
Ate Ref		00	Amit Kumar	K Gunjan	Sudhir Babu	20.04.2013

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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.	1. INTENT OF SPECIFICATION: 1.1. The intent of this document is to establish the minimum requirement of design, engineering, selection, manufacture, assembly, inspection, shop testing, shop painting, delivery FOR site properly packed for transportation suitably protected from weather including transit insurance of all equipment, supervision of Erection & Commissioning, final handling over as mentioned hereinafter for the Inert Gas Extinguishing system (IGES), which form part of project. 1.2. It is not the intent to completely specify all details of design, manufacture and construction. Nevertheless the equipment and installation shall conform to high standard of engineering and shall be capable of performing in continuous commercial operation in a manner acceptable to the Purchaser and end customer. 2. SPECIAL NOTES TO BIDDERS 2.1. This specification shall be read in conjunction with all its enclosures. In case of any discrepancy arising between this job specification & its enclosures, the most stringent of all (as determined by purchaser) shall be followed. Further, if a requirement in this specification or any of the enclosures, 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, 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. 2.2. 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. 2.3. Any specific hardware/software/item/ etc. required as indicated in 2.2. above but not listed elsewhere in this specification or its enclosures, shall be deemed to be included in the basic price quoted by the bidder.		
	Ref. Doc	Also, all mounting hardware/ accessories/fittings/conduits/etc. required for the completion of the Inert Gas Extinguishing system (IGES) package shall be	

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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.		deemed to be included in the basic price quoted by the bidder. Bidder, at no point of time, shall be eligible to raise any extra claim in this regard. 2.4. The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipments and the IGES as a whole. These shall be executed on the basis of proven design principle and in accordance with the latest state of the art in such a manner that the purpose to be served by the plant is fulfilled in every respect and a maximum of operational dependability and efficiency are assured. Standardization of equipment, materials etc. shall be employed in the design. Care shall be taken to ensure safe operation as well as simplicity of assembling and dismantling of all parts of the plant. 2.5. By accepting the contract, the bidder shall be deemed to have accepted the obligation of supplying everything that is necessary for the completion of the IGES as per the intent of this specification, regardless of any omission in the specification or on the drawings. 2.6. Even though, the requirements are specified in detail to the extent possible, bidder to apply good engineering practices in the design, selection of equipment, manufacturing, procurement, transportation, fabrication, painting, inspection & testing, supervision of erection & commissioning of system etc., wherever same is not clearly spelt out. 2.7. Bidder to note that the Purchase Order for the entire IGES system for the 2 x 250 MW BSEB Barauni thermal power project shall be placed on lump sum fixed prices based as per tender specification requirements. Bidder to further note that they shall not be permitted for any claim for additional commercial implication on any account during the detail engineering stage including the following: • Change (increase/decrease) in dimensions of equipments/areas • Change in location of equipments/areas within the battery limits. • Change (increase/decrease) in quantities in the equipments/areas covered by different IGES facilities • Furnishing of any Input drawing to bidder at any stage of contract execution • Changes in any of the Input drawings. • Other conditions mentioned elsewhere in this specification. 2.8. Bidder shall quote strictly as per the scope of supply and requirements of this specification.		
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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.			2.9. Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained. 2.10. In case bidder feels that it is necessary to exclude some components of scope of supply or some of the features of specification requirements due to any technical constraints, bidder shall bring the same to the notice of purchaser during pre-bid stage and take their prior approval before submission of their bid. 2.11. All such clarifications required by the bidder shall be intimated to BHEL together as a single notice within a week of receipt of enquiry by bidder. In case no such clarifications are sought during pre-bid stage, it will be assumed that bidder has no comments or observations on BHEL's specification and no deviations to the specifications will be taken by the bidder. 2.12. Bidder to quote strictly as per BHEL's price format. Failure to do shall make their offer liable for rejection. Any tampering/modification/change of the BHEL's price format is not allowed and is liable for rejection of bidders offer. 2.13. Incase Bidder is unable to offer due to any specific requirement of specification, Bidder shall bring out the same in their regret letter. Otherwise it will be considered that non participation by the bidder is attributable to reasons other than any specification requirements. 2.14. Compliance with this specification shall not relieve the bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions. 2.15. Accordingly, bidder to furnish their comments if any on this specification as a part of pre-bid query. 2.16. 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. 2.17. The intending tenderers shall be deemed to have visited the site and have studied the conditions before submitting the Bids. Non-familiarity with the site conditions will not be considered a reason either for extra claims or for not carrying out the work in strict conformity with the drawings and specifications.	
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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.	regarding the requirement of any additional tools and tackles will be final and binding on the Purchaser. 5. All special tools and tackles shall be handed over purchaser, prior to the issuance of the PROVISIONAL ACCEPTANCE CERTIFICATE for the IGES. 6.3. RECOMMENDED 3 YEARS SPARES: 6.3.1. The bidder shall quote separately with unit prices as optional price for the recommended list of spare parts for 3 years operation, with recommended quantities for the equipment covered under this specification. 6.3.2. Bidder shall furnish such a list with unit rate for each item along with offer. 6.3.3. Bidder to note that item shall not be considered for price bid evaluation to finalize the L1 bidder. 7. BIDDER'S SCOPE OF SERVICES 7.1. TAC APPROVAL Obtaining TAC (or the authority presently having jurisdiction or as may be applicable) shall be in the scope of the bidder. The system shall be designed for maximum insurance rebate. All activities related to this including preparation of documents, furnishing clarifications, information etc. as and when required, till final approval is obtained, will have in bidder's scope. All comments, modifications etc. suggested by the TAC / TAC accredited agency shall have to be incorporated by the bidder without any extra cost to the purchaser. 7.2. SUPERVISION OF ERECTION & COMMISSIONING: 7.2.1. Supervision of erection, commissioning performance testing & final handing over to end customer for the supplied system shall be included in bidder's scope of service. 7.2.2. 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. ➤ Travel expenses (inclusive of any clearance charges like Visa fee etc, insurance) from / to vendor works to site. 7.2.3. Per diem charges shall be applicable from the day bidder's person reaches site, up to the day he leaves the site.		
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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.		7.2.4. For the purpose of tender total no of 50man days to be covered in 7 visits have been considered. However, either or both of the number of man days or no of visits may change on either side based on the actual site requirement. 7.2.5. All payments towards supervision of E&C shall be made only after BHEL-site supervision. 7.2.6. 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. 7.2.7. Bidder to quote supervision of erection and commissioning activities strictly as per BHEL's price format. 7.3. LIST OF MAJOR SERVICES INCLUDED IN BIDDER'S SCOPE: a. Detailed Engineering b. Engineering for interfacing all inputs and outputs c. Submission and obtaining approval of all engineering documents d. Engineering for procurement e. Preparation of all MTOs and MRs, as required f. Ordering of all equipments and materials g. Preparation of Documentation and obtaining owner/consultant approvals for the same h. Overall Project Management and progress reporting to owner/consultant i. Expediting suppliers and sub bidders j. Procurement k. Manufacture, fabrication and assembly at works l. Inspection and testing including third party Inspection m. Painting at works , painting at site including touch up paint n. Dispatch and transportation of equipments, consumables, construction aids and other material to site. o. Preparation of all fabrication drawings. p. Furnishing activity wise work program and taking necessary approvals from the related department in the refinery before carrying out any activity. Any statutory approval, if required, shall also be taken. q. Supervision of erection and commissioning of the complete Inert Gas Extinguishing System. r. Insulation with cladding and painting s. Material Reconciliation Material re-conciliation will be done jointly by Purchaser's erection office (BHEL-PSER) & Sub-vendor. Bidder to note that the payment		
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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.		towards the supply for any item will be made only after the completion of the material reconciliation activity at site. Bidder to further note that no separate payment shall be made by Purchaser for material reconciliation activity (material reconciliation at site will not be considered as a part of supervision of E&C activity) & any price of this service will be deemed to be included in the basic price of supply of the package quoted by the bidder. t. Mechanical Completion u. Preparation of startup and operating manuals v. Supervision of Pre-commissioning activities and rectification w. Supervision of Commissioning and reliability run x. Running of the Inert Gas Extinguishing System as per Purchaser / End customer's requirements till final handing over. y. Successful Performance guarantee testing z. Handing over the plant to the owner - aa. Coordination and statutory approval from government/non-government bodies/agencies - bb. Supply of all test reports /certificates - cc. Providing as built drawings - dd. Training of the Clients Engineering and Operating Personnel NOTES: 6. Bidder to note that the above list is not exhaustive and any other service required as per the intent of this specification / project requirements /good engineering practice shall be deemed to be included in bidder's scope without any commercial implication to the purchaser. 7.4. Training To End Customer: 7.4.1. Prior to handing over of the system to Owner, the supplier shall provide operational training to Owner's operating personnel, which shall consist of control system operation, troubleshooting procedures, emergency procedures, safety requirements etc. 7.4.2. The duration of the training shall be for a minimum of seven working days. 7.4.3. The cost of all such training shall be included in the price quoted by the bidder. 7.5. After award of work, before finalizing his layout especially the layout/levels of equipments cable/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. 7.6. Arrange for services of manufacturer's installation / commissioning engineer at site during mechanical completion / pre-commissioning & commissioning of all the major equipment and systems is included in bidder's scope. All the cost		
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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.	7.7. including that towards boarding, lodging, servicing, Insurance, Local Travel, Service charges etc. for arranging all the above visits shall be deemed to be included in the bidder's quoted price. Bidder shall not be eligible to raise any extra claim in this regard. 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, however, responsibility for adequate manning the system shall be that of bidder. 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.		
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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.		8. CLARITY OF SCOPE IN OTHER AREAS (SCOPE MATRIX)																						
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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.											3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Bidder equipment terminals by Bidder.
							4.	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Bidder	BHEL	
							5.	Lighting	BHEL	BHEL	
							6.	Cable trays, accessories & cable tray supporting system.	BHEL	BHEL	BOQ to be furnished by the bidder after award of contract.
							7.	Below grade grounding system.	BHEL	BHEL	
							8.	Conduit and conduit accessories for cabling between equipments supplied by bidder	Bidder	BHEL	Cabling shall be through conduits. However bidder can use the trunk route where available for laying of cables. Conduits shall be supplied by bidder and shall be medium duty, hot dip galvanized cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage
							9.	Equipment grounding & lightning protection	BHEL	BHEL	
							10.	Motors with base plate and foundation hardware	Bidder	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
							11.	Cable glands and lugs for equipment supplied by bidder	Bidder	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
							12.	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Bidder	BHEL	
Ref. Doc		13. a) Input cable schedules b) Cable interconnection	Bidder Bidder	-	Cable listing for control cables for bidder-supplied equipment (soft						

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		NOTES: 9. Counter flanges at all the terminal points is included in bidder's scope. 10. Isolation Valve at all terminal points is in bidder's scope. 11. All necessary supports cross over, approach ladder required for the proper erection and operation of all equipment supplied by bidder shall be included in bidder's scope. 12. All lugs, glands and termination kits for the equipments supplied by the bidder shall also be included in bidder's scope. 13. Bidder to furnish utility list with the offer indicating the requirements of the above services.																			
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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.	8.4 EXCLUSIONS 8.4.1 Storage, preservation of Materials/Equipments at site (however detailed storage and preservation procedure shall be furnished by bidder) 8.4.2 Erection and Commissioning (supervision of Erection and Commissioning is in the bidder's scope) <u>ADDITIONAL POINTS</u> GENERAL 1. Bidder shall note that INERT GAS EXTINGUISHING SYSTEM shall be offered on turnkey basis for areas specified, meeting specification requirements. 2. Fiber optic cables shall be used for communication between various Inert Gas Extinguishing systems if the distance is greater than 1000m. 3. Bidder shall meet the requirement of vibration level, noise level as per specification. 4. Bidder shall meet the complete basis of design, all calculations, equipment selection criterion, layout drawings/schemes/G.A. drawings and documents like data sheet, technical particulars etc. shall be subject to CUSTOMER & or BHEL approval during detailed engineering stage. 5. Bidder shall note that all drawings and documents shall be AutoCAD based. For inputs from customer, BHEL will extend all efforts to get the same in soft copy, but there is no commitment about soft copy. 6. Bidder to comply adherence with codes and standards indicated in the specification. 7. Bidder shall note that quality plan shall be subject to CUSTOMER & BHEL approval after award of contract i.e. during detailed engineering. All comments as given by BHEL/ customer shall be taken care by bidder without any commercial & delivery implication. 8. Bidder to comply with Sub-Vendor list enclosed with the specification. If any item is left over other than indicated in the Sub-Vendor list, Sub-Vendor name shall be furnished during detail engg. subject to BHEL/ customer approval. Non-acceptance of any Sub-Vendor by BHEL / customer shall not have any commercial & delivery implication. 9. Bidder shall include adequate necessary supports / frames as required for supporting the piping / equipments etc. on lump sum basis and no unit rates shall be applicable for these items. Bidder to note this and confirm. 10. Bidder shall note that makes of equipments / items not specified in the enclosed sub bidder list shall be subject to CUSTOMER & BHEL approval during detailed engineering stage. 11. Materials required for earthings at the vendor-supplied equipments shall be included in the bidder's scope of supply.	Ref. Doc	

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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.		12. Bidder shall meet the performance guarantee of the equipments shall be as per data meeting specification requirements and system requirement. 13. Bidder to confirm acceptance to furnish drawings/documents as per the drawings/documents distribution as per project requirements. 14. Bidder to confirm that instruments required for performance testing of various Equipments / systems of the package shall be arranged by bidder at site without any cost Implication to BHEL. 15. Bidder to confirm that all instruments for testing shall be calibrated before taking up testing. 16. Bidder shall furnish one set of catalogue for equipment items offered for this package. 17. Bidder to confirm that entire Inert Gas Extinguishing System shall be subject to approval by TAC accredited agency to qualify maximum premium discount and responsibility to get approval from TAC Accredited agencies shall rest on the Bidder only. 18. Noise level near equipments at 1 m horizontal and 1.5 above floor level shall be max. of 85 dB. <u>Additional following points/clauses to be noted by the bidder:</u> 1. Painting to suit environment for all equipments/items for this package shall be in the scope of Inert Gas Extinguishing system bidder. 2. Adequate/necessary supports/frames as required for supporting the piping/equipment etc. as lump sum basis is in the scope of Inert Gas Extinguishing plant bidder and no unit rate shall be applicable for these items. 3. Makes of equipment/items shall be subject to approval by Customer and or BHEL. 4. The inert gas release panel shall be accommodated in the same enclosure housing microprocessor based main fire alarm panel (supplied by others) envisaged to be located in main control room of power plant building or in the gas cylinder room.. 5. Pl. note that 240V, 1Ph power supply for IRD blower shall be provided by BHEL at one point. Bidder to lay a power supply cable for further working in its scope.		
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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.		9. TECHNICAL DETAILS: 9.1. Applicable Codes & Standards 9.1.1. The design, engineering, installation, testing, commissioning of the package shall be as per all relevant & applicable codes/standards, however specifically the following : 9.1.1.1. NFPA (National Fire Protection Association) codes. ❖ All other applicable NFPA codes for Clean agent / Foam /DCP system / CO2 system. ❖ NFPA 2001: National Fire Protection (Standard on Clean Agent Fire Extiguishing System) 9.1.1.2. BIS Codes for Fire Fighting Equipments ❖ 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) 9.1.1.3. ANSI B 16.5 - Pipe flanges and flanged fittings. 9.1.1.4. SMPV rules , PESO Nagpur (For Storage Cylinders) 9.1.1.5. Clean Agent Manufacturer's recommendations 9.1.1.6. NACE : RP-0169-97, RP-0285-95 9.1.1.7. BS : 7361 Part I-1991 (Formerly CP 1021-1973) 9.1.1.8. VDE: 0150, protection against corrosion due to stray currents from DC installations. 9.1.1.9. DIN :30676		
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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.		9.1.1.10. Petroleum Act, 1976(Govt. of India., Corrosion control in Petroleum production TPC Publication No.5) 9.1.1.11. Statutory Requirements 9.1.2. Requirements of the following local statutory authorities (as applicable) shall be taken into account for compliance: a. Factories Act b. Indian Petroleum Rules c. Tariff Advisory Committee (TAC) Guidelines (for Insurance purposes) d. Indian Boiler Regulation Act (IBR) e. Civil Aviation Rules f. Indian Railway Authority g. Indian Electricity Act h. Indian Electricity Rules i. Central Electrical Authority (CEA) j. NACE : RP-0169-97, RP-0285-95 k. BS : 7361 Part I-1991 (Formerly CP 1021-1973) l. VDE : 0150, protection against corrosion due to stray currents from DC installations. m. DIN : 30676 n. IEC/NEC : Relevant codes for Cathodic protection o. Fire insurance regulations. p. Regulations laid by Chief Electrical Inspector of State. q. Regulations laid by Chief Inspector of Explosives. r. Regulation laid by Factory Inspector of State. s. Petroleum Act, 1976(Govt. of India., Corrosion control in Petroleum production TPC Publication No.5) t. Director General, Factory Advice Service and Labour Institute, Bombay u. Central Mines Research Institute (CMRI), Dhanbad v. Department of Atomic energy w. Requirement of Petroleum & Explosives Safety Organization (PESO), Nagpur, India. x. Standards prescribed by Oil Industry Safety Directorate (OISD), Ministry of Petroleum and Natural Gas, Govt. of India. y. Ministry of surface transport. z. Department of Water Resources, Gujarat. - aa. Stipulations stated in Environmental clearance granted by Ministry of Environment and Forest, Govt. of India.		
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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.		bb. Liquid Effluent Discharge as per Minimal National Standards for Liquid effluents and air emissions confirming to Pollution Control Board Standards cc. Stipulations of Environmental authorities of the State of Gujarat. dd. Other legislations relating to Environmental protection such as (but not limited to) : • Hazardous wastes (Management and Handling) Rules 1989. • Water (prevention and control of pollution) Act, 1974 • Water (Prevention and Control of Pollution) Act, 1977. • Environment (Protection) Act, 1986 • Forest (Conservation) Act, 1980 • Municipal Byelaws of Urban Development Authority of State Government for Buildings in Township. ee. Pollution Control Board. ff. Weights and Measures Dept. gg. National Institute of Oceanology. hh. Central/State Govt. regulations for ROU & land acquisition. ii. National Highway Authority of India. jj. Public Works Department (PWD). kk. Forest Authority ll. Imigration/Canal Authority 9.1.3. 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. 9.1.4. All addenda including the latest addenda to all the above codes and standards (latest editions) shall be followed by the bidder. 9.1.5. In case of any conflict between this specification and above codes, standards and guidelines requirements, the most stringent requirement of these shall govern and the decision of purchaser in the resolution of the any such conflict shall be final. It shall be bidder's sole responsibility to clearly bring out/highlight the same distinctively in his pre-bid queries, 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. 9.1.6. All materials supplied under this contract shall be new and unused. All equipments connected with the above systems shall be ISI marked or from companies which carry ISO certification or FM/UL/Vds/LPCB approved.				
			Ref. Doc			

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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.	9.1.7. All equipment/items supplied shall conform to the provisions of statutory & other regulations in force in India and the State/Province where the project is executed, such as the Indian Factories Act, Indian Electricity (Supply) Act, Indian Electricity Act, Indian Electricity Rules, International Electric Technical Commission (IEC) Publication, Environmental Rules, etc. Obtaining of all permission and approvals from statutory authorities for the installation of the plant and machinery, and to ensure that the purchaser /end customer does not face any problems in future on account of non-conformance with these regulations as indicated above, shall be the responsibility of the bidder. 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 Inert Gas Extinguishing System will have to be done by the bidder. 9.1.8. Any special approvals that may be applicable for certain items, like for explosion-proof items from CMERI-Dhanbad, etc., shall be have to be duly considered and ensured. 9.1.9. The bidder shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at his office.			
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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.		10. DESIGN CRITERIA AND PHILOSOPHY Clean Agent Inert Gas Extinguishing System General 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) Design, manufacture and installation of INERT gas fire extinguishing system shall be in strict accordance with NFPA-2001 standard/ manufacturer's standard as the case may be and certified by UL/ FM/VDS/LPCB. c) Gas cylinder storage room is located b/w col. no 11 & 12 in D-E bay. Agent Supply, Design Concentration, Quantity & Discharge Time a) Minimum design concentration of INERET gas fire extinguishing system shall be 37.5% (minimum) at 70⁰F by volume. However higher concentration may be used, if it is specified by the agent manufacturer/system supplier (OEM) for the area protected. b) The complete volume of the rooms including the above false ceiling shall be considered for estimation of quantity of gas and containers. c) When determining the gas quantity, the minor leakage losses through window and door opening have been 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 for effective extinguishment. 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. d) 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). e) The discharge time period shall be such that the design concentration is achieved within 60 seconds. The flow calculations shall establish this criterion.		
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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.	f) The quality of gas shall conform to relevant design standard such as NFPA-2001 or as specified by listing authorities. Storage Containers a) All the storage containers shall be provided under an enclosure. It shall not be kept open to atmosphere. b) The storage containers shall be securely installed as per the listed installation manual with a provision for convenient individual servicing and container weighing. Such servicing or weighing shall be possible without shutting down the system. c) 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. d) The storage containers shall not be charged to a fill density or super pressurization level different from the manufacturer's listing. e) The design pressure for storage cylinders shall be suitable for the maximum pressure developed at 55⁰C and shall be designed to meet the requirements in NFPA-2001. f) 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. g) The storage cylinders shall have accessories such as 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. h) All the pressure gauges/switches, manifold connections etc. shall be easily removable for servicing/maintenance without any loss of gas. Distribution a) Piping fittings, 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.		
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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.		b) 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. c) The fire detection system to be employed shall be as specified elsewhere. Operating devices shall be by mechanical, electrical and pneumatic means conforming to NFPA-2001. The power supply to electrical actuators shall be backed up with reliable battery supply. Such batteries shall be charged automatically by battery chargers. Power supply shall be taken from the Fire detection/alarm system panels of the respective units. Required annunciations such as "Gas released", "Failure of automatic actuation" etc. shall be exhibited in the fire alarm panel. d) Where pilot cylinders are employed for actuation of the cylinder banks the number of pilot cylinders shall be as per the listed design manual. e) Facility for manual release of gas through push buttons shall be provided along with selection facility of "Auto/Manual" from the panel. f) In addition to this, local manual release through lever operation shall also be provided near the cylinder banks. g) All manual-operating devices shall be identified to the hazard they protect. h) Manual abort switches shall be provided for each of the area/zone and the same shall be provided as per NFPA-2001 or as specified by listing authorities. i) The gas releasing devices at cylinder outlets shall be of re-usable type after discharge at any instant. j) Supervision of automatic actuation devices, power supply, manual actuation circuits, and complete wiring shall be provided through control system/panel and the healthiness shall be reported or indicated in the panel automatically. Complete control system shall be listed and approved by UL/FM/VdS/LPCB. Design, Installation & Testing	
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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.	a) 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. The system flow calculations shall be performed using a calculation listed or approved by UL/FM/VDS/LPCB and shall be approved by TAC/TAC accredited agency. b) 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 will be provided for each protected area as per system requirement. c) After installation, the complete system shall be inspected and tested as per the recommendations of Chapter-4 & relevant Clauses of Appendix-A 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. d) Prior to handing over of the system to Owner, the supplier shall provide operational training to Owner's operating personnel, which shall consist of control system operation, troubleshooting procedures, emergency procedures, safety requirements etc. e) The complete installation, testing, commissioning & training shall be carried out by the Contractor under the supervision of the Manufacturer/designer at site. f) Performance test of this system will be carried out by releasing circuit without discharge the agent in all the area and the parameters will be measured.(Discharge test is not recommended as per NFPA-2001) Safety a) All the safety requirements recommended in NFPA-2001 or as specified by listing authorities shall be incorporated in the installation by the Bidder. b) Appropriate warning signs shall be fixed outside of those areas protected by the system and also in areas where the gas may spread indicating clearly the hazard associated with the system such as Noise, turbulence, cold temperature, physiological effects on personnel 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.	c) Apart from written warning signs, audio-visual type warning signs (i.e.) hooters & strobe lights shall be provided for pre-discharge and post-discharge activity. The sounder shall have selectable tone options. d) The gas shall be discharged after a set time delay on receiving signal from the fire detection system. The duration of the timer shall be up to a range of 0-5 minutes settable (adjustable in 1 minute variation) at site after conducting test to find out the duration for evacuation of the personnel from the area. e) To prevent the loss/release of gas automatically or manually during maintenance, the system shall have the facility of "LOCKOUT". The status of the system lockout condition shall be annunciated audio visually in the panel. 10.1.1. INSTRUMENTATION & CONTROL All instruments i.e. pressure switches, pressure gauges, level switches, level indicators etc. as per approved drawings shall be provided. 10.2 Electrical design Parameters 1. Equipment design temperature (IS-9676) : 50°C 2. Minimum temp for battery sizing : 10 ° C 3. Lt Motor Voltage: AC 415 V, 3 phase, 50 Hz (for motors up to 160 kW) 4. Frequency : 50 Hz 5. Design voltage variation: +/- 10 % 6. Design Frequency variation: +/- 5 % 7. Combined variation (Voltage & Frequency) : 10 %(sum of absolute values) 8. Fault Level at rated voltage: 50 KA (1 sec)		
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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.		11. INERT GAS EXTINGUISHING SYSTEM EQUIPMENT DETAILS 11.1. <u>AUTOMATIC CLEAN AGENT SYSTEM</u> 11..1.1. Total flooding Clean Agent System (Inert Gas System only viz: IG-01, IG-55, IG-100 & IG-541) shall be provided for Control Room floor. 11..1.2. The clean agent system shall be a total flooding centralized system with directional valves and have 100% standby cylinders. 11..1.3. 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) CCR & EER ROOM LAYOUT (Ref Drg No : PE-DG-374-100-I401) 11..1.4. Bidder shall design the system to meet the minimum requirements of total flooding fire extinguishers Clean Agent System as per NFPA-2001 and having design concentration as specified at 70⁰ F (21⁰ C) for the single largest risk area of the control room to be protected. 11..1.5. The system design shall be total flooding and Clean Agent requirement shall correspond to the single largest risk area of control room to be protected. 11..1.6. System supplied and design calculation shall be approved by UL/FM/Vds/LPCB and TAC accredited agency. 11..1.7. All equipments shall be approved by UL/FM/Vds/LPCB and cylinders alongwith cylinder valves assemblies shall be seamless and approval by Chief Controller of Explosives, India/PESO. approved. 11..1.8. It shall be noted that Clean Agent system to be provided shall meet the requirements of NFPA-2001 (Latest). Hence anything specified as 'mandatory' in NFPA-2001, although not specifically mentioned in this specification, shall form part of this specification. 11..1.9. The principle of operation shall be as follows : 11..1.10. 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 MFAP. 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, at least 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 MFAP), the clean agent extinguishing system will get actuated and the time delay for the release starts (normally 10 seconds		
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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.			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 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. 11..1.11. 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. 11..1.12. The system shall be designed based on the single largest risk area of the control room 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. 11..1.13. 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. 11..1.14. 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. 11..1.15. 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). 11..1.16. System Operation 11..1.17. The system shall comprise of the following mode of operation and actuation and cancellation facility etc. with necessary control panel:	
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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.				a. Automatically due to fire detection in protected area b. Operation of manual release push button located adjacent to protected area. c. By operating manual lever provided on electrical/manual control head on pilot cylinder d. By push button actuation at Clean Agent Control panel , in manual mode		
			11..1.18.	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.		
			11..1.19.	CLEAN AGENT GAS & ITS GROUPING/DISTRIBUTION		
				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. b. Suitable combination of cylinders shall be made to cater to all the risk areas individually. c. Both primary and standby cylinders shall be permanently connected to distribution piping through manifold and arranged for easy and automatic changeover. 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 specified in the table below:		
			11..1.20.	Gas properties and its discharge characteristics:		
11..1.21.	Physical properties of Clean Hydrocarbon Agents and Inert gas agent shall meet the requirements in table A-1-4.1 (a) and (b) respectively, of NFPA-2001					
Properties of Agents used as Fire Extinguishing Agents (Shall be as per NFPA-2001 latest edition)						
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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.		<table border="1"> <thead> <tr> <th>Name of gas</th> <th>Formula</th> <th>NOAEL %</th> <th>LOAEL %</th> <th>Agent Container charging pressure at 70 deg F @</th> <th>Agent container charging pressure at 130 deg F @</th> <th>Design concentration</th> </tr> </thead> <tbody> <tr> <td>IG-541</td> <td>N2(52%) AR(40%) CO2(8%)</td> <td>43</td> <td>52</td> <td>2900/2175 psig</td> <td>3433/2575 psig</td> <td rowspan="4"> *Design concentration for type of clean agent selected shall be in accordance to approval taken from UL/FM/Vds/LPCB (NFPA clause 5.4) </td> </tr> <tr> <td>IG-100 (N2)</td> <td>N2 100%</td> <td>43</td> <td>52</td> <td>4061/3236/2404 psig</td> <td>4754/3773/2799 psig</td> </tr> <tr> <td>IG-55</td> <td>N2 50% AR50%</td> <td>43</td> <td>52</td> <td>2962/2222 psig</td> <td>3300/2475 psig</td> </tr> <tr> <td>IG-01 (AR)</td> <td>AR 99.9 %</td> <td>43</td> <td>52</td> <td>2964/2370 psig</td> <td>3304/2650 psig</td> </tr> </tbody> </table>						Name of gas	Formula	NOAEL %	LOAEL %	Agent Container charging pressure at 70 deg F @	Agent container charging pressure at 130 deg F @	Design concentration	IG-541	N2(52%) AR(40%) CO2(8%)	43	52	2900/2175 psig	3433/2575 psig	*Design concentration for type of clean agent selected shall be in accordance to approval taken from UL/FM/Vds/LPCB (NFPA clause 5.4)	IG-100 (N2)	N2 100%	43	52	4061/3236/2404 psig	4754/3773/2799 psig	IG-55	N2 50% AR50%	43	52	2962/2222 psig	3300/2475 psig	IG-01 (AR)	AR 99.9 %	43	52	2964/2370 psig	3304/2650 psig
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NOAEL: No Observable Adverse Effect Level, The highest concentration at which no adverse physiological or toxicological effect has been observed. LOAEL: Lowest Observable Adverse Effect Level, The lowest concentration at which an adverse physiological or toxicological effect has been observed. * Or higher % quantity of volume as specified by Clean Agent Manufacturer for clean Agent system. However the maximum discharge concentration shall not exceed NOAEL ** System pressure shall be selected as specified in in scope of work/job specs.																																							
11..1.22. The agent discharge shall be substantially completed in a nominal 60 sec. 11..1.23. 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. The min O₂ concentration shall be as per NFPA-2001																																							
11..1.24. SYSTEM FLOW CALCULATION 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 TAC accredited agency. The system design shall be within the manufacturers listed limitations.																																							
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		11..1.26. CLEAN AGENT STORAGE CYLINDERS		
Ref. Doc			a. The clean agent storage cylinders shall be designed to hold clean agent at ambient temp. Cylinders shall be of approved type and freshly imported. Minimum design level pressure of storage cylinders shall be as per cl 4.1.4 and table A-4.1.4.1 of Annexure –A to NFPA-2001. b. The design pressure for cylinders shall be suitable for the maximum pressure developed at 55⁰C. c. The cylinders shall be charged to a fill density or super pressurization (super pressurization means the addition of a gas to fire suppression agent cylinder necessary to achieve the pressure required for proper system requirement) d. Bidder shall select the capacity of cylinder based on the storage space available and for better replacement and inter changeability. The bidder shall preferably select the capacity of cylinders keeping in view the filling ratio as per NFPA-2001	

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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.		e. The cylinder shall be seamless, brand new (date of manufacturing cylinder shall not be older than 1 year from the date of bid opening) never rested and month and year of manufacture shall be latest f. Each cylinder shall have a permanent name plate, specifying the agent tare and gross weight in addition to the pressurization level, nominal agent volume. g. Cylinder shall bear the mark of manufacturer, serial no, single test certificate issued by authority having jurisdiction and shall be approved by competent authority of the country of origin (UL/FM/Vds/LPCB) in addition to approval by PESO Nagpur. Cylinders without approval shall not be accepted. A reliable means of indication shall be provided to determine the pressure in refillable cylinders. PESO approval of the cylinder is a must. Cylinder shall conform to the requirement of NFPA 2001 and shall be compatible with the engineered system being provided along with design analysis. h. Each cylinder shall have pressure relief valve to protect the cylinders against excess pressure condition. i. Pressure gauges with isolation valves on manifold shall be provided. j. Automatic means such as check valve shall be provided to prevent agent loss if the system is operated when any cylinder is removed for maintenance. 11..1.27. LAYOUT OF CYLINDERS Clean agent cylinder shall be arranged in the following manner: a. In a battery of cylinders manifold together, leading to distribution piping and discharge nozzles for the risk to be protected, including below false floor and above false ceiling spaces, along with a reserve battery of clean agent filled cylinders with manifold and directional valves, including arrangement for automatic changeover to any of the two banks after actuation of main cylinders to be provided in each risk area i.e. 100 % reserve. b. The cylinder storage racks shall be provided for main as well as for reserve cylinders. c. The manifold cylinders referred above shall be securely mounted on the floor and suitably supported in a rack with provision for convenient individual servicing, according to the manufacturers installation manual. Such servicing shall be possible without shutting down the systems.		
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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.		11..1.28. PIPING , FITTING AND DISCHARGE NOZZLES 11..1.28.1. Piping & Fittings - Pipe shall be provided as per requirements specified in cl 4.2.1 of NFPA-2001. Pipe thickness calculation shall be as per ASME B31.1 power piping code. Normally welded joints shall be provided. Threaded pipes, if used, shall have threads in joints and fittings conforming to ANSI B1.20.1 - Pipe fittings shall be provided as per cl no 4.2.3 of NFPA-2001 - All CS studs, bolts and Nuts shall be hot dip galvanised as per ANSI A153 for corrosion resistance. - The pressure reduction device shall be easily identifiable. - The clean agent piping layout shall be such that pipes of one risk shall not pass through that of another risk. - All valves shall be approved for intended use. The gasket, O-ring and other material shall be compatible to the clean agent material. - 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: - The beam and ribs which criss-cross the ceiling - Path of AC ducts - Cabling in false flooring - Light fitting, detectors etc. 11..1.28.2. Discharge Nozzles Discharge nozzles shall conform to cl 4.2.5 of NFPA 2001 and shall be of brass and shall be FM/UL approved. Discharge nozzles used in the system shall be listed for the use intended for discharge characteristics. The selection of nozzle orifice shall be such discharge time required to achieve 95 % of the minimum design concentration for flame extinguishment based on 20 % safety factor shall not exceed 10 seconds/60 seconds for the inert gas selected as per cl 5.7.1.2 of NFPA 2001. Each nozzle shall be permanently marked to identify the manufacturer as well as type and size of orifice. 11..1.29. OPERATING DEVICES - Operating devices shall include agent releasing devices or valves, discharge controls and shutdown equipment necessary for successful performance of the system.		
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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.		b. Power supply shall be made available at one point only. Converter, if required, shall be in bidder's scope. c. All devices shall be designed for the service they will encounter and shall not readily be rendered inoperative. The clean agent system shall be designed to function properly for the temp. Range specified in NFPA-2001. 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. The normal manual control(s) for actuation shall be located for easy accessibility at all times, including at the time of a fire. The manual control(s) shall be of distinct appearance and clearly recognizable for the purpose intended. Operation of any control shall cause the complete system to operate in its normal fashion. f. 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. 11..1.30. Local Control Panel for Clean Agent System a. The local Control Panel shall be free standing, floor mounted type and shall be suitable for both auto and manual operation. Panel shall be made out of minimum 16 gauge CRCA sheets. Doors and covers shall be made out of 14 Gauge CRCA sheets. Panel shall be naturally ventilated totally enclosed, dust and vermin proof with IP-41 enclosure as a minimum. The clean agent system shall be actuated automatically by the signal received from the fire alarm panel. Signal from fire alarm panel shall energize the solenoid valve to trigger the dumping operation in the respective protected area/zone. Necessary control/interlock cabling between fire alarm panel and clean agent system panel using multi-core 2.5 sq. Mm cu conductor PVC insulated flame retardant cable shall be provided by Bidder. Control panel shall be equipped with adequate rating battery charger and Ni-Cd battery with 24 hour back up. b. Control panel shall be provided with all alarms , indicators caution/sign board and relay control switch meeting all the		
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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.		requirements of NFPA-2001 and shall include but not be limited to the following: I. • Two alarm and one fault indicator lamp for each zone • Combination of alarm silence and alarm off switch • Combination of fault silence and trouble lamp switches • Alarm test switch • Alarm re-set switch II. Audible and visual pre-discharge alarms shall be provided within the protected area to give positive warning of impending discharge. The operation of the warning devices shall be continued after agent discharge until positive action has been taken to acknowledge the alarm and proceed with appropriate action. Two no potential free contacts shall be provided for purchaser's use, one for indication of start of dumping operation and other for indication of end of dumping operation. III. 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. IV. All indication lamp shall be LED type with minimum size of 10 mm c. Warning and instruction signs at entrances to and inside protected areas shall be provided. d. A control box /clean agent panel shall be provided for manual control at the exit doors of each risk area comprising of selector switches for selection of main/reserve and auto/manual push button for clean agent release. e. Potential free contacts shall be provided form clean agent panel to shut off fire damper/louvers/ and AC system f. Supervision of automatic system shall be provided and shall include electrical supervision of the actuating devices and wiring. g. Operating instruction shall be displayed on a nameplate fitted permanently on the clean agent skid. h. For clean agent extinguishing systems, a pre-discharge alarm and time delay, sufficient to allow personnel evacuation prior to		
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11..1.31.

NOTES:

11

11.2.

11..2.1.

NOTES:

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11..2.2.

discharge, shall be provided. The delay shall be minimum 30 sec.
However it shall be adjustable from 30 to 120 sec.

Material of Construction

The material of construction shall be as per this specification for the item specified. For other items, the MOC used in the system shall be in accordance with NFPA-2001 or as specified by equipment manufacturer for the intended use (if same is not specified in NFPA-2001). The MOC shall be UL/FM/Vds/LPC approved

The clean agent room shall be located at El + 100.00 M Lvl between grid E-G /6'-8 (Refer Drg no : 0-38142-02437)

ELECTRICAL SYSTEM

WIRING TYPE

SI No	Area	Type of wiring
a.	Process plant / Building / Shed	Armoured cable
b.	Large service building	Surface conduit/Concealed conduit in office building
c.	Buildings with false ceiling	Surface conduit above false ceiling
d.	Substation (Switchgear Room)	METSEC channel/Concealed conduit
e.	Substation (Cable Cellar)	Surface Conduit/armoured cable
f.	Other buildings in safe area	Black enameled surface conduit/PVC

Fire alarm cables shall be laid in overhead cable trays / instrumentation trenches as far possible. In case these are not available. Cable shall be laid along berm of the roads.

CABLE SIZE

The power and control cables shall have the following minimum cross sectional areas:

SI No	Area	Details
a.	Medium voltage power cable	From 2.5 mm ² up to 16 mm ² -Copper, Above 16 mm ² -Aluminium
b.	Control cables	2.5 mm ² (Copper)

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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.		<table border="1"> <tr> <td>c.</td> <td>Fire alarm system</td> <td>1.5 mm² (Copper)</td> </tr> </table>				c.	Fire alarm system	1.5 mm ² (Copper)
		c.	Fire alarm system	1.5 mm ² (Copper)				
NOTES: 13 Fire alarm System cable sizes are indicative only and these shall be finalized as per the recommendations of equipment manufacturers. However minimum conductor size shall be as mentioned above. 11.3. INSTRUMENTATION 11.3.1. The design and installation of instruments shall be generally in accordance with ISA/API recommended practices and other applicable standards like BIS, IBR etc. Material specifications and practices shall, in general, conform to appropriate ASTM or equivalent standards. 11.3.2. All instruments and equipments shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and/or chemicals may be present As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-55 as per IEC-60529/ IS-13947 and secure against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive plant atmosphere. 11.3.3. Instruments shall be suitable for Zone 1 & 2 classified areas as applicable certified by a statutory body with gas grouping as per requirement. Additionally, Instruments shall be certified by PESO (Petroleum Explosive Safety Organization)/CCE (Chief Controller of Explosives), India. Also indigenous flameproof equipment shall comply with BIS requirement. 11.3.4. Following points must be considered while designing an intrinsically safe system: - - All intrinsic safety barriers shall be active isolating type and shall have isolation between input, output and power supply. - Barriers must be selected based on entity concept. Cable parameters shall also be considered while matching entity parameters. - The signal transfer accuracy of barrier shall be at least equal to or better than the transmitter selected. - Each instrument in the hazardous area and the intrinsic safety barrier shall be certified for intrinsic safety by a statutory authority. - Each input and output in a loop shall have separate barrier. No barrier shall be shared between two loops or input/outputs. - Any intrinsically safe loop requiring any device to be connected in the hazardous side permanently or temporarily shall also be intrinsically safe. - Configuration tools whenever required for any intrinsically safe item which forms part of the intrinsically safe item shall also be certified intrinsically safe.								
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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.			h. Universal barrier with programmable capability shall be used for temperature inputs i.e. for thermocouple/RTD inputs. i. It is desirable to use one make of barrier for entire plant. The series shall be of MTL / P&F or equivalent reputed makes. 11..3.5. Material of construction and end connection rating shall be as per piping material specification as a minimum. 11..3.6. Process switches, wherever specified, shall be provided with sealed micro switch contacts rated for the specified application. Contacts shall be 1 no. DPDT preferably. Otherwise 2 nos. SPDT can be considered. Contacts used in intrinsically safe applications shall be gold plated. 11..3.7. Smart transmitters where used shall be with an accuracy of $\pm 0.075\%$ of span with a range ability of 10:1 unless specified otherwise. Hand held communicator shall be supplied for smart transmitters and fieldbus transmitters. All transmitters shall have minimum static pressure rating of 100 kg/sq.cm.g. 11..3.8. Threaded end connections shall be to NPT as per ANSI B 1.20.1. Flanged end connections shall be as per ANSI B 16.5. 11..3.9. All cable entries to junction boxes shall be from side or bottom. 11..3.10. Solenoid valves used in hazardous area shall be flameproof (Ex'd'). Solenoid coil shall be rated for continuous operation of the upper limit of supply voltage (i.e. rating shall be 110 V DC continuous). Class F rating for solenoid valves preferable. 11..3.11. a. Following power supply voltage levels shall be used, unless otherwise specified: ▪ For Instruments, Control Systems, 110 V AC$\pm$.10% (UPS) 50 Hz $\pm$.3 Hz ▪ Solenoid Valves, Relays, lamps 110 V DC$\pm$.10% ▪ Input interrogation voltage .24 V DC$\pm$ 10% ▪ Panel/cabinets lighting 230 V AC $\pm$. 10% b. All instruments, control systems (PLC) shall be able to operate at the following power supply specification: ▪ Voltage level: 110 V AC$\pm$10% ▪ Frequency: 50 Hz $\pm$3 Hz. ▪ Switch over time: 5 milli seconds. c. Any voltage level other than 110VAC UPS (including 24 V DC) if required for powering any subsystem, input interrogation, relays and lamps etc, same shall be generated by the bidder using dual redundant bulk power packs. The bulk power supplies shall be redundant and shall be sized for 35% loading of its capacity in normal time. In the event of	
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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.		failure of one of these supplies the load in backup power shall not exceed 70% of capacity of Bulk power supply (BPS). 11..3.12. Signal Interface Philosophy 11..3.12.1. Direct signals from field to control room and MFAP a. All signals from field to central control room/Satellite Rack Room (SRR) shall be terminated in the junctions boxes located at appropriate locations in the field. b. Separate junction boxes shall be used for the following type of signals: i. -Intrinsically Safe Analog Inputs/Outputs (4-20 mA) ii. -Non Intrinsically Safe Analog Inputs/Outputs (4-20 mA) iii. -Intrinsically Safe Thermocouple Inputs iv. -Intrinsically Safe RTD Inputs v. -Intrinsically Safe contact Inputs vi. -Non Intrinsically Safe contact Inputs. vii. -Non Intrinsically Safe contact Outputs. viii. -Intrinsically Safe contact Outputs. c. All pulsed signals or serial signals shall be routed directly to control room(s) without the use of intermediate junction boxes, in general. In case, where single cable length is a problem, intermediate junction boxes can be used, however in all such case, same junction box shall not share signals from two or more device. d. Whenever multidrop serial communication is adopted, intermediate junction boxes may be used for multi-dropping purpose only. 11..3.12.2. Signals from bidder's scope to purchaser a. Whenever signals are required to be routed for purchaser's use, bidder shall use separate dedicated junction box or terminal strip for each type of signal i.e for 4-20 mA/alarm/contacts/temperature element etc. b. In case of serial signals, contractor shall provide a separate dedicated port for purchaser's use. 11..3.12.3. Repeat Signals from Sub-Package Local Panel a. Generally separate junction boxes shall be used for interfacing signals from sub-package to control room.		
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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.		b. Where signals as indicated in clause above is less in number and do not justify separate junction boxes, all such signals may be routed via local control panel if provided by bidder.																																																											
		c. All such signals shall be terminated on separate terminal strips in the local control panel. The terminal strips shall be segregated as explained elsewhere. The non-intrinsically safe signals shall be provided in certified flame proof junction boxes in local panels.																																																											
		d. Intrinsically safe barriers for all intrinsically safe signals, wherever required, shall be provided.																																																											
		e. Repeat signal, which is a part of fieldbus segment, shall be repeated to LCP through remote indicator. Remote indicator shall be part of same segment, which the respective transmitter is connected in the same segment.																																																											
		NOTES:																																																											
		14 Generally locating barriers in the local panels shall be avoided.																																																											
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vii.	For any other signal not covered but required for completion of job	BY BIDDER	BY BHEL
viii.	Serial Links between field and control room (if applicable)	BY BIDDER	BY BHEL
4.	Cables		BY BHEL
i.	Between field instruments and junction boxes & field instruments and local panel	BY BIDDER	BY BHEL
ii.	Between junction boxes and local panel.	BY BIDDER	BY BHEL
iii.	Between local panel and control room	BY BIDDER	BY BHEL
iv.	All types of system cables indoor/ outdoor for Bidder supplied systems	BY BIDDER	BY BHEL
v.	All earthing cables and strips (GI / Cu)	BY BIDDER	BY BHEL
5.	Installation materials		BY BHEL
6.	Impulse tubing/ piping, tube/ pipe fittings, valves and valve manifolds	BY BIDDER	BY BHEL
7.	Cables, cable trays, cable glands and accessories	BY BIDDER	BY BHEL
8.	Instrument air valves and pipes, tubing, fittings etc.	BY BIDDER	BY BHEL

11..3.14. Power Supply Requirement

		110V AC 50Hz. UPS	110V DC	24V DC See note below	110 V AC Non UPS	230 VAC 50Hz
	Solenoid valve		√			
	I/P , Transmitters Voltage			√		

NOTES:

15 24 V DC wherever required shall be generated by 110 V AC

11..3.15. Signal type

a) For Smart transmitters:	4- 20 mA DC with superimposed Digital Engineering Data (HART) LCD display in Engineering Unit and % for level in field
b) Fieldbus	: Foundation Fieldbus
c) Pneumatic	: Signal 0.2- 1 kg/cm ² g

11..3.16. INSTRUMENT CABLES

11..3.16.1. Single pair/triad cables shall be used between field instruments and corresponding type of junction box/ Local Control Panels/PLCs.

11..3.16.2. All the cables shall be Flame Retardant (FR) type. Fire resistant cables shall be used wherever specifically required.

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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.	11..3.16.3. Multi cables between junction boxes in the field and the Panels in the control rooms shall be as per following philosophy: - Signals: (4-20mA or switch contact) :6 / 12 pair individually and overall shielded (screened) and armoured, twisted, 0.5 mm² conductor. - RTD: 6 / 8 Triad individually and overall shielded (screened) and armoured, twisted, 1.5 mm² conductor. - Solenoid valves: 6 /12 pair overall shielded, armoured, 1.5 mm² conductor NOTES: 16 Higher conductor size shall be selected to limit the voltage drop within the specified limit. 11..3.16.4. Fieldbus network cables between wiring/ terminal blocks and panels in control room / shall be individually shielded twisted pair overall screened cable, called Type A cable. 11..3.16.5. The color of outer sheath, inner sheath and individual core for each type of cable shall be as mentioned below: <table border="1"> <thead> <tr> <th>Sl.No</th> <th>Type of cable</th> <th>Signal type</th> <th>Outer sheath</th> <th>Conductor +ve</th> <th>Insulation -ve</th> </tr> </thead> <tbody> <tr> <td>a.</td> <td>Signal</td> <td>IS</td> <td>blue</td> <td>blue</td> <td>Black</td> </tr> <tr> <td>b.</td> <td>Signal</td> <td>Non IS</td> <td>black</td> <td>blue</td> <td>Black</td> </tr> <tr> <td>c.</td> <td>Alarm /control/power</td> <td>IS</td> <td>blue</td> <td>blue</td> <td>Black</td> </tr> <tr> <td>d.</td> <td>alarm/control/po wer</td> <td>Non IS</td> <td>black</td> <td>blue</td> <td>Black</td> </tr> <tr> <td>e.</td> <td>extension cable</td> <td>IS</td> <td>As per IEC 60584-3</td> <td></td> <td></td> </tr> </tbody> </table> NOTES: 17 Triad cable shall have blue, black and brown color. 11..3.17. JUNCTION BOX 11..3.17.1. The junction box shall be suitable for the type of signal and type of multicore cables used 11..3.17.2. The following types of junction boxes shall be used: - For all intrinsically safe and safe signals: Weatherproof junction boxes - For all input/output connected to explosion proof/flameproof instruments junction boxes : Explosion proof/flameproof - In addition separate junction boxes shall be used for DCS, PLC and/ or other system.				Sl.No	Type of cable	Signal type	Outer sheath	Conductor +ve	Insulation -ve	a.	Signal	IS	blue	blue	Black	b.	Signal	Non IS	black	blue	Black	c.	Alarm /control/power	IS	blue	blue	Black	d.	alarm/control/po wer	Non IS	black	blue	Black	e.	extension cable	IS	As per IEC 60584-3		
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11..3.17.3. In general separate junction boxes shall be used for the following: a. 4-20 mA DC signals (IS) b. 4-20 mA DC signals (non-IS) c. Thermocouples d. RTDs e. Contact signals [(Field switches push buttons etc (I.S))] f. Contact signals [(Field switches push buttons etc (non I.S))] g. Interlock and shutdown signals (Solenoid valves) h. Power supply to various instruments						
NOTES: 18 Separate junction boxes shall be provided for fieldbus instrumentation and non-field bus instrumentation.						
11..3.17.4. 3-way junction boxes shall be used for connecting field transmitter and field mounted (remote type) analog indicator in series with control room receiving equipment.						
11..3.17.5. Each JB shall be provided with 2 multi-cable entries with one plugged with weather proof plugs. Plugs shall be flame proof also in case of flameproof JB's.						
11..3.17.6. Junction boxes, cable glands and accessories shall be weather proof if area classification is safe. Junction boxes, cable glands and accessories shall be weather proof and flameproof for flameproof instruments. Slipper type PVC sleeves shall be used over cable glands for all cable entries in junction boxes to avoid water entry in junction boxes.						
11..3.17.7. One junction box shall be connected to one multicable only. The other cable entry shall be plugged.						
11..3.17.8. The junction boxes in the field as well as local panels shall be provided with sufficient number of terminals to terminate all the pairs of multi-cable (including spare pairs) and shields of individual pairs as applicable.						
11..3.17.9. The junction boxes shall have cable entries suitable for the multi and single cables used. 20% additional cable entries must be provided. Unused entries shall be plugged.						
11..3.17.10. Junction boxes (JB) shall have the following features: a. JB shall be either Weather proof type or Weather proof and flameproof type. No other type of junction boxes shall be offered / provided. b. The enclosure shall conform to the following standards: Weatherproof housing: IP 55 to IEC-60529/IS-13947 Flameproof housing: Flameproof/Ex (d) as per IEC-60079/IS-2148. c. Junction boxes with top entries shall not be offered. The size of cable entries shall be as per the cable sizes. d. Each junction box shall have spare entries as follows: i) Minimum of 2 Nos. for 6P/12C JB ii) 4 numbers for 12P/24C JB.						
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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.			e. All spare entries shall be provided with plugs certified Exd for flameproof junction boxes.			
			11..3.18. ELECTRICAL JUNCTION BOX a. The material of construction of electrical junction boxes shall be die-cast aluminium of minimum 5 mm thick (LM-6 alloy). b. Weather proof junction box shall have hinged type door with neoprene gasket, which shall be fixed to the box by plated countersunk screws. c. Flameproof junction box shall have detachable cover, which shall be fixed to the box by means of cadmium plated triangular head/hexagonal head screws. d. Flameproof junction boxes for signal, alarm and control shall have the following warning engraved/integrally cast on the cover: "Isolate power supply elsewhere before opening" e. Power junction boxes (junction boxes for power supply cable / distribution) shall have either the warning cast or shall have warning plate with following marking and shall be suitable for incoming armoured power cable up to 150 sq.mm conductor size: "Isolate power supply elsewhere before opening". f. Terminals shall be spring loaded, vibration proof, clip-on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.			
			11..3.18.1. All terminals used in signal, alarm and control junction boxes shall be suitable for accepting minimum 2.5sq.mm copper conductor, in general.			
			11..3.18.2. Each junction shall have minimum of 30% spare terminal of those actually required to be utilized. Number of terminals for various types of junction boxes shall be as follows: 24 Nos. for 6 pair junction box. 48 Nos. for 12 pair junction box 36 Nos. for 6 triad junction box. 48 Nos. for 8 triad junction box.			
			11..3.18.3. Terminals shall be identified as per the type of input signal e.g all terminals for intrinsically safe inputs shall be blue while others shall be grey in color. Junction boxes shall be provided with external earthing lugs.			
			11..3.18.4. The junction boxes shall have terminals suitable for the cable wire size and shall preferably be of Phoenix or equivalent make. All wiring/ terminal blocks used in FISCO service shall be orange in colour while other service shall be painted gray.			
			11..3.18.5. The multi cable entry for 6 pair Junction Box (JB) shall be 1" NPTF and for 12 pair/ 8 triad junction box, it shall be 1 1/2" NPTF.			
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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.			11..3.18.6. Each junction box shall be provided with 2 multicable entries with one plugged with weatherproof, flameproof plug as required. Multicable entries shall be from the bottom whereas 1 pair/triad from the side. 11..3.18.7. One junction box shall be connected to one multicable only. The other cable entry shall be plugged. 11..3.18.8. The junction boxes in the field as well as local panels shall be provided with sufficient number of terminals to terminate all the pairs of multi-cable (including spare pairs) and shields of individual pairs as applicable. 11..3.19. GENERAL REQUIREMENT OF INSTRUMENTS 11..3.19.1. Ranges for instruments shall be selected in general, such that in normal process operation the indication is between 40% to 60% of span for linear and 60% to 80% of span for square root inputs. The set range for field instruments shall be 1.1 times the maximum process value or 1.4 times the operating process value whichever is higher rounded to the nearest ten 11..3.19.2. All transmitters shall have an integral output meter. Remote mounted meters may be provided for specific applications. 11..3.19.3. Major instrumentation shall be electronic type with final control elements as pneumatic. 11..3.19.4. Electronic Instruments - All electronic instruments requiring separate power supply, shall generally operate on 24 V DC. - Electronic transmitters shall generally be two wire type. These shall have transmission/output signal of 4-20 mA DC and shall be capable of delivering rated current into external load of at least 600, When powered with 24 V DC nominal voltage. - Fieldbus based instrument shall be used in general. If FF transmitter is not available as standard, contractor may provide SMART transmitter. If Smart transmitter is not available electronic (microprocessor based) transmitter with 420mA output shall be used. - Fieldbus transmitter when selected, shall be digital, two-way, bus powered, multidrop communication link among intelligent measurement and control devices - All receiver instruments shall be microprocessor based and shall operate on voltage input of 0.25 to 1.25 V, 1 to 5 V, or 0 to 10 V DC, in general. - The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4. All electronic instruments shall be immune to Radio frequency interference caused by Hand held Radios/ Radio stations/ Hands free systems/ Cell phone mobiles used in proposed wireless communication system.	
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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.			g. Unless specified otherwise, the instruments shall have an over-range protection of at least 130% of range or maximum/ design pressure, whichever is higher, as a minimum. h. The meter electronics shall be protected against transients induced by lightning and power supply surges. Transient protection of electronics shall preferably be provided in the terminal block. The transient protection shall meet the requirements specified in IEC-60587. i. For flow meters which include transducer, preamplifier, transmitter, display unit, etc, contractor shall ensure that the input /output signals and performance characteristics of individual instruments are compatible with each other. j. Terminals for electrical connections shall be clearly identified, and polarity shall be permanently marked. Electrical conduit entries shall have internal ½” NPT threads. k. Peak to peak ripple and total noise level in the analog output signal shall not exceed 0.25% of the maximum signal. l. The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 and shall be immune to RFI and EMI radiation.		
			11..3.19.5. Pneumatic instruments a. Pneumatic Instruments whenever used shall operate on air supply of 1.4 kg/cm²g and shall b. They shall have transmission and output signal of 0.2 to 1.0 kg/cm²g. c. Instruments in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. All connections shall be plugged after degreasing process in order to avoid entrance of grease or oil particles. d. Any gasket used in the assembly of the instruments shall be spiral wound type only with suitable filler material. e. Compressed asbestos fibre (CAF) gaskets shall not be used.		
			11..3.20. CONTROL PANELS		
			11..3.20.1. All control panels shall be provided in pre-tubed/pre-wired conditioned and shall be completely tested at manufacturer's works prior to dispatch.		
			11..3.20.2. Control panels shall be free standing type and fabricated preferably from 2 mm thick cold rolled steel sheet shall be used for front side and all other side shall be 1.6 mm of CRCA.		
11..3.20.3. Angle iron frame work shall use a minimum section of 50 x 50 x 4 mm angle.					
11..3.20.4. The finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filler and two coats of high grade lacquer with wet sanding between coats. Two coats of paint in panel color shall be given for non-glossy high stain finish.					
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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.			11..3.20.5.	Panel face final color can be any of the following shades as per to IS-5 : a. Opaline green : ISC No.- 275 b. Light Admiralty Grey : ISC No.- 697 c. Sky blue : ISC No.- 101				
			11..3.20.6.	Panel rear interior surface, frame work and mounting plates shall have a finish color of pale cream to IS-5 ISC No.- 352 or Beige to IS-5 ISC No.-388.				
			11..3.20.7.	A final coat of paint shall be given at site. Equivalent color shade according to BS/RAL are also acceptable.				
			11..3.20.8.	Control panel shall be open back with each section of typically 2100 mm high, 1200 mm wide and 800 mm deep, when mounted inside the control room on 100 mm channel base covering wall to wall, else these shall be totally enclosed cubicle type. The panel width may be increased if necessary.				
			11..3.20.9.	Enclosed cubicle panels shall have removable hinged doors, generally at the back for easy maintenance and accessibility of the instruments. Doors shall be double leaved type with handle and shall be provided with lock and key. Adequate illumination shall be provided inside the panel. All light fittings shall be suitable for 230 V, 50 Hz AC.				
			11..3.20.10.	No process fluid of any kind, except instrument air shall enter the control panel. Also power supply greater than 230 V shall not enter the local panel.				
			11..3.20.11.	All cable entries to the local panel shall be from panel bottom only using cable glands of adequate size. Cable gland plate thickness shall be a minimum of 3 mm cold rolled cold annealed (CRCA) as a minimum. All unused cable entries must be plugged.				
			11..3.20.12.	Space heater shall be provided where condensation is expected.				
			11..3.20.13.	The design of control panel shall incorporate provision for expansion by installing adequate spare capacity. Each panel shall be designed to accommodate the following additional equipment, as a minimum; 20% of panel front/inside mounted instruments including lamps, push buttons, switches, relays etc. 20% additional power feeders each provided with switch fuse assembly. 20% additional spare windows in alarm annunciators. 20% spare cable entry points.				
			11..3.20.14.	Panel layout shall be designed considering ease of operation. No push button or hand switch shall be located below 600 mm. Instrument Mounting heights, in general, shall be as follows:- Miniature and subminiature Bottom row 1100 mm instruments (3 rows) Middle row 1350 mm Top row 1600 mm				
			Ref.	Doc				

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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.	- Annunciators -1950 mm - Electric push buttons/ Switches, lamps etc. -700 mm																																										
	11..3.20.15.	The internal panel layout shall be designed considering proper approach for instruments, terminals and other accessories for maintenance, easy removal and online calibration. No instrument, terminals, power distribution box etc shall be mounted on the panel side plates inside the panel.																																									
	11..3.20.16.	All lamps, status as well as alarm, shall be provided with lamp test facility. One single lamp test push button shall be used for each panel.																																									
	11..3.20.17.	Color Scheme																																									
	<table border="1"> <tr> <td>1</td> <td>Status Lamps</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>On/Open/Permissive</td> <td>Green</td> </tr> <tr> <td></td> <td></td> <td>Off/Close/Emergency</td> <td>Red</td> </tr> <tr> <td>2</td> <td>Alarms</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>Normal/Pre-trip alarms</td> <td>White</td> </tr> <tr> <td></td> <td></td> <td>Shutdown alarms</td> <td>Red</td> </tr> <tr> <td>3</td> <td>Push/Pull buttons</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>On/Open</td> <td>Green</td> </tr> <tr> <td></td> <td></td> <td>Off/Close</td> <td>Red</td> </tr> <tr> <td></td> <td></td> <td>Emergency shut-down (ESD) (Push-button with cover/ Mushroom push button)</td> <td>Red</td> </tr> </table>			1	Status Lamps					On/Open/Permissive	Green			Off/Close/Emergency	Red	2	Alarms					Normal/Pre-trip alarms	White			Shutdown alarms	Red	3	Push/Pull buttons					On/Open	Green			Off/Close	Red			Emergency shut-down (ESD) (Push-button with cover/ Mushroom push button)	Red
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TABLE: 41																																											
11..3.21.	Panel piping & tubing																																										
11..3.21.1.	Instrument air header shall be adequately sized with brass packless isolation valves and shall be complete with suitable dual filter-cum-air reducing station.																																										
11..3.21.2.	Panel tubing from the bulk head to the panel instruments and instrument air supply to the panel instruments shall be of 6 mm x 1 mm polyethylene tubing. The tubing shall be laid in plastic slotted ducts. Panel air header and tube fittings shall be of brass, suitably protected against corrosion. Shut off valves shall be installed in all branch lines taking off the transmission and output signal. Each tube shall be identified at both the terminating ends.																																										
11..3.22.	Panel Wiring																																										
11..3.22.1.	Open terminals shall generally be avoided. Terminal strips shall be of 'Phoenix/ Wago/ Elmex' or equivalent type and shall preferably be mounted in an enclosure. Fused terminal may be used wherever necessary.																																										
11..3.22.2.	A minimum of 1 mm ² multi stranded PVC insulated copper conductor shall be used in general. All wiring shall be laid in the PVC troughs. No trough shall be more than 70% full.																																										
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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.	11..3.22.3. Wires carrying measurement signals associated with thermocouples, resistance thermometers, pH instruments and other low level signals shall be routed in separate troughs/wire ways and not alongwith power cables. 11..3.22.4. Power wiring and control wiring shall be separated by not less than 150 mm. The crossing, if unavoidable, shall be as close to right angles as possible. 11..3.22.5. Extension cables/wires shall be used for all thermocouple inputs. 11..3.22.6. Intrinsically safe wires, non-intrinsically safe and power cables shall be routed in separate wire ways, independently. Intrinsically safe wiring and terminals shall be light blue in color and shall be separated from non-intrinsically safe terminals at least by 50 mm. 11..3.22.7. Separate cabinets shall be considered for wiring/ termination of Fieldbus signals. 11..3.22.8. All incoming power feeders shall be terminated on separate terminals suitable for the incoming feeder size. These shall be located at the bottom of the panel and shall be suitably covered for protection against accidental shorting and for human safety. 11..3.22.9. Following design philosophy shall be followed while deciding the internal layout of panels: <table border="1"> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td>1.</td> <td>Distance between terminal strip and side of the panel upto 50 terminals width</td> <td>100 mm (min.)±trough</td> </tr> <tr> <td>2.</td> <td>Distance between two adjacent terminal strips</td> <td>100 mm (min.)±trough</td> </tr> <tr> <td>3.</td> <td>Distance between gland plate and bottom of the strip</td> <td>300 mm (min.)</td> </tr> <tr> <td>4.</td> <td>Distance of terminal strip from instrument/trough/panel top</td> <td>100 mm (min.)</td> </tr> </table> 11..3.23. LOCAL CONTROL PANELS 11..3.23.1. Local control panel for the package units shall be installed within the battery limit of the package considering operational and maintenance requirements and accessibility. 11..3.23.2. In case of skid mounted packages, panel shall be located away from the skid. In case local control panel is housed outdoor i.e. not in a local control room, it shall be designed to meet IP-55 requirements. 11..3.23.3. In addition, panel must be provided with a rain cum sun shade canopy/shed. Local control panel/panels shall be totally enclosed cubicles. Panel sizing shall be carried out based on equipment being installed keeping in view the maintenance clearances and easiness. Although the panel dimensions shall be guided by the actual requirements, typical dimensions of 2100 mm operational (height) x 1200 mm (width) x 1000 mm (depth) shall be kept in mind while finalising the panel size.						1.	Distance between terminal strip and side of the panel upto 50 terminals width	100 mm (min.)±trough	2.	Distance between two adjacent terminal strips	100 mm (min.)±trough	3.	Distance between gland plate and bottom of the strip	300 mm (min.)	4.	Distance of terminal strip from instrument/trough/panel top	100 mm (min.)
1.	Distance between terminal strip and side of the panel upto 50 terminals width	100 mm (min.)±trough																
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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.		11..3.23.4. Local control panels located in the hazardous area shall be either purged type or flameproof Exd as finalized by the purchaser. In case pressurised panels are finalized the same shall be purged and pressurised as per NFPA-496 requirements to render space within the panel non hazardous. For panels located in IEC Zone 2 hazardous area type Z purging shall be used with a purge fail alarm in central control room. In case, panels are located in Zone1, the power shall be cut-off on pressurisation X-purge requirement of NFPA-496. An alarm shall be provided on local panel and a contact shall be provided for remote annunciation, whenever the panel pressurisation falls below 2.5 mm of H2O. A protective device to protect the panel from over pressure must be provided. Panel pressurisation with start-up panel purging scheme shall be fully automatic however it shall be started manually from a push button. Solenoid valves and differential pressure switch required for panel purging shall be flameproof, however other items like relays, switches/pushbuttons, timers etc. shall be located in a flameproof housing. Other items like valves, restriction orifice plates, dual filter regulators, pressure gauges, variable area flowmeters etc required for pressurisation, shall also be located in the non-pressurised section of the panel 11..3.24. SOLENOID VALVES 11..3.24.1. Solenoid valves in classified areas shall be flameproof type and shall be rated for 110 V DC. All solenoid valves shall be certified weatherproof to IP-65 as a minimum, in addition. 11..3.24.2. The solenoid coil design shall be suitable for working continuously with the specified voltage levels. 11..3.24.3. Solenoid valves body material shall be SS 316. Bidder shall categorically analyze selection with respect to cabling distance, type of cable, before finalizing make/model. 11..3.25. PRESSURE GAUGES AND DIFFERENTIAL PRESSURE GAUGE • Pressure gauges shall be weatherproof to IP 55 as per IEC 60529 / IS 13947, as a minimum, with dial size of 150 mm and shall have screwed bezels. • Pressure gauge sensing element shall be an elastic element like bourdon tube, bellow, diaphragm etc. of SS316 and movement of Stainless steel, as a minimum. • The design of pressure gauges shall confirm to IS-3624. • Case material shall be SS304 and vapor-tight.		
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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.	• Dial markings and dial colour shall be as per IS 3624. The pointer stops shall be provided at both ends of the scale to restrict the pointer motion beyond 5% above the maximum of scale and less than 5% below the minimum of the scale. • Pointers shall have external micrometer adjustment for gauge zero adjustment. • Unless otherwise specified, the accuracy including repeatability and hysteresis shall be $\pm 1\%$ of full scale for Direct pressure gauges, $\pm 2\%$ of full scale for Chemical seal type pressure gauges and for Differential pressure gauges. • Over range protector shall be provided. • In case of pressure gauges with diaphragm seal, same shall be installed between the seal and the gauge. • Snubbers/pulsation dampners/gauge sever of SS304 shall be used for all pulsating services. These shall be floating pin type, externally mounted and externally Over range protector and Snubbers, whenever used, shall be same as socket material, as a minimum. • Where vibrations and pressure fluctuations are expected, Glycerin filled type shall be used. In case of vibrating services like pump outlets, flexible armored hoses shall be used in place of impulse piping and gauges shall be mounted on separate stanchions. • Bourdon element shall be welded to socket and tip end shall be stress relieved. • Pressure gauges with range as 0 to 100kg/cm²g and above shall have safety type solid front case. • The pressure gauges shall have an over-range protection of at least 130% of maximum working pressure, as a minimum. • Process connection shall normally be 1/2" NPTM bottom. • Sensing element for Draft gauges shall be suitable to measure the draft ranges such as capsule, bellows. • All pressure instruments shall be provided with 2- valve manifolds along with Prefabricated hook ups made of SS316. • All Differential pressure gauges shall be provided with 3-way manifold of SS316. It shall be suitable for mounting on 2" pipe. Mounting accessories shall be provided with gauge. • All differential pressure gauges shall be of magnetic piston type. Alternatively DP transmitter with local indication shall be provided. • All gauges shall be provided with a blowout device i.e. blow out disc of aperture not less than 25mm for gauges with dial size 100mm and above, while 20mm for gauges with dial size less than 100mm. • The process connection shall be 1½" flanged for all application except where line size is below 1", chemical seal type pressure gauges with ½"NPT connection are acceptable for 1" below line size.		
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			11..3.27. Instrument Valves and Manifolds a. Bidder shall provide instrument valves (miniature type) and valve manifolds wherever required. b. Body rating shall be as per piping class or better. All valves and manifolds shall be forged type only.		
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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.			c. For all valves and manifolds with body material of carbon steel/stainless steel, the valve trim material shall be SS316, as a minimum. For any other body material, trim material should be same as body material as a minimum. Superior trim material shall be selected as required by process conditions. Packing material in general shall be of PTFE. The o-ring materials wherever used shall also be of PTFE. d. Instrument Valves (Miniature) shall be of globe pattern needle valves forged/ bar stock with inside screwed bonnet, with back-seated blow out proof system. e. Instrument Air Isolation Valves (Miniature) shall be full-bore ball type with forged body. f. Instrument Air Needle Valves (Miniature) shall be globe pattern-needle valves. g. For all these valves types, Body material shall be SS316. h. End connection shall be ½”NPTF to ANSI B 1.20.1 for Instrument Valves (Miniature) and Instrument Air Isolation Valves (Miniature) and ¼” NPTF to ANSI 11..3.28. CABLES 11..3.28.1. All cables shall have PVC insulated primary insulation of 85°C PVC as per IS-5831 Type C. Thickness of primary insulation shall be 0.5 mm as a minimum. For PE insulated cables, primary insulation shall be of 70° C Polyethylene. Inner and outer jacket (sheath) shall be made of extruded flame retardant 90°C PVC to IS-5831 Type ST-2 and meeting flame retardant requirements for bunched cables as per IS 10810 (Part 62) category AF or IEC 60332 category A. Minimum Oxygen index of PVC shall be 30% at 27 °C ±2°C, temperature index shall be over 250°C, a rip cord shall be provided for inner sheath, Outer sheath shall be suitable for protecting the cable against rodent and termite attack. 11..3.28.2. All cables shall be fire retardant as per standard IEC 60332-3 Part 3 Cat.A. Fire resistance cables whenever specified shall be as per IEC 60331 Cat. A. 11..3.28.3. Following are the Specific Requirements for fire resistant cable: a. The cables shall have circuit integrity as per IEC 60331. b. Primary insulation shall be heat resisting elastomeric which can withstand temperature up to 90°C such as silicon rubber/mica glass tape/EPR (medium grade) as per IS 6380. Insulation thickness shall be 1.0mm minimum and shall confirm to IEC 60092. c. A wrapping of tape made of PETP (polyethylene terephthalate)/woven glass shall be provided over core insulation. d. Individual pair triad shall be shielded. The shield shall be aluminum backed by glass e. Mica/PETP tape with the metallic side down helically applied with 25% overlap on either side and 100% coverage. Minimum shield thickness shall be as per IEC 60092. Drain wire shall be 0.5mm² (7/0.3mm dia),		
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					11..3.28.4.	The insulation grade shall be 600 V/1100 V as a minimum and shall meet insulation resistance, voltage and spark test requirements as per BS-5308 Part-2.
					11..3.28.5.	a. All cables shall be armoured. Armour over inner jacket shall be of galvanized steel wire/flat as per IS-1554 part I. Requirement and methods of tests for armour material and uniformity of galvanisation shall be as per IS 3975 and IS 10810 (Part 40) respectively. b. All the cores of single pair or multipair shall be twisted and numbers of twist shall not be less than 10 per meter. c. The thickness of the sheath shall be as per IS 1554 part 1. d. Tolerance in overall diameter of cable shall be within ± 2 mm over offered value. e. Overall twist of all pair/triads shall be as per bidder's standard. f. The cables used in installations under the jurisdiction of Director General of Mines and Safety (DGMS) shall meet all requirements of DGMS. The word “Mining Cable” shall be embossed on the cable outer sheath as per IS 1554 (Part 1).
					11..3.28.6.	For signal and control cables, inner sheath colour shall be black. Outer sheath colour shall be light blue for intrinsically safe application and black for others.
					11..3.28.7.	Maximum DC resistance of the conductor of the completed cable shall not exceed the Following: a. 12.3 O/km at 200C for cables with 1.5 mm2 conductor. b. 39.7 O/km at 200C for cables with 0.5 mm2 conductor.
Ref. Doc	11..3.28.8.	The mutual capacitance of the pair/ triad or adjacent cores shall not exceed 250 pF/m at a frequency of 1 kHz and between the pairs/ triads for PE				

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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.			Insulated cables shall not exceed 100 pF / metre at a frequency of 1 KHz. The capacitance between any core and screen shall not exceed 400 pF/ m at a frequency of 1 kHz. 11..3.28.9. L/R ratio of adjacent cores shall not exceed 40 μH / O for cables with 1.5 mm² conductor and 25 μH / O for cables with 0.5 mm² conductors. 11..3.28.10. The drain wire resistance including shield shall not exceed 30 O/km. Electrostatic noise rejection ratio shall be over 76 dB. 11..3.28.11. A pair of communication wire shall be provided for multipair/multitriad cables. Each wire shall be 0.5 mm² of plain annealed single or multi-strand copper conductor with 0.4 mm thick 850C PVC insulation. Insulation shall be green and red colour coded. 11..3.28.12. Bidder shall ensure a minimum of 20% of quantity of each type of cables provided as spare including any special cable. And in each multipair cables 20% pairs shall be kept as spare. 11..3.28.13. Running length of the cable shall be printed at least at every 1-meter interval. 11..3.28.14. For multipair/ multitriad cables, pair identification shall be provided with numbers at interval of not more than 250mm as per bidder's standard. The embossing /engraving shall be legible and indelible. 11..3.28.15. Signal Cables a. Single pair shielded signal/alarm cables shall be used between field instruments/ switches and junction boxes/local control panels. b. Multipair individually and overall shielded signal/alarm cables shall be used between junction boxes/local control panels and control room / satellite rack room as the case, in general. c. The Type-I single pair/triad cables shall be 1.5mm² conductor size made of annealed electrolytic copper conductor of 7 strands with each strand of 0.53 mm diameter. Type-II Multipair/ Multi-triad cables with individual pair/ triad shield and overall shield with 1.5mm² conductor size shall have 7 strands of annealed electrolytic grade copper conductor with each strand of 0.53 mm diameter. Type-III (Multi-pair / Multi-triad cable with only overall shield) cable shall be same as type-II cable, except that the individual pair/ triad shall not have shielding. Type-IV Multi-pair /Multi-triad cable (with individual pair shield and overall shield) with 1.5 mm² conductor shall have 7 strand with each strand of 0.53 mm diameter. Type-V Multi-pair / Multi-triad cable (with overall shield only) shall be same as type IV except that the individual pair/triad shall not have the shielding. d. Each pair/triad shall be shielded. Shield shall be aluminium backed mylar/polyester tape bonded together with metallic side down helically applied with either side having 25% overlap on either side and 100% coverage. Minimum shield thickness shall be 0.05 mm in case of single pair/ triad and 0.075 mm in case of multipair/ triad cable.			
						Ref. Doc

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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.		e. Drain wire shall be provided for individual pair and overall shield which shall be 0.5 mm² multi stranded bare tinned annealed copper conductor. The drain wire shall be in continuous contact with aluminium side of the shield. f. All multi pair cables shall have 6 pair/12 pairs only while multitriad cable shall have 6 triads/8 triads only. 11..3.28.16. CONTROL CABLES a. Single pair control cables shall be used between field mounted solenoid valves and junction boxes/local control panels and shall meet the requirements specified above. b. Multipair control cables shall be used between junction boxes/local control panel and control room mounted devices in general. These cables shall have only overall shielding. c. These control cables shall have 1.5 mm² conductor size with 7 stranded conductors of annealed electrolytic grade copper, with each strand of 0.53 mm diameter as minimum. 11..3.28.17. POWER SUPPLY AND OTHER CABLES a. All power supply cables shall be as per IS-1554 Part I and shall have copper/aluminum conductors depending on conductor size. b. Minimum conductor size shall be 2.5 mm² of copper conductor. c. For higher sizes, aluminum conductor can be considered. d. All these cables shall be PVC insulated and armoured. 11..3.28.18. Cable Glands, Plugs and Reducers/Adaptors a. All cables glands shall be of nickel-plated brass and they shall be double compression type suitable for armoured cables. b. Flame proof glands wherever required shall be provided with Exd certification. c. Bidder shall provide a minimum of 20% of cable glands as spare. d. All cable glands shall be weather proof to IP-55. e. Cable glands shall be NPT for all field items and junction boxes where as ET thread with check nuts for control room end. f. Cable glands shall be provided to suit the cable dimensions along with tolerances. Various components like rubber ring, metallic ring, metallic cone and the outer / inner nuts etc. shall be capable of adjusting to the tolerances of cable dimensions.		
Ref. Doc				

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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.			g. Reducers / adapters shall be nickel-plated brass, as a minimum. These shall also be weatherproof and / or flame proof wherever specified and certified for the electrical area classification specified. h. Plugs shall be of nickel-plated brass and shall be certified flameproof when used with flameproof junction boxes. 11.4. PIPING: 11..4.1. PIPE SUPPORTING CRITERIA & GENERAL GUIDELINES 11..4.1.1. All piping shall be adequately supported, guided or anchored so as to prevent undue vibration, deflection/expansion or loads on connected equipment and piping and leakage at joints. 11..4.1.2. Piping at valves requiring periodic maintenance, shall be supported in such a way so that the valves can be removed with a minimum necessity of installing temporary pipe supports. 11..4.1.3. Pipe support pedestal drawing shall be submitted for information and the type of pedestal including load capacity shall be marked on Isometrics. Piping support standard, with load bearing capacity, shall be submitted for purchaser's review. 11..4.1.4. Piping system shall be properly supported taking into account the following: a. Sustained Loads -Weight of Piping (Bare pipe, service fluid, valves, flanges etc) -Weight of Insulation (if any) -Weight of online equipments (if any) -Weight of instruments (if any) -Pressure relief loads due to safety valve operation -Dynamic loads due to pulsating flow/two phase with slug flow b. Occasional Loads -Seismic loads (as and when required) c. Thermal Loads -Thermal loads due to operating/design/steam out/decoking or any other possible abnormal condition. 11..4.1.5. Additional supports, guides, anchors, special supports like spring supports and sway braces shall be provided based upon detailed analysis of piping system to restrict the forces on nozzles of critical equipments like pumps, compressors, turbines, exchangers, Air coolers etc. 11..4.1.6. A permanent support, either resting or spring support shall be provided for lines which do not need any supporting otherwise but require supporting during maintenance. 11..4.1.7. Adequate care shall be taken for small bore (1 1/2 and below) branch from piping. a rule, for all lines in 600# & above classes, lines having two phase flow	
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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.			and lines having Pulsating flow such as discharge of reciprocating compressors & reciprocating pumps, all small bore branches, e.g. vents, drain, orifice taps, pressure tapings, temperature tapings, sample connections, PSV inlet, TSV inlet etc. shall be provided with 2 number stiffeners at 90° to each other from the main pipe to impart adequate stiffness to the branch connection. 11..4.1.8. The stiffeners shall be made of 6mm thick flats of material equivalent to the pipe material. Further, irrespective of line rating, the stiffeners shall be provided for all orifice taps, all small bore tapings from PSV inlet / outlet lines and all small bore tapings from Control Valve manifolds. 11..4.1.9. Pipe support design shall be such that deflection in piping systems due to sustained loads shall not exceed 15mm, between two adjacent supports. 11..4.1.10. All piping shall be laid such that weld seam always lie in the upper quadrant. 11..4.2. PIPE SIZE 11..4.2.1. Pipe sizes shall normally be 0.5", 0.75", 1.0", 1.5", 2.0", 3", 4", 6", 8", 10",12",14",16" 11..4.2.2. Welded pipes shall be acceptable only with longitudinal weld made employing automatic welding. 11..4.2.3. Galvanized Pipes shall be only Hot Dip galv. to ASTM A53. 11..4.3. FITTINGS 11..4.3.1. All fittings shall be seamless in construction unless otherwise specified. 11..4.3.2. Thickness of fittings at ends to match pipe thickness for BW fittings. 11..4.3.3. SW fittings shall be 3000#, 6000#or 9000# depending on the pipe thicknesses S80, S160 and above S160 respectively. 11..4.3.4. Upto 600# all branch connections shall be as follows, unless specifically mentioned otherwise in PMS: a. Up to 1-1/2" NB Half couplings/ Tee b. 2" and above Tees/ Pipe to pipe with or without reinforcement pad 11..4.3.5. For reducing BW fittings having different wall thickness at each end, the greater one shall be employed and the ends shall be matched to suit respective thickness. 11..4.3.6. All welded fittings shall have maximum negative tolerance equivalent to pipe selected. 11..4.3.7. All welded fittings shall be double welded. Inside weld projection shall not exceed 1.6mm, and the welds shall be ground smooth at least 25mm from the ends.	
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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.		11..4.3.8. For fittings made out of welded pipe, the pipe itself shall be of double welded type, manufactured with the addition of filler material and made employing automatic welding only.																								
		11..4.3.9. All welded fittings shall be normalized for CS, normalized & tempered for AS; and 100% radiographed by X-ray for all welds made by fitting manufacturer as well as for welds on the parent material.																								
		11..4.3.10. Bevel ends of all BW fittings shall undergo 100% MP/DP test.																								
		11..4.4. FLANGES																								
		11..4.4.1. Flanges shall be as follows:																								
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11..4.4.2. All flange joints on piping system including flanges on the equipments , manholes etc shall be tightened using Hydraulic bolt tensioners per the following table:																										
<table border="1"> <thead> <tr> <th>Nominal bolt diameter</th> <th>Condition</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>All</td> <td>When specified by process licensor/ bidder /project Specifications</td> <td></td> </tr> <tr> <td>50 mm & over</td> <td>All joints</td> <td></td> </tr> <tr> <td>38 mm & above & below 50mm</td> <td>a)class 600 & above b) joints with leakage potential c)critical joints</td> <td></td> </tr> <tr> <td>25 mm & above & below 38mm</td> <td>a) joints with leakage potential b)critical joints with equipments</td> <td></td> </tr> </tbody> </table>				Nominal bolt diameter	Condition	Remarks	All	When specified by process licensor/ bidder /project Specifications		50 mm & over	All joints		38 mm & above & below 50mm	a)class 600 & above b) joints with leakage potential c)critical joints		25 mm & above & below 38mm	a) joints with leakage potential b)critical joints with equipments									
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11..4.4.3. All the stud bolt length shall be longer by one diameter to facilitate bolt tensioning.																										
11..4.4.4. Following Joints shall be considered as Joints with leakage potential :																										
I. Joints involving tapped holes II. Items not subjected to hydrotest eg. Joints for equipment manholes III. equipment mounted temp, pressure & level instruments, line mounted temp connections, online instrument joints like control valves and safety valves, compressor volume bottles.																										
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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.		IV. Items involving two sets of gaskets with one set of bolt eg orifice flange joint, joints with spectacle blind, spacer, flangeless wafer check valve, wafer type butterfly valves.																												
		11..4.4.5.		Critical joints with equipments shall include inlet & outlet flanges of pumps.																										
		11..4.4.6.		For Ring Joint Flanges, Blinds and Spacers, the hardness shall be as follows :																										
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		11..4.4.7.		For RTJ flanges, blinds & spacers, the hardness of the groove shall be specified on the test report. Bore of weld neck flange shall correspond to the inside diameter of pipe for specified schedule/thickness. Ends shall be bevelled to suit the specified schedule / thickness. For RTJ flanges, only octagonal section ring joint flanges shall be used.																										
11..4.5.		GASKETS																												
11..4.5.1.		Asbestos filler for spiral wound gasket shall not be permitted. All gaskets shall be non-asbestos type.																												
11..4.5.2.		Full face gaskets shall have bolt holes punched out																												
11..4.5.3.		Non-metallic ring gaskets as per ASME/ANSI B16.21 shall match flanges to ASME/ANSI B16.5 upto 24", and ASME/ANSI B16.47 or AWWA for sizes > 24" unless otherwise specified.																												
11..4.5.4.		Spiral wound gaskets as per ASME B16.20 shall match flanges to ASME/ANSI B16.5 upto 24", and ASME B16.47 series 'B' for sizes > 24" unless otherwise specified.																												
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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.	All isolation valves in the fire water network shall be Gate Valve type 11..4.6.1. SW valves –Up to 1½ inch, for 150#, 300#, 600# (except ball & plug valves). 11..4.6.2. Ball & Plug valves shall be flanged for all sizes. 11..4.6.3. Flanged valve- 2" inch above for 150#, 300#, 600#. 11..4.6.4. BW valves -900# and above 11..4.6.5. All flanged valves (except forged) shall have flanges integral with the valve body. 11..4.6.6. Weld-on flanges shall be made by full penetration joints and 100% radiographed. 11..4.6.7. Yoke material shall be at least equal to body material. 11..4.6.8. Forgings are acceptable in place of Castings but not vice-versa. 11..4.6.9. DIMENSIONS: Face-to-Face/End-to-End dimension shall be as per ANSI B16.10. In case the same is not covered under B16.10, the dimension shall be as per BS 2080 / Manufacturer's Std. <table border="1"> <thead> <tr> <th>Valve type</th> <th>Class</th> <th>For sizes ≥</th> </tr> </thead> <tbody> <tr> <td>Gate/globe</td> <td>150</td> <td>12"</td> </tr> <tr> <td></td> <td>300</td> <td>12"</td> </tr> <tr> <td></td> <td>600</td> <td>12"</td> </tr> <tr> <td>Gate /globe/y-globe/stop-check</td> <td>900</td> <td>6"</td> </tr> <tr> <td></td> <td>1500</td> <td>3"</td> </tr> <tr> <td></td> <td>2500</td> <td>3"</td> </tr> <tr> <td>Ball/plug(other than pressure balance plug)</td> <td>150</td> <td>6"</td> </tr> <tr> <td></td> <td>300</td> <td>6"</td> </tr> <tr> <td></td> <td>600</td> <td>4"</td> </tr> <tr> <td></td> <td>900</td> <td>3"</td> </tr> <tr> <td></td> <td>1500</td> <td>3"</td> </tr> <tr> <td>Butterfly</td> <td>150</td> <td>6"</td> </tr> <tr> <td></td> <td>300</td> <td>6"</td> </tr> </tbody> </table> 11..4.7. OPERATION Generally the valves are hand wheel or lever operated. 11..4.7.1. Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500 mm on each side. Effort to operate shall not exceed 35 kgf at hand wheel periphery. 11..4.7.2. However, failing to meet the above requirement, bidder shall offer gear operation. 11..4.7.3. Quarter-turn valves shall have "open" position indicators with limit stops.			Valve type	Class	For sizes ≥	Gate/globe	150	12"		300	12"		600	12"	Gate /globe/y-globe/stop-check	900	6"		1500	3"		2500	3"	Ball/plug(other than pressure balance plug)	150	6"		300	6"		600	4"		900	3"		1500	3"	Butterfly	150	6"		300	6"
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	Class	Size	qty															
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	300	Upto 16"	10%															
	11..4.8. RADIOGRAPHY OF CAST VALVES																	
	11..4.8.1. All casting shall be of radiographic quality. This requirement to be ensured by sample radiography before proceeding with the actual production.																	
	11..4.8.2. Radiography procedure, areas of casting to be radiographed, and the acceptance criteria shall be as per ASME/ANSI B16.34.																	
	11..4.8.3. Radiography requirement for casting shall be as follows:																	
	11..4.9. Ball/Plug/Butterfly Valves																	
	11..4.9.1. Each valve shall be supplied with a lever/wrench except for gear operated /motor operated valves.																	
11..4.9.2. Soft-seated Ball, Plug & Butterfly valves shall be supplied with antistatic devices.																		
11..4.9.3. The ball of Ball valves shall not protrude outside the end flanges.																		
11..4.9.4. Ball valves shall be floating ball type/ trunion mounted type as per following:																		
<table border="1"> <tr> <th>Sl No</th> <th>Class</th> <th>Floating Ball</th> <th>Trunion Mounted</th> </tr> <tr> <td>1</td> <td>150</td> <td>8 " & below</td> <td>10" & above</td> </tr> <tr> <td>2</td> <td>300</td> <td>4" below</td> <td>6" & above</td> </tr> <tr> <td>3</td> <td>600 & above</td> <td>1.5 " & below</td> <td>2 " & below</td> </tr> </table>			Sl No	Class	Floating Ball	Trunion Mounted	1	150	8 " & below	10" & above	2	300	4" below	6" & above	3	600 & above	1.5 " & below	2 " & below
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11..4.9.5. Use of soft seated ball/plug/butterfly valves shall be suitably selected based on temperatures handled.																		
11..4.9.6. Butterfly valves shall be suitable for throttling application.																		
11..4.10. STRAINER																		
11..4.10.1. Pressure drop calculations shall be furnished during detail engg stage.																		
11..4.10.2. Type of Strainers:																		
<table border="1"> <tr> <td>Y Type</td> <td>Upto 1½" irrespective of service 2" & above in steam service</td> </tr> <tr> <td>T type</td> <td>2" & above in services other than steam</td> </tr> </table>			Y Type	Upto 1½" irrespective of service 2" & above in steam service	T type	2" & above in services other than steam												
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11..4.10.3. All 2" & higher sized Y type strainers shall be provided with 3/4" threaded tap and solid threaded plug as drain connection on the blind flange. For less than 2", this shall be 1/2" size.																		
11..4.10.4. Bottom flange of Y-type strainer shall not have tapped hole. Full length standard size studs shall be used for joining blind flange.																		
Ref. Doc																		

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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.		11..4.10.5. For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP/MP checked. 11..4.10.6. All the strainers shall be hydrostatically tested at twice the design pressure. 11..4.11. STUD, BOLTS, NUTS AND JACK SCREWS 11..4.11.1. All bolting shall be as per ASME/ANSI B18.2.1 for Studs, M/C Bolts and Jack screws, and ASME/ANSI B18.2.2 for nuts. 11..4.11.2. Threads shall be unified (UNC for . = 1" dia and 8UN for > 1" dia) as per ANSI B1.1 with class 2A fit for Studs, M/C Bolts and jack screws, and class 2B fit for nuts. 11..4.11.3. Stud bolts shall be threaded full length with two heavy hex nuts. Length tolerance shall be in accordance with the requirement of table F2 of Annexure F of ASME B16.5 11..4.11.4. The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process. 11..4.11.5. The length of the studs/ bolts should be such that minimum two threads should be out of the nut on either side. 11..4.11.6. All the stud/ bolt should have metallurgical certificates in case of alloy/ SS metallurgy with identified colour marking at the stud ends/ bolt side face. 11..4.11.7. Heads of jack screws and M/C bolts shall be heavy hexagonal type. Jack screw end shall be rounded. 11..4.11.8. Wherever bolt tensioning is specified stud bolt length shall be longer by minimum one diameter to suit bolt tensioner. Excess threads shall be protected by a threaded nut. 11..4.12. WELDING PROCESSES 11..4.12.1. Welding of various materials shall be carried out using one or more of the following processes with the approval of the Engineer-in-charge : • -Shielded Metal Arc Welding process (SMAW) • -Gas Tungsten Arc Welding process (GTAW). 11..4.12.2. Automatic and semi-automatic welding processes shall be employed only with the express approval of the Engineer-in-charge. 11..4.12.3. The welding procedure adopted and consumables used shall be specifically approved. 11..4.12.4. A combination of different welding processes could be employed for a particular joint only after duly qualifying the welding procedure to be adopted and obtaining the approval of engineer-in-Charge. 11..4.12.5. For additional details "Welding Specification for Fabrication of Piping as mentioned elsewhere shall be referred.		
Ref. Doc				

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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.			11..4.12.6. Potable water shall be used for testing of Carbon steel & Alloy steel piping. For testing of Stainless Steel piping maximum chlorine content in water shall be 15-20 ppm.		
			11..4.12.7. All small bore piping and steam tracer lines, size ¾” and below shall be welded by TIG process for all type of joints, e.g. Butt Weld, Socket Weld, tee etc.		
			11..4.13. BOLT TENSIONING AND BOLT TORQUES		
			11..4.13.1. Bidder shall include Quality checks during plant construction and proper Records /documents should be maintained. Special attention is needed for high-pressure system, handling hazardous material.		
			11..4.13.2. Mechanical integrity of flange joints in high-pressure systems has to be ensured by the bidder. A standard check list for this activity along with post box-up checks should be developed and practiced.		
			11..4.13.3. The following guidelines shall be used besides other relevant codes like ASME etc. This checklist should include following points :		
			a. Ensuring right type of Gasket, fasteners etc., conforming to the specifications as per design and drawing.		
			b.		
			i. Alignment of flanges and inspection of threads in case of tapped holes in flanges.		
			ii. Inspection of gasket surface		
			iii. Ensuring that gasket is properly seated.		
			iv. Checking that fasteners are tightened upto required depth in tapped holes.		
			v. Ensuring that fasteners are tightened as per tightening procedure and using specific torque value with well-maintained tools and torque wrenches.		
			c.		
			i. All critical joints should be boxed up under the supervision of the Purchaser’s representative		
			ii. Each joint shall be boxed up and tightened by only skilled Technician duly approved by competent authority.		
			d.		
			i. Checking the individual joint for any leak during system pressure testing by using special tapes, soap solution or as per relevant code.		
			ii. Inter-face joints should be system pressure tested as per relevant code to ensure their integrity.		
			e.		
			i. Differential hardness between RTJ gasket and flange shall be considered.		
Ref.	Doc				

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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.	11..4.13.4. All the points in the checklist, including the names of the persons involved in the execution/inspection of the boxing up of critical and high-pressure joints, should be recorded. Purchaser / End customer reserve the right to review these records at site. 11..4.13.5. Box-up of interface flange joints which are not subjected to hydrotest, need extra attention. Separate records shall be maintained for such joints. 11..4.14. HYDRAULIC BOLT TENSIONER 11..4.14.1. Flange connections with bolting of nominal diameter 25mm (1 in) and over shall have sufficient clearance and access to allow the use of hydraulic tensioning equipment. 11..4.14.2. Hydraulic bolt tensioning shall be used for the following: <table border="1"> <thead> <tr> <th>NOMINAL BOLT DIAMETER</th> <th>CONDITION</th> </tr> </thead> <tbody> <tr> <td>50mm and over</td> <td>All joints</td> </tr> <tr> <td>38mm and over</td> <td>Class 600 and over</td> </tr> <tr> <td>25mm and over</td> <td>a. Joints subject to high temperature or cyclic duties. b. Joints with leakage history.</td> </tr> </tbody> </table> 11..4.14.3. Stud bolts shall be longer by one diameter to facilitate the bolt tensioning for all sizes specified in table above. Excess thread shall be protected by a threaded cap. On bolts at ambient temperature duty the cap should have a grease nipple. 11..4.14.4. An applied bolt stress of 30,000 to 40,000 lb/in², and typically 35000 lb/in² is adequate for most duties. It should not generally exceed 50% of the bolt material yield stress. The applied bolt stresses should be individually calculated for particularly critical or problematic joints.			NOMINAL BOLT DIAMETER	CONDITION	50mm and over	All joints	38mm and over	Class 600 and over	25mm and over	a. Joints subject to high temperature or cyclic duties. b. Joints with leakage history.
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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.	12. PAINTING 12.1. Refer Annexure -II 13. INSPECTION AND TESTING 13.1. Bidder shall maintain an effective Quality Assurance System, to ensure that all equipment and material supplied as a part of the Inert Gas Extinguishing System package meet required Quality standards and specifications. 13.2. After award of contract bidder shall submit Quality Plan for approval. The quality plan shall be submitted in BHEL quality plan format. Bidder to note that all the cost involved in any of the inspection & testing requirements as per the approved quality plan shall be deemed to be included in the price quoted by the bidder. Bidder shall not be eligible to raise any extra claim on account of any inspection & testing of the complete IGES as per the approved quality plan. 13.3. GUIDELINES FOR ITPS / QAPS FOR IGES 13.3.1.1. CLEAN AGENT SYSTEM The entire Clean Agent system shall be got approved from TAC . Only listed and or approved equipment and devices shall be used in the systems. All critical equipments such as cylinders, cylinder valves, directional valves , pressure reducers, nozzles, actuation controls , pressure gauges etc. shall have approval from UL/FM/Vds/LPC. In order to determine that the system has been properly installed and will function as specified , the following test shall be performed: The approval of installation shall be subject to satisfying the requirements of cl 6-7 of NFPA-2001. a. A thorough visual inspection of the installed system and hazard area. The piping, operational equipments and discharge nozzle shall be inspected for proper size and location. The location of alarms and manual and emergency release shall be confirmed. The hazard area shall be inspected closely for un-closable openings and sources of agent loss. The bidder shall furnish the composition certificate of clean agent satisfying the requirements of table 4-1.2 a for halogenated agent and table 4-1.2 b for IG agent quality requirements of NFPA-2001. filling certificate shall be provided specifying from which original clean agent drum the gas has been taken and which cylinder is filled.		
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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.			Requirement s for H2, sour service						
		9b	Product analysis	Chemical composition	One sample per heat or As per specificati on	Inspection Report	-	W	R
		10	Destructive Testing (for SS Material)	Corrosion properties	Highest thickness and highest carbon/H T Lot	Lab Report	-	H	H
		10 A	Ferrite check of SS pipes (if applicable)	% ferrite check	Random on pipe body/wel d	Inspection report	-	W	RW
		11	Galvanizing (if applicable)	Integrity of galvanized coating	100%	Inspection/I ab report	-	W	RW
		12	Hydro testing	Leak check	100% by supplier, At random by PURCHAS ER / END CUSTOME R	Inspection Report/Hydr o Graph	-	H	H
		13	Final inspection	Surface condition, straightness, end finish, Bevel Angle, Root Face, Outer dia. , Thickness, Length, Coating, Marking, color coding, End Caps	100% by supplier, At random by PURCHAS ER / END CUSTOME R	Inspection report	-	H	H
		14	weight checking	Weight	100%	Inspection report	-	W	-
		15	Final inspection (for AS & SS pipes)	PMI check	As per 6- 81-0001	Inspection report	-	R	RW
		16	Marking	Pipe no , acceptance no. , H No. Size,	100%	-Do-	-	W	RW

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1e	Casting,forgi ngs for Austenitic StainSteel body and bonnet only.	Inter Granular Corrosion (IGC) Test and Stabilisation Heat Treatment	Per Heat /Per solution Annealed Lot	HT chart on TC	p	R	R																																																																																													
1f	All Castings	Radiography Examination	As per datasheet (if applicable)	Films and report	p	R	R																																																																																													
1g	Bars for Trim Materials	Chemical Analysis	All Heats	Lab Reports	p	R	R																																																																																													
II	Bought Finished and Sub Contract Items																																																																																																			
2a	Stems,	Surface Defects	As per	Inspection	p	R	R																																																																																													
Ref. Doc																																																																																																				

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		2b	-do-	Diamension	As per supplier sampling Plan	Inspection report	p	R	R
		2c	Stems, Gaskets, Gear Unit, Fastener, Gland , Packing etc.	Physical and chemical properties	All heat Lot	Supplier's TC	p	R	R
		III	WPS/PQR/ WPQ						
		3a	Previous qualification for Overlay/Stel liting (body seat ring/wedge)	Thickness of overlay/ stelliting hardness	100% by supplier and PURCHASER / END CUSTOMER	WPS/PQR/WP Q EIL Specs	-	P	R
		3b	New qualification for Overlay/Stel liting (body seat ring/wedge)	Thickness of overlay/ stelliting hardness	100% by supplier and PURCHASER / END CUSTOMER	WPS/PQR/WP Q EIL Specs	-	P	Ne w H O l d R
		IV	Product Evaluation and Testing						
		4a	Finished Valve	Shell Test Gate/Globe/Chec k Back Seat- Gate/Globe Seat Test- Gate/Globe/Chec k	100% by supplier and PURCHASER / END CUSTOMER as per specs	Test Report	-	P	H
		4b	Finished Valve	All Mandatory Test or Supplementary Test, Helium Leak Test (Hydrogen Service)	100% by supplier and PURCHASER / END CUSTOMER (Helium Leak Test) as per specs	Test Report	-	P	H
		4c	-Do-	Functional/Opera tional Test (For motor Operated	100% by supplier and PURCHASER /	Test Report	-	P	H

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		6	Selected Coupons Testing	Physical/chemical/corrosion/service/properties	100% by supplier & PURCHASER / END CUSTOMER	Test Records	R	H	H																																																																								
		7	Cleaning and Finishing	Blast Cleaning, Galvanizing, Pickling, passivation, Supplier's standard etc.	100% by supplier & Random by PURCHASER / END CUSTOMER	Inspection Report	R	H	R or W																																																																								
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			marking, color coding etc.	ER / END CUSTOMER -10 % min				
9	Positive Material Identification (Final Inspected Fittings)	Compliance with Stipulated Material	100% by supplier & Random by PURCHASER / END CUSTOMER -10 % min	PMI Report	-	H	H	
10	Final Release and Certification	Final Stamping, Issue of Inspection certificate	100% by supplier & PURCHASER / END CUSTOMER	Final offer list	-	H	H	
11	Packing and dispatch	Protective coating/type of packing/end protection etc.	100% by supplier & Random by PURCHASER / END CUSTOMER	Supplier records	-	H	-	
12	Documentation	Verification of TCs and compilation of Inspection reports	100% by supplier & 100% by PURCHASER / END CUSTOMER	MTC, Inspection Release Notes	-	H	H	

13.3.5. Inspection and Test Requirements of FLANGES, SPECTACLE BLINDS & DRIP RINGS

Sl no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming Material	Heat no, mill Test Certificate, Chemical Composition & Other Applicable Test	100%	Mill TC/Lab report	-	W	R
2	Heat Treatment as applicable	Cycle(Time Temp)	100%	HT Chart	-	W	R
3	Identification of Heat	Selected of Test Coupons	Each HT Lot/Each heat	Forging Identification Report	-	H	H

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		8	Final inspection	PMI check	100% by supplier, random by PURCHASER / END CUSTOMER	Inspection report	-	W	W																																																																							
		9	Final Inspection	PMI check	100% by supplier random by PURCHASER / END CUSTOMER	PMI report	-	W	RW																																																																							
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13.3.6. INSPECTION AND TEST REQUIREMENTS OF BOLTING MATERIAL

Sl no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1a.	Raw Material Inspection	Marking and correlation with TC	100%	Tc , Inspection Report	-	W	R
1b.	Raw Material Inspection (Check Test)	Chemical composition	One sample per heat	Inspection Report	W	R	-
1c	Raw Material Inspection	Internal soundness	One sample per heat	Inspection Report	W	R	-
1d	Raw Material Inspection	Spectro Analysis	100%	Inspection Report	-	W	R
2	Thread Rolling, hot forging of Nuts, Machining	Process control	As per Internal QA plan	Inspection Report	-	W	-
3	Heat Treatment (Q&T, N&T, SA as applicable)	HT cycle (Time and Temperature)	100%	Inspection Report	-	W	R
4	Selection of Samples	Test piece Marking	Heat of Material, Heat Treatment Charge/Size	Inspection Report	-	H	H
5	NDT (if applicable)	Surface & Internal Imperfection	100 % by supplier, at random by PURCHASER / END CUSTOMER	Inspection Report	-	W	RW
6	Destructive Testing	Mechanical properties	Each HT Lot/Each Heat no size	Lab Report	-	H	H
7	Galvanising (if applicable)	Thickness, Embrittlement , Adherence , Finish and Appearance	As listed in A 153	Inspection/Lab Report	-	W	R

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		Sl no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
							1	2	3
		1	Incoming Material Like forging and casting for body bonnet and nozzle, springs, Bellows etc.	- Chemical and Mechanical Properties, hardness check, NACE requirements Charpy V-notch impact testing. - Solution annealing/pickling	100 %	MTC/Test Lab Certificates	P	P/R	R
				- Radiography of valve castings - Bend test and magnetic particle Inspection of body and bonnet casting	100%	Radiography report/MPI reports	-	P/R	R
		2	Accessories like back floe preventer, pilot filter, etc for pilot operated valves	MTC	100%	Sub-supplier's Test certificate	P	P/R	R
		3	Machining of components	Dimension, finish	100 %	Supplier's Test Records	-	P	-
		4a	Final Inspection on assembled valves	- Visual - Correctness of Tag plate - Verification of required accessories - Helium leak test - Dye penetration test	100%	Inspection witness record	-	P	W
		4b	Final Inspection	- Dimensional check - Hydrostatic test - Cold bench set pressure - Seat leakage test - Valve lift test - Blow down/Relosing pressure test	100% by supplier , at random by Purchaser / End Customer	Supplier's Test record/Inspection witness record	-	P	W
				IBR (if applicable)	100%	IBR stamp and certificat	-	W	R

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4d		Capacity test as per ASME	Sample	Type test reports	-	R	R																																				
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13.3.12. INSPECTION AND TEST REQUIREMENTS FOR SOLENOID VALVES. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Sl no</th> <th rowspan="2">Stage/ Activity</th> <th rowspan="2">Characteristics</th> <th rowspan="2">Quantum of check</th> <th rowspan="2">Record</th> <th colspan="3">Scope of Inspection</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Incoming Material Like body, conductor material etc.</td> <td> - Mechanical identification, conductor resistance and insulation of conductors </td> <td>100 %</td> <td>MTC/Test Lab Certificates</td> <td>P</td> <td>W/R</td> <td>R</td> </tr> <tr> <td>2</td> <td>Solenoid valve</td> <td>Visual, dimensional, connection size</td> <td>100%</td> <td>Supplier's Test record</td> <td>-</td> <td>P</td> <td>-</td> </tr> <tr> <td>3</td> <td>Final Inspection</td> <td> - Visual and Dimensional check - HV Test - Seat leakage test by air/N2 - Correctness of Tag plate - Verification of required accessories - Connection size - Insulation resistance Test - Pneumatic Test by Air/N2 - Operational test </td> <td>100%</td> <td>Inspection witness record</td> <td>-</td> <td>P</td> <td>W</td> </tr> </tbody> </table>									Sl no	Stage/ Activity	Characteristics	Quantum of check	Record	Scope of Inspection			1	2	3	1	Incoming Material Like body, conductor material etc.	Mechanical identification, conductor resistance and insulation of conductors	100 %	MTC/Test Lab Certificates	P	W/R	R	2	Solenoid valve	Visual, dimensional, connection size	100%	Supplier's Test record	-	P	-	3	Final Inspection	- Visual and Dimensional check - HV Test - Seat leakage test by air/N2 - Correctness of Tag plate - Verification of required accessories - Connection size - Insulation resistance Test - Pneumatic Test by Air/N2 - Operational test	100%	Inspection witness record	-	P	W
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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.	<table border="1"> <tr> <td></td> <td></td> <td>including verification of pickup and drop voltage</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4</td> <td>Submission of certificates:-</td> <td> - Certificate of statutory approval authority like CCOE/PESO for use in electrically hazardous area. - Degree of protection certificate as applicable - Type test report from testing agency like CIMFR, BASEEFA . FM/UL, PTB etc, for suitability in specified Hazardous area - Valid BIS license for indigenous supply. - Material test report for body and trim. - Traceability of records </td> <td>Prototype for each module</td> <td>Statutory approval certificates/ Type Test certificate</td> <td>-</td> <td>R</td> <td>R</td> </tr> <tr> <td>5</td> <td>Packing and Painting</td> <td> - Visual - Proper packing to prevent any damage during transportation - Suitable protection to prevent entry of foreign material </td> <td>100%</td> <td>Packing List/supplier's record</td> <td>-</td> <td>W</td> <td>-</td> </tr> </table>										including verification of pickup and drop voltage							4	Submission of certificates:-	- Certificate of statutory approval authority like CCOE/PESO for use in electrically hazardous area. - Degree of protection certificate as applicable - Type test report from testing agency like CIMFR, BASEEFA . FM/UL, PTB etc, for suitability in specified Hazardous area - Valid BIS license for indigenous supply. - Material test report for body and trim. - Traceability of records	Prototype for each module	Statutory approval certificates/ Type Test certificate	-	R	R	5	Packing and Painting	- Visual - Proper packing to prevent any damage during transportation - Suitable protection to prevent entry of foreign material	100%	Packing List/supplier's record	-	W	-										
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13.3.13. INSPECTION AND TEST REQUIREMENTS FOR JUNCTION BOXES AND CABLE GLANDS.																																											
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		3b	Final Inspection	• Physical dimensional verification and workmanship • HV and insulation resistance Test • Air leakage test report on pneumatic JBs	100 % by supplier and on sample basis by PURCHASER / END CUSTOMER	Supplier's test record and inspection witness report	-	P	W, H
		4	Submission of certificates: -	• Certificate of statutory approval authority like CCOE/PESO for use in electrically hazardous area. • Degree of protection certificate for instrument housing • Type test report from testing agency like CIMFR, BASEEFA, FM/UL, ATEX, PTB etc, for suitability in specified Hazardous area • Traceability of records	Prototype for each module	Statutory approval certificates/ Type Test certificate	-	R	R
		5	Packing and Painting	• Visual • Suitable protection to prevent entry of foreign material	100%	Packing List/supplier's record	-	W	-
Ref. Doc									

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		SI no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
							1	2	3
		1	Incoming steel sheet for panel fabrication	Surface finish, dimensions, chemical treatment	100 %	Material Test Certificates /Test Lab Certificates	P	W/R	R
2	Boughtout components like indicators, relays, controllers, annunciators, lamps, recorder. Switches, push buttons, zener barriers, Isolators, Power supplies , pressure indicator, pressure switch etc.	Make , model no, calibration test certificate	100%	Material Test Certificates /Test Lab Certificates	-	P/R	R		
3a	Final Inspection	- Dimensional test report - HV and insulation resistanceTest - Calibration test report - Performance test report including wiring scheme checks, airline/tubing check for pneumatic panels, functional check of accessories & shutdown and Interlock logics by simulation - For pneumatic panels, leak test for tubing at 1.5 times the minimum air supply	100% by supplier	Supplier's record	-	P	R		
Ref. Doc									

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		3b	Final Inspection	pressure	100 % by supplier and on random basis by PURCHASER / END CUSTOMER	Supplier's test record and inspection witness report	-	P	W, H
Ref. Doc		- Physical dimensional test report - HV and insulation resistance Test - Visual check including type and size of wire used - Correctness of model no , tag plate , connection size - Performance test report including wiring scheme checks, airline/tubing check for pneumatic panels, functional check of accessories & shutdown and Interlock logics by simulation. - For pneumatic panels, leak test for tubing at 1.5 times the minimum air supply pressure - Component layout arrangement - Easy accessibility for maintenance/replacements of components - Size check and leak test for all airlines/tubings. - HV and insulation resistance Test - Semi graphic check (if applicable) - Paint shade and thickness check - Wiring color code, ferruling & continuity check - Wiring scheme check & functional check of instruments and accessories. - For pressurized panels, required volume change &							

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				pressurization check.																												
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5	Packing and Painting	- Visual - Suitable protection to prevent entry of foreign material. - Proper packing to prevent any damage during transportation	100%	Packing List/supplier's record	-	W	-																									
Legends: CCE or CCOE- Chief Controller of Explosives, DT-Destructive Test, DP or DPT-Dye Penetration Test, HT-Heat Treatment, H-hold(Do not proceed without approval) ID- Inside Diameter, PMI- Positive Material Identification, IBR-Indian Boiler regulation, ITP- Inspection and Test Plan, M- Monitor, NDT Non Destructive Testing, P-Perform, PO-Purchase Order, PR- Purchase Requisition, PQR-Procedure Qualification Record, QAP- Quality Assurance Plan, Random-10% (min 1 no) of each size and type of bulk item, R-review, RT-Radiography Testing, RW-Random Witness, TC-Testing Certificate, TPI or TPIA-Third party Inspection Agency, VDR- Bidder data Requirement, WPS-Welding Procedure Specification, WPQ- Welder's Performance Qualification, W- Witness (Give due notice, work may proceed after schedule date). MT or MPT- Magnetic particle Test, MTC-Manufacturer Test Certificate , UT –Ultrasonic Test, VDR- Bidder Data Requirement,1: Sub- Supplier, 2: Bidder ,3: Purchaser / End Customer NOTES: 19 The above guidelines are the minimum requirements. ITP shall be developed by bidder based on this specification requirements / codes and statutory																																
Ref. Doc																																

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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.		20 13.4. 13.4.1. 13.4.2. 13.4.3. 13.4.4. 13.4.5. 13.4.6. 13.4.7. 13.4.8. 13.4.9. 13.5. 13.5.1.	requirements and shall be submitted to Purchaser for approval during detail engineering stage. Bidder at no point of time shall be eligible to raise any extra claim on account of any requirement necessitated as a part of approval of QAPs/ ITPs. INSPECTION Bidder, to ensure that the equipment and material supplied, meet all the specifications laid down in the contract In case bidder find any deviation or non- conformity with respect to the agreed specifications, during manufacturing of the item and where corrective action is not feasible, the bidder shall report the same to Purchaser and / or in the designated “Waiver / Deviation Request” format and seek prior approval from Purchaser / before proceeding with the job. Bidder shall notify in writing to the Purchase, at least two weeks (Ten working days) in advance of the date and the place at which the items will be ready for witnessing of inspection / testing by Purchaser In case any postponement becomes necessary, the CONTRACTOR shall provide written notification at least 48 hours prior to the original scheduled date. Bidder after satisfying that all inspection requirements as per approved ITP and applicable specifications / documents have been taken care by 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 etc. duly endorsed by their Quality Control Manager. The bidder shall ensure that all items covered by IBR/CCE regulations are inspected at the manufacturer’s works and duly certified by competent authority. 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. 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. Dimensional check up to a minimum of 10% should be done for all pipes and fittings at supplier’s shop and witnessed by TPIA. Additionally 1% dimensional check will be carried out at site by the bidder and witnessed by Purchaser / . 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. INSPECTION CERTIFICATE TPIA shall issue an Inspection Certificate after satisfactory completion of all required ‘H’, ‘W’, & ‘R’ stages of Inspection by all parties concerned as per	
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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.	13.5.2. approved ITP and after ensuring compliance to specified requirements of all relevant applicable documents. The Inspection Certificate shall give reference of the approved documents including ITP referred for inspection and tests carried out and short supplies, if any. Bidder shall submit, copy of each Inspection Certificate (IC) / Inspection Release Note (IRN) issued by TPIA, along with all attachments mentioned therein. The IC / IRN shall include the following as minimum: a. Job No. / Project Title / PO. No. / Purchase Specification No., Date of inspection and b. Status of the visit - Initial / Intermediate / Final. c. Item Tag No. / Name / Total quantity ordered / released / offered for inspection and accepted during the visit. d. Manufacturer's Name e. Date & Place of Inspection, name of Inspection Agency and Inspection Authority. f. Reference of Documents with Revision status.(It shall be clearly indicated in the inspection certificate that "inspection has been carried out based on code 1 drawings and approved ITP".) g. Verification of calibration documents. h. Details of Inspection carried out. i. Works Certificate with details of Hydrostatic Test and PMI / Leak Tests (if applicable) for Fabricated equipment ii. Works Certificate with details of Performance Test, Mechanical Run Test (if specified in PR) and String Test (if applicable) for Rotating Equipment iii. Works Certificate with details of acceptance tests witnessed and Certificate of statutory approvals if applicable, for electrical items iv. Works Certificate with details of calibration, and Certificates of statutory approvals if applicable, for instruments. v. Works Certificate with details of Mechanical tests, PMI and Helium Leak tests if applicable, for all bulk items such as pipes, valves, fittings, fasteners and gaskets. vi. Works Certificate accompanied with details of basis for acceptance, for all other items i. Results of Inspection. j. Deviations, if any. 13.6. INSPECTION AGENCY: Purchaser / Third Party appointed by purchaser / appointed third party / End Customer / End Customer appointed third party.			
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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.		13.7. GUARANTEE: The inspection agency shall be indicated in the quality plan and shall be as per the approved quality plan. The Bidder shall guarantee the performance of the IGES throughout the year. After completion of the installation, the system shall be balanced and necessary adjustments shall be carried out for all equipment until all guaranteed performance requirements are satisfied. All instruments and services required for the above tests shall be provided by the bidder. All the instruments installed and required for conducting acceptance test shall be only calibrated instruments			
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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.						14. MARKING , PACKING AND DESPATCH
						14.1. MARKING
						14.1.1. 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.
						14.1.2. For ease of identification, the color of painted strip (wherever required) shall be as per the applicable standard.
						14.1.3. 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.
						14.2. DESPATCH
						14.2.1. 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.
						14.2.2. 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.
						14.2.3. The equipment 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.
						14.3. The following minimum packing procedures shall be followed :
						14.3.1. All items shall be dry, clean and free from moisture, dirt and loose foreign material of all kinds.
						14.3.2. All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.
						14.3.3. Rust preventive on machined surfaces to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent.
						14.3.4. Ends shall be suitably protected, and the protectors shall be securely and tightly attached.
14.3.5. 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.						
14.3.6. Carbon steel, LTCS and low alloy steel valves shall be painted with one coat of inorganic zinc silicate primer.						
14.3.7. Prior to shipment components of the unit shall be completely cleaned, Flange faces and other machined surfaces shall be protected by coating with easily removable rust preventive. All the equipments shall be properly packed to prevent damage during transit damage, loading, unloading and storage.						

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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.	14.3.8.	All electrical, instrumentation etc, shall be properly packed to prevent damage during transit due to vibration, physical contact, moisture ingress, rainwater and pilferage.	
	14.3.9.	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 at the job site. Each instrument shall be sealed in plastic bags containing moisture absorbing dessicants.	
	14.3.10.	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. Bidder shall be responsible for any damage to equipment/material due to above reasons.	
	14.3.11.	Spare parts shall be packaged separately and clearly marked as 'Spare Parts'	
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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.	15. DOCUMENTATION: 15.1. MASTER DOCUMENT LIST 15.1.1. A master documentation shall be prepared during kick off meeting identifying all the DOCUMENTS / DRAWINGS to be submitted by the bidder as part of documentation. 15.1.2. Bidder shall ensure submission of all documentation as per approved Master Document List. 15.1.3. Bidder to note that the dates of submission of all the documents shall be finalized by him considering the time required for approval of various documents at Purchaser's end. It shall be solely bidder's responsibility to get approval on the entire document from purchaser to meet project schedule. 15.2. DRAWING APPROVAL / REVIEW CATEGORY: 15.2.1. The master document list shall clearly identify the class of review to be performed against each document. 15.2.2. Following classes of review shall be followed for all the documents engineered by the bidder • APPROVAL (A) Approval is mandatory and bidder cannot proceed without obtaining Purchaser's approval. • INFORMATION / RECORDS (I) This type of documents shall be submitted to Purchaser for his information. Bidder can proceed if Purchaser's comments are not received within 14 working days of receipt in Purchaser's office. However, if any deviation to contract specification for any design deficiency is detected in the course of review after stipulated period, it shall be the responsibility of the bidder to see that such deviations and deficiencies are corrected to ensure compliance to contract without any cost and time implication to purchaser 15.3. DRAWINGS REVIEW AND APPROVALS 15.3.1. Bidder to understand that efficient handling of drawings and documents to be prepared by him under the contract is the key to the timely completion of the IGES system. By accepting the contract the bidder undertakes to ensure that all drawings and documents to be submitted by him to the Purchaser /End Customer shall be of professional quality and conforming to the contractual requirements. 15.3.2. Bidder to note that the dates of submission of all the documents shall be finalized by him considering the time required for approval of various			
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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.		15.3.3. 15.3.4. 15.3.5. 15.3.6. 15.3.7. 15.3.8. 15.3.9. 15.3.10. 15.3.11. 15.3.12. 15.3.13. 15.3.14. 15.3.15.	documents at Purchaser's end. It shall be solely bidder's responsibility to get approval on the entire document from purchaser to meet project schedule. Computer aided design and drafting shall only be used except in exceptional cases where manual drafting may be resorted to, if unavoidable. All the dimensions should be in metric units. Each drawing submitted by the bidder shall be clearly marked with the name of the Owner, the unit designation, the specifications, title, the specification number and the name of the Project with revision No. and date. If standards, catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English. All documents before forwarding to Purchaser will have to be vetted in detail by bidder. Document received without vetting will be returned without review. Also any inaccuracies/mistakes found will not only be rectified by the bidder but the bidder shall remain liable for bearing charges towards efforts spent by Purchaser for discussing the same. Delay owing to these shall be to the account of bidder The bidder shall thoroughly review and approve all Sub-Vendor documents, before forwarding to Purchaser Only the approved drawings duly stamped and signed by a competent engineer of bidder shall be submitted to purchaser for review. Documents submitted without meeting pre-requisite requirements will be returned without review. Review of drawings and documents issued by bidder shall be carried out by Purchaser / End customer. Approval/ review of the drawings/ documents by the Purchaser /End customer would be only limited to the review of compatibility with basic designs and concepts. The approval and/or review by the Purchaser/End customer shall not be construed by the bidder as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings. The sole responsibility of the correctness of Design, Engineering & supervision of erection and commissioning shall lie with the bidder, irrespective of the fact that the Drawings/Documents submitted are reviewed or not by the Purchaser /End customer. The bidder shall correct all faulty designs & supervision of erection and commissioning detected at any stage of work (irrespective of the fact whether drawings related to such faulty designs & or constructions are approved by purchaser), without any cost and time implication to the Purchaser. The Bidder shall be responsible for and shall pay for any alterations of the Work to be accrued out by other agencies due to any discrepancies, errors or omissions in the Drawings or other Particulars supplied by him whether such drawings or particulars have been approved by the BHEL/ End customer or not.	
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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.			15.3.16. Revisions in drawings/documents shall be clearly marked within clouds. No revision without clouding shall be recognized and the same shall not be considered reviewed and approved. All revised drawings / documents shall be associated with comments compliance report, 15.3.17. Normally all drawings / documents shall be reviewed by the purchaser with 14 working days of receipt of drawing at Purchaser's end. 14 days shall be reckoned from the date of receiving the hard copies of the documents at purchaser's center. 15.3.18. However, for all documents where multi-disciplinary activity is involved, the bidder, after submission for Purchaser's review, shall in his own interest, visit Purchaser's office for discussion for expeditious review of documents. 15.3.19. In absence of visit of bidder's engineering team at Purchaser's office approval/review time shall be 15 working days. 15.4. ENGINEERING COMPLETION: 15.4.1. The Engineering shall be considered as completed after the following activities are finished: • Final approval of all the Drawings / Documents which are in 'Approval' Category as per Master Document List (MDL) • After successful review of drawings/documents which are in 'Information' Category as per Master Document List (MDL) • Final approval of detailed Bill of Quantity (BOQ). 15.5. ERECTION & COMMISSIONING DOCUMENTATION: 15.5.1. ERECTION DOCUMENTATION: 15.5.1.1 Erection document List shall be prepared during Engineering review meeting (after award of contract) identifying all the DOCUMENTS / DRAWINGS required for completion of Erection activities of the complete system, to be submitted by the bidder as part of documentation. 15.5.1.2 The Bidder shall submit for Purchaser's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following : • Instructions for packing, shipping, receiving, handling, ware-housing and storage.	
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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.	• Part number/Dispatch link-up of all the equipments/items supplied and also their co-relation with system/drawing/approved BOQ. • Instructions for location and installation of equipment furnished by this specification. • Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification. • Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays. • Check lists and quality assurance hold points. • Formats for all related documentation. • The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering. • The Bidder shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg. 15.5.1.3 Erection Manuals The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. • Erection strategy. • Sequence of erection. • Erection instructions. • Critical checks and permissible deviation/tolerances. • List of tool, tackles, heavy equipments like cranes, dozers, etc. • Bill of Materials • Procedure for erection. • General safety procedures to be followed during erection/installation. • Procedure for initial checking after erection. • Procedure for testing and acceptance norms. • Procedure / Check list for pre-commissioning activities. • Safety precautions to be followed in erection all equipments and electrical supply distribution during erection 15.5.2. COMMISSIONING DOCUMENTATION: 15.5.2.1 The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various Equipment / systems covered under the contract, for the approval of employer.			
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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.		15.5.2.2 Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking. 15.5.2.3 The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system. Commissioning schedule is a document envisaged for commissioning of a system. The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is as per the following: Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices. Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting. Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self contained one: a) Plant Details/Design data b) Testing Objective/Proposals c) State of the Plant required prior to commissioning - o Erection Status with respect to Mech. Elect and C&I - o Services required - o Safety requirements d) Test method including completion/acceptance criteria e) Results f) Testing Programme g) Mech/Elect/C&I –Plant item completing list h) List of Drawing/documents required for carrying out the testing. 15.5.2.4 The contractor shall submit the list of commissioning documentation to be submitted by him, alongwith their submission schedule for various equipment/systems covered under the contract, with in 6(six) month from the date of award of contract, for the acceptance of employer. 15.5.2.5 The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least		
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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.	12 months before the scheduled date of commissioning of the equipment/systems.																																		
	15.6. FOLLOWING MAY BE NOTED WRT THE DRAWING SUBMISSION SCHEDULE:																																		
	<table border="1"> <thead> <tr> <th>SL NO.</th> <th>DESCRIPTION</th> <th>NUMBER OF COPIES TO BE SUBMITTED</th> <th>WHEN TO SUBMIT</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Initial drawings/documents under approval and information category.</td> <td>4</td> <td>As per approved Master document list</td> </tr> <tr> <td>2.</td> <td>Revised drawings/documents incorporating BHEL's comments.</td> <td>4</td> <td>Within 1 week of receipt of commented Drawings from BHEL</td> </tr> <tr> <td>3.</td> <td>Final Drawings/documents</td> <td>17</td> <td>Within 2 months of placement of order.</td> </tr> <tr> <td>4.</td> <td>Erection Documentation</td> <td>8</td> <td>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.</td> </tr> <tr> <td>5.</td> <td>Draft O & M Manuals with out test certificates</td> <td>2</td> <td>2 months before the delivery date of equipment</td> </tr> <tr> <td>6.</td> <td>Revised O & M Manuals with Test Certificates to be submitted to BHEL (Hyderabad)</td> <td>17</td> <td>Within one month after dispatch of equipment</td> </tr> <tr> <td>7.</td> <td>Final O&M Manuals in a CD</td> <td>3</td> <td>Within one month after dispatch of equipment</td> </tr> </tbody> </table>				SL NO.	DESCRIPTION	NUMBER OF COPIES TO BE SUBMITTED	WHEN TO SUBMIT	1.	Initial drawings/documents under approval and information category.	4	As per approved Master document list	2.	Revised drawings/documents incorporating BHEL's comments.	4	Within 1 week of receipt of commented Drawings from BHEL	3.	Final Drawings/documents	17	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)	17	Within one month after dispatch of equipment	7.	Final O&M Manuals in a CD	3
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15.7. DOCUMENT SUBMISSION PROCEDURE																																			
15.7.1. All Drawings/Datasheet/Design calculation etc. shall be submitted in soft as well as hard copy. Soft submission of all drawings/documents is mandatory.																																			
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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.			15.7.2. All drawings/ shall be submitted in Autocad format & all documents in MS office/PDF 15.7.3. Bidder shall furnish all documents in A4 Size (210 mm x 297 mm) paper or folded in A4 size unless otherwise specified. All drawings and sketches shall be in multiples of A4 size like A3 (297 mm x 420 mm) or A2 (420 mm x 594 mm) etc., but folded to 'A4' size. Final documentation shall be submitted in bound volumes and softcopy shall be furnished in non - writable CD. 15.7.4. It has been observed that at times mails fails to deliver because of problem in sender's /receiver's server .Hence it is recommended that bidder shall intimate concerned BHEL personal about any soft copy submission over phone immediately after any drawing / document is submitted for BHEL's review / approval. 15.7.5. Hard copies of all the documents shall be forwarded to the following address: Name: (Name will be intimated during detail engineering) Address: Bharat Heavy Electrical Limited New Engineering Building PE&SD RC Puram Hyderabad- 32 15.7.6. Date of receipt of hard copies shall be considered as date of submission of any document. Soft copy submission shall be considered as advance submission of drawing/document 15.7.7. BHEL's normal working hour is 7.00 AM to 3.15 PM from Monday to Saturday. 15.7.8. Bidder to ensure that all documents are received with in BHEL working hours. Any submission done after normal office hour/ weekly Off/Public Holidays shall be deemed as submitted on next working day. 15.7.9. BHEL shall furnish Approval/Observation of Drawings/Datasheet/Design calculation etc. on Soft Copy only. 15.8. INPUT DRAWINGS 15.8.1. 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 to go ahead with the engineering of the package, and shall not expect the Purchaser to automatically supply the same after order placement – the required base drawings/documents shall be furnished to the Bidder within reasonable period of receipt of such requisition from Bidder. 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. 15.8.2. 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 .Bidder to however note that they will not be eligible to raise any extra charges on account of this.	
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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.		15.8.3. All relevant input drawings will be made available to the bidder during detail engineering stage as when they are revised or prepared. 15.8.4. Bidder to note that they shall not be eligible to raise any extra claim on account of furnishing of new drawings or revised drawings by purchaser during offer execution stage. 15.9. REVIEW MEETINGS & KICK OFF MEETING: 15.9.1. 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. 15.9.2. Bidder in his own interest may visit Purchaser's office to expedite the approval of critical drawings, which may affect the progress of project. 15.9.3. A kick off meeting shall be held at Purchaser's office, preferably within 2 weeks of order. 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-Vendor lists proposed by Bidder. - Utility requirements. - List of input drawings required from BHEL - Preliminary General Arrangement & layout drawings 15.9.4. 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. 15.10. The following minimum documentation shall be submitted by the bidder during detail engineering stage: - Billing Breakup - P & ID of the IGES system - IGES layout - List of equipments - All equipment GA drgs - All equipment data sheets		
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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.			g. Foundation drawing for all the equipment supplied by the bidder(if required) h. Civil interface details i. Field alignment diagram j. Piping specifications k. Valve Material specification l. Line schedule and line list m. Inergen system piping layout n. Isometrics of all piping layouts. All isometrics shall have support markings and bill of materials o. Piping support details p. Control / annunciation panel drawings q. Instrument data sheets with hook up drgs r. Instrument Index s. Instrument sizing calculation t. Logic diagram u. Instrument loop diagram v. Instrument cable schedule. w. Wiring drawing x. Cable schedule y. Utility list z. Operation & Control philosophy aa. Welding specification charts bb. Nondestructive Testing specifications cc. Shut down and start up sequence dd. List of consumables ee. Operation write up ff. Quality plan gg. Painting schedule & procedure (shop painting & site painting) hh. Packing procedure ii. Erection drawings jj. Erection procedure kk. Testing procedure ll. Pre commissioning procedure mm. Commissioning procedure nn. Field quality plan oo. Supply quality plan pp. List of major bidders along with Proven Track Record(wherever applicable) qq. O & M Manuals rr. Any other document, as deemed necessary by Purchaser, at any stage of contract execution.		
			15.11. AS BUILT DRAWINGS		
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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.		15.11.1. As built drawings and documents will be generated within one month of completion of activities on respective items of work. 15.11.2. Bidder shall furnish reproducible and electronic files of all the drawings under their scope to Owner/ certified as "As Built Issue." 15.11.3. Upon completion of identifiable units or components of the fabrication, construction and installation phase of the project, the bidder will complete all the related plans to the "as built" stage including all Sub-Vendor drawings and furnish Purchaser with the following : 6 complete sets of full size prints of the drawings and 4 sets of reduced size prints. 6 complete bound sets of Manufacturer's specifications including design calculations. - As Built drawings generated specifically for this job in electronic media (AutoCAD 10 or above). - All bidder drawings & documents either in AutoCAD or in scanned images stored in electronic media. 6 complete sets of all operating & maintenance instructions in electronic media or in scanned images converted in electronic media. 6 complete sets in hard binders of the Manufacturer's data book including certified prints and data for all items including test reports. Data Book shall be complete with index as tag numbers associated with Manufacturer's data shown. Equipment data shall include as a minimum requirement the principal and description of operation, drawings and dimensions, spare parts lists and unpriced purchase orders and bill of materials. 6 bound copies each of the Spare Parts data book and the Lubricants inventory schedule. 6 complete sets of field records shall be signed by the CONTRACTOR'S and Owner's representatives at the site. - Original approvals and related drawings and documents from the statutory authority. 3 Copies of correspondence with the statutory authorities. 15.12. Drawings/documents with following titles shall contain as a minimum the following Information: 15.12.1. Drawing and Document Schedule This document lists out drawings and documents prepared and/or submitted by bidder to purchaser either during engineering or as a part of final documentation. This document shall be submitted as first document of submission for review after award of contract. Following information shall be available in this document:		
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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.	a) Name, Category of approval and number of each drawing and document listed. b) The schedule for the document submission considering the project schedule. 15.12.2. Utility Requirements This document lists out the following information regarding utilities required by the bidder - List of utilities required i.e. Power (UPS, Non UPS), Instrument air, Cooling water, Steam for tracing, Nitrogen etc. - Location and estimated/actual requirement at each location. The requirement shall be listed as minimum/normal/maximum. - In case of AC power, the In-rush current with duration and power factor shall also be indicated for each location. 15.12.3. General Arrangement Drawing A general arrangement drawing shall indicate: - Outline dimensions (minimum three views) (All principal dimensions). - Allowable forces and moments on suction and discharge nozzles. - Location (in all three planes), size, type, rating and identification of all purchaser's interface connections including those of vents, drains lubricating oil, sealing fluid, cooling water, steam & Electrical Instrumentation. - Direction of rotation viewing from the driving end. - Weight of each assembly/component. - The weight & location of center of gravity of the heaviest assembly/components that must be handled for erection. - Identification and weight, dimensions of the heaviest assembly / subassembly / component required to be handled for maintenance. - Maintenance clearances and dismantling clearances. - Speeds of Driven Equipment and driver and driver rating. Location of driver terminal box (in case of Electric Driver) - Layout of auxiliary equipment and operating platform. - Make, Type and Size of couplings and the location of guards and their coverage. - A list of reference drawings if any. - A list of any special weather-protection and climatic features. 15.12.4. Foundation Drawings A foundation drawing shall indicate complete information required for foundation design by purchase including the following:			
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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.	a. b. c. d. e. f. g. h. i. j. k. Foundation bolt sizes, pipe sleeve details, pocket sizes and locations and also distance between the first/ nearest anchor bolt and pump suction and discharge nozzle centerlines. Grouting thickness and other necessary technical details. Static weight of each skid/independently grouted item and location of center of gravity of each of such skid/items in all three planes. Weight distribution for each bolt/sub sole plate location and total static weight. Dynamic loading caused due to various items grouted independently. The direction and magnitude of unbalance forces and moments generated by each such item at the worst operating condition and short circuit moments of motor drivers at the C.G. of the pump-motor base plate. GD2 value of each item resolved to driver speed. Maximum permissible amplitude of vibration on the foundation at base level. Total mass of rotating parts. Total mass of reciprocating parts. Suggested dynamic factor and ratio of foundation weight to weight of skid/equipment as per bidder experience. 15.12.5. Layout Drawing This drawing shall include at least the following: a. b. c. d. Layout of all skid/equipment and their auxiliaries, vessels, control panels, exchangers etc. Bidder shall furnish an optimized layout (considering the space allocated, site wind conditions, area classification, the type of equipment located in the vicinity etc.) indicating elevation and dimension of skids/equipment. Minimum spacing required between the various skids/equipment and between the skids and the walls/columns/roof for an easy accessibility and maintenance. Recommended Horizontal clearances: Equipment spacing • Small pumps (3.7 kw & less) : Mounted on common foundations with suitable centre to centre distance. • Medium pumps (22.5 kw & less) : 900 mm clear aisle Layout for water piping, trenches for water piping, cable tray/trenches layout.			
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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.	e. f. g. h. Piping arrangement and piping support arrangement/ location for Layout for auxiliary equipment and operating platform details. Erection & Construction schedule: Erection scheme and schedule of all equipments must be considered during equipment layout to have smooth erection Platforms with ladder access shall be provided for Items that require occasional operating access including valves, spectacle blind and motor operated valves, sampling points etc. Constructability, Operation & Maintenance Requirement: • Overhead and side clearance for exchangers and pumps • Provision of Heat Exchanger tube bundle pulling area • Clearances for easy movement of working personnel • Provision of monorails for pumps and exchangers 15.12.6. Field Alignment Diagram The diagram shall indicate the relative displacement to be kept between the centerlines of various equipments at the time of installation, so that under normal running conditions the equipments get fully aligned. This relative displacement should be decided on the basis of centerline temperature rise data of driver, gear box/transmission system, driven equipment. 15.12.7. P&I Diagrams (with Bill of Materials) a. Bidder shall supply P&I Diagrams along with Bill of Materials of each system in the bidder's scope of supply or specified in the order. b. P&I Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve sizes and class shall be clearly marked on the P&ID. c. Bidder's scope and purchaser's scope shall be clearly demarcated. d. Each item shall be identified by an item No./item tag no., which shall correspond to the item no. shown on the bill of materials. e. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable. f. Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing. g. The legends shall be as per ISA.			
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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.		15.12.8. Cross-sectional Drawing (with Bill of Materials) - The bidder shall supply cross-sectional or assembly type drawings for all equipment furnished showing all parts, design assembly and running clearances, and balancing data required for erection and maintenance. - Each part shall be numbered which shall correspond to the part number on the bill of materials. - The bill of materials shall include the part no., name of component, materials quantity installed per unit & sizes where applicable (say for bolts, nuts, rings, gaskets etc.). - All boughtout items shall also be indicated with make and brief specifications. - A separate cross-sectional drawing showing installation and setting dimensions for the seals shall be furnished. 15.12.9. Performance Characteristic Curves - Bidder shall provide complete performance curves to encompass the map of operations, with any limitations indicated thereon. - All curves submitted prior to final performance testing shall be marked "PREDICTED". Any set of curves resulting from a test shall be marked "TESTED". - Certified test curves and data shall be submitted within 15 days after testing and shall include head, power recalculated to the proper specific gravity and efficiency plotted against capacity. If applicable, viscosity corrections shall be indicated. If NPSHR test is specified, the water NPSHR curve (drawn upto minimum continuous flow) shall also be included. - The curve sheet shall include the maximum and minimum diameters of the impeller design supplied the eye area of the first stage impeller, the identification number of the impeller or impellers and the pump serial number. 15.12.10. Data Sheet Bidder shall provide completely filled in data sheets, first for "as purchased" and then for "as built". This shall be done by the bidder correcting and filling out the data sheets and submitting copies to the purchaser. 15.12.11. Piping Layouts - All piping layouts shall have clearances, loops, equipment foundations, columns, beams, technological structures, platforms, gratings, hand		
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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.		rails, anchors, sections, guides, supports, connections to equipments, orientation, coordinates etc. b. Blow up details wherever required for clarity shall be made. c. All dimensions shall be in millimeters whereas all levels and coordinates shall be in meters. d. Vital installations and battery limits shall be marked with coordinates. e. Dimensioning shall be done with equipment centerlines or main structural columns as reference grids. f. GADs shall be printed in 1:33 1/3 scale for unit piping g. All the information regarding instruments, equipments and line identification, direction of flow for lines, Insulation Type and Thickness, elevations and locating dimensions shall be clearly marked on piping plans. Information including operating platforms, ladders, staircase, and monorails with capacity shall also be marked wherever applicable. h. Davit drop out areas, maintenance areas shall be clearly marked on the GADs. i. Electrical cable and instrument trays etc. shall be shown in piping plans to avoid reference to other drawings. j. Nozzles on equipments shall be shown in double line thin and firm. Actuators, valves hand wheels shall be drawn to scale for valves 2" and larger. k. Piping plans shall show all lines indicated in P&ID's and also lines generally not covered in P&ID. l. Nozzle schedule table giving nozzle number, size, rating, facing, projection, elevation and orientation shall be inserted in the GADs. m. Isometric shall be drawn on A3 size sheets. System Isometrics, if required by IBR authorities shall be prepared on AO size. BOM and all support requirements shall be shown on the Isometric by using symbols and designations in accordance with Piping Support Standard. n. All vessel mounted instruments, items i.e. trims shall be detailed in isometrics. o. Each line on the piping GADs and isometrics shall be clearly marked to denote the complete line designation as marked in P&ID's. p. Following symbols shall be used in Piping drawing:- • Bottom of the pipe level: BOP. (Above Grade/ Platform/ Floor etc. shall be 500mm minimum for un-insulated lines and to be suitably raised for insulated lines to maintain clearance of min. 500mm from bottom of insulation.) • Center of the Pipe Level: C/L EL. • Top of Steel/Top of Rod: T.O.S./T.O.R. • Platform Elevation/Highest Paved Point Elevation: TOG EL/HPP EL		
Ref. Doc		15.12.12. Instrument work Specifications		

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Ref. Doc			15.12.23. Instrument Cable Schedule (For conventional loops)	

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		Ref. Doc	

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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.	vessels, exchangers, boilers, heaters, compressors, blowers, turbines, pumps, agitators, dryers, centrifuges, filters, etc. • Details of preventive maintenance and predictive maintenance. • Gasket details with respect to pressure ratings and temperature. • Coupling details, like, type of coupling and coupling bolts with make, serial No. and dimensional details. vi) Method for alignment including optical, if required. • Tightening torque with respect to critical services and sizing of bolts/studs. vii) Maintenance trouble shooting • Trouble shooting guide for critical equipment like compressors, turbines, blowers, screw pumps, heaters, boilers, centrifuges, conveyors, filters etc. viii) Maintenance training • Training needs and areas identified. • Instructions covering start-up, normal shutdown, emergency shutdown, operating limits and routine operational procedures. ix) A description of equipment construction features and the functioning of component parts or systems (such as control, lubrication, sealing systems etc. x) Outline and sectional drawings, schematics and illustrative sketches in sufficient 'details to identify all parts and clearly show the operation of all equipment and components and the methods of inspection and repair. Standardized sectional drawings are acceptable only if they represent the actual construction of the equipment. xi) The following maintenance information: • Maximum and minimum bearing, labyrinth and seal clearances including any other clearance between moving and stationary parts of the equipment affecting proper running and maintenance of the equipment.			
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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.	16. SUB VENDOR LIST 16.1. All the equipment shall be sourced from recommended Bidders only as specified in this specification. 16.2. Further the supplied model shall be under regular manufacturing range and have proven track record (Bidder / Sub-Vendor 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). 16.3. Supply items for which no definite “make/brand” is indicated, shall be procured only from makes & models having proven track records and requires purchaser approval. 16.4. Sub bidder list for the bought out items applicable for the project: Refer ANNEXURE-I.		
	Ref. Doc		

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			17.1. Inert Gas Extinguishing system as envisaged in this bid document shall be executed by the bidder on Lump Sum Turnkey (LSTK) basis.			
			17.2. 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.			
			17.3. The equipment supplied shall be complete in all respects. The bidder shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment. Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, 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 in bidder scope Only.			
			17.4. It will be the bidder's sole responsibility to specifically highlight any of the missing equipments / items required for the proper & intended use of the Inert Gas Extinguishing System as a part of their offer. In case nothing is highlighted by the bidder, it will be assumed that all the items required for the intended use of the Inert Gas System are included in the bidder's scope of supply and supervision of E&C for the desired operation of the IGES system.			
			17.5. All hardware/software/item/ etc. required as per tender specification or subsequent tender correspondences or for desired satisfactory operation of package or due to good-engineering practice or as prescribed by relevant/applicable code/standard, but not listed exclusively in this specification, shall be deemed to be included in the basic price quoted by the bidder. Also, all mounting hardware / accessories /fittings/conduits/etc. required for above the package shall be included in the basic price of respective item. Bidder, at no point of time, shall be eligible to raise any extra claim in this regard.			
			17.6. Drawings attached with this specification are preliminary & are not exhaustive in nature. These drawings may get revised during detail engineering. All other inputs required for engineering of the Inert Gas Extinguishing system will be furnished to the bidder during detail engineering stage, as and when the same is available with BHEL. Bidder to note that they shall not be eligible to raise any extra claim on account of revision of input drawings or any other input drawings during detail engineering stage.			
			17.7. Only main items shall be considered for price bid evaluation. Optional items (RO – rate only)shall not be considered for price bid evaluation			
			17.8. Prices quoted by the bidder shall remain firm till the successful handing over of the Inert Gas Extinguishing plant to end customer. Any request for upward			
Ref. Doc						

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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.		revision of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL. 17.9. Bidder to quote only base rates for all the items, Applicable taxes and duties shall be indicated separately. 17.10. 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. 17.11. Bidder shall confirm to the unpriced bid as part of their offer 17.12. Billing Breakup Methodology: 17.12.1. Billing break-up (BBU) shall be submitted to BHEL in following methodology: 17.12.1.1. The BBU shall be prepared only for the pro-rata billing purpose. 17.12.1.2. BBU will contain complete list of items required for the completion of the project as per specification and shall be dispatched by bidder irrespective of the items/quantities are indicated in the document or not. 17.12.1.3. Any additional requirement of the item already indicated in the document will be updated in the subsequent revision of this document. All such item will be dispatched as “free item” term to BHEL. 17.12.1.4. Inspection & Testing of all items shall be as per approved quality plan. The entire item shall be dispatched to site only after the completion of Inspection and testing requirement as per approved quality plan. Non-inclusion of any item does not absolve the vendor from meeting the requirement. 17.12.1.5. Vendor shall obtain prior permission from BHEL after submitting all the documents before ensuring dispatch of all main items applicable for project. 17.12.1.6. Inspection & quality: All the items applicable for this project shall be inspected as per approved quality plan. It may be noted that any item shall be dispatched to site only after complying with the Inspection requirements as per approved quality plan. 17.12.1.7. As separate document indicating the details of all the items having SHELF LIFE shall be furnished. Prior permission from BHEL shall be taken before dispatch of any of the item having shelf life. 17.12.1.8. Applicable taxes & duties shall be extra. 17.12.2. BBU shall be a comprehensive document having details of all the items applicable for this project .There should not be any Non-Billable item to be supplied at site. 17.12.3. BBU shall be submitted as per “Payment Terms of Annexure-BB”				
			Ref. Doc			

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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.	17.12.4. Wherever Lot items are indicated, same shall be quantified in details in a separate annexure. Similarly all Accessories/ Instruments/ items are to be defined with comprehensive details It is to be ensured that all fittings, accessories (including Bolts, fittings etc.), Instrument and other items, if any, shall be listed in separate line items or in a separate annexure. 17.12.5. In case requirement of any such item / additional item is detected at any stage of the contract execution, BBU will be revised to reflect the same. However all the additional items will be supplied as a 'Zero Value Item', without any commercial implication to BHEL. All the contractual requirements shall be valid for these additional items also.			
		Ref. Doc		

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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.	18. DEVIATIONS TO SPECIFICATIONS:		
	18.1. Bidders are advised to quote strictly as per BHEL's specification requirements. In case bidder excludes some components of scope of supply or some features of specification requirements, the bidder will be required to include the same in the scope during offer evaluation stage /contract execution stage without any additional commercial and price implications on account of the same. Bidder to note that they won't be entitled for any price impact on account of withdrawal of deviation taken from BHEL spec during technical scrutiny stage. Price impact will be allowed by BHEL only to the extent of change of specification during tender evaluation stage, if any, from BHEL end.		
	18.2. In case bidder feels that it is necessary to exclude some components of scope of supply & some features of specification requirements, due to genuine constraints if any, bidder has to clearly bring out the same to the notice of BHEL and take their prior approval before submission of bid. Bidders are requested to bring out only those deviations which are impractical to meet (or) not technically advisable as per the experience of bidder, for BHEL's review before the submission of bid. All such clarifications required by the bidder shall be intimated to BHEL together as a single notice within a week of receipt of enquiry by bidder.		
	18.3. All such deviation or variation from the scope, requirement and/or intent of this specification shall be clearly defined under relevant attachment of the Bid forms irrespective of the fact that such deviations/ variations may be standard practice or a possible interpretation of the specification by the Bidder. Except for those deviations/ variations covered as a part of pre bid clarification, it will be the responsibility of the bidder to fully meet the intent and the requirements of the specification within the quoted price. No other deviation whatsoever from this specification, except for the have been specifically agreed by purchaser as a part of pre-bid clarification shall be considered.		
	18.4. Bidder to note that all such applicable deviations /clarification shall be listed separately and submitted to BHEL as a part of pre-bid query. All such applicable deviations /clarification shall have cross reference to page number /section/clause/para etc. of this specification or its annexure with proper reasons for the deviations for purchaser's consideration. Any such applicable deviations /clarification not listed under the above section, even if reflected in any other portion of the bidder's proposal shall not be considered applicable.		
Ref. Doc	18.5. In case the bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, he shall recommend the same along with reasons in a separate section as a part of pre-bid query to enable purchaser take a suitable decision on the requirement of the same.		

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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.	18.6. 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. System wise BOQ shall be finalized based on approved drawings during detail engineering stage.			
Ref. Doc				

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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.		19. DEFINITIONS 19.1. BIDDER: Bidder means the party supplying IGES for this project. 19.2. SUB VENDOR : Sub vendor means any party on whom bidder suborders materials and items (like tubes, forgings etc) 19.3. QUALITY ASSURANCE PLAN (QAP) / INSPECTION AND TEST PLAN (ITP) : It is a document generated by the supplier with complete listing of various inspection stages, tests, material certification requirements and parties involved with their respective roles in inspection; indicating the requirements of Hold (H),Witness (W) Inspection, and Review (R) of Quality control documents / records for an item. QAP and ITP are considered synonymous. 19.4. HOLD POINT: A Hold Point is a stage designated in the ITP/QAP, which requires Witness Inspection by TPIA and / or OWNER before supplier can proceed with further processing, except where prior written permission for further processing or waiver of Witness Inspection by OWNER is obtained. 19.5. WITNESS POINT A Witness point is a stage designated in the ITP/QAP, which requires witness inspection by TPIA and / or Owner. EPCC/LSTK CONTRACTOR / Supplier shall perform the activity after proper notification has been given to TPIA and OWNER for witnessing the activity. The CONTRACTOR/ Supplier is not obliged to hold further processing, if TPIA and / or OWNER are not available to witness the activity or does not provide the comments before the date notified with proper notification period. 19.6. REVIEW POINT A review point is a stage designated in the ITP/QAP which requires the concerned agencies i.e. CONTRACTOR / TPIA /OWNER, to verify the documents for their correctness and to confirm that the said documents meet the requirements laid down. 19.7. THIRD PARTY INSPECTION AGENCY (TPIA) Third Party Inspection Agency means an inspection agency appointed by the EPCC/LSTK CONTRACTOR for carrying out Inspection and witness of tests of equipment and material being procured by the CONTRACTOR for the Project. 19.8. INSPECTION CATEGORY Inspection category determines the scope of Inspection for the Supplier, TPIA, OWNER for various equipment and material depending upon their use, serviceability, safety criteria and complexity. 19.9. MECHANICAL COMPLETION :Mechanical Completion of systems shall mean that all installation works of the system have been completed and hydro tested in accordance with approved construction drawings, approved specification, applicable code as defined in the document, accepted international good engineering practices and all the activities have been completed in a comprehensive manner by the bidder. 19.10. PRE-COMMISSIONING Activities : Pre commissioning activities, which are required to be performed after completion/ installation, inspection, hydro testing etc. of an equipment/ system to make it ready for commissioning.		
Ref. Doc				

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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. 20. LIST OF ANNEXURES: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3">LIST OF ANNEXURES</th> </tr> <tr> <th>Sl No</th> <th>Drawings/Documents</th> <th>Drg/Doc no/Annexure</th> </tr> </thead> <tbody> <tr><td>1.</td><td>Sub-Vendor List</td><td>Annexure-I</td></tr> <tr><td>2.</td><td>Painting</td><td>Annexure-II</td></tr> <tr><td>3.</td><td>Price Bid</td><td>Annexure-III</td></tr> <tr><td>4.</td><td>Master Document List format</td><td>Annexure-IV</td></tr> <tr><td>5.</td><td>Guidelines for QA QC plan</td><td>Annexure-V</td></tr> <tr><td>6.</td><td>Manufacturer quality Plan</td><td>Annexure-VI</td></tr> <tr><td>7.</td><td>Bill of Material Format</td><td>Annexure-VII</td></tr> <tr><td>8.</td><td>Pre Bid Query Format</td><td>Annexure-VIII</td></tr> <tr><td colspan="3">Power House Building</td></tr> <tr><td>9.</td><td>Main Plant Equipment Layout</td><td>PE-DG-374-100-M002-R6</td></tr> <tr><td>10.</td><td>TG Hall Equipment layout at EL. (+) 0.0 M</td><td>PE-DG-374-100-M003-R6</td></tr> <tr><td>11.</td><td>TG Hall Equipment layout at EL. (+) 8.5 M</td><td>PE-DG-374-100-M004-R6</td></tr> <tr><td>12.</td><td>TG Hall Equipment layout at EL. (+) 13.5 M</td><td>PE-DG-374-100-M005-R6</td></tr> <tr><td>13.</td><td>Equipment Plan at 13.5M, 19.0M & 25.5M Floor</td><td>PE-DG-374-100-M006-R5</td></tr> <tr><td>14.</td><td>Main Plant Cross section</td><td>PE-DG-374-100-M007-R5</td></tr> <tr><td>15.</td><td>Plot Plan</td><td>PE-DG-374-100-M001-R6</td></tr> <tr><td>16.</td><td>Control Room Layout</td><td>PE-DG-374-100-I401-R1</td></tr> <tr><td>17.</td><td>Schematic of Inert Gas Extinguishing System</td><td>-</td></tr> <tr><td>18.</td><td>Interface diagram for various packages for Fire Protection system</td><td>PEMC-03892</td></tr> </tbody> </table> NOTES: 21 Bidder to note that the above annexures are preliminary in nature .These drawings may get revised and /or new drawings will be furnished to bidder during detail engineering .Bidder to however note that they will not be eligible to raise any extra charges on account of this.					LIST OF ANNEXURES			Sl No	Drawings/Documents	Drg/Doc no/Annexure	1.	Sub-Vendor List	Annexure-I	2.	Painting	Annexure-II	3.	Price Bid	Annexure-III	4.	Master Document List format	Annexure-IV	5.	Guidelines for QA QC plan	Annexure-V	6.	Manufacturer quality Plan	Annexure-VI	7.	Bill of Material Format	Annexure-VII	8.	Pre Bid Query Format	Annexure-VIII	Power House Building			9.	Main Plant Equipment Layout	PE-DG-374-100-M002-R6	10.	TG Hall Equipment layout at EL. (+) 0.0 M	PE-DG-374-100-M003-R6	11.	TG Hall Equipment layout at EL. (+) 8.5 M	PE-DG-374-100-M004-R6	12.	TG Hall Equipment layout at EL. (+) 13.5 M	PE-DG-374-100-M005-R6	13.	Equipment Plan at 13.5M, 19.0M & 25.5M Floor	PE-DG-374-100-M006-R5	14.	Main Plant Cross section	PE-DG-374-100-M007-R5	15.	Plot Plan	PE-DG-374-100-M001-R6	16.	Control Room Layout	PE-DG-374-100-I401-R1	17.	Schematic of Inert Gas Extinguishing System	-	18.	Interface diagram for various packages for Fire Protection system	PEMC-03892
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	Rev. No.	Date	Revision Details	Prepared By	Revised By	Approved By
	00	20.04.13	ORIGINAL ISSUE	--SD--	--SD--	---SD---
	Ref. Doc.					

ANNEXURE-1

SUB-VENDOR LIST

SL. NO.	ITEMS	MAKES	REMARKS
1.	BATTERY CHARGER	AMARA RAJA POWER SYSTEMS LTD	
		HBL POWER SYSTEMS LTD	
		KERALA STATE ELECTRONICS	
		DUBAS ENGINEERING PVT LTD.	
		CHHABI ELECTRICALS P LTD.	
		STATCON POWER CONTROLS LTD.	
2.	SEALED MAINTENANCE FREE BATTERY	AMARA RAJA POWER SYSTEMS LTD	
		EXIDE INDUSTRIES LIMITED	
		HBL POWER SYSTEMS LTD	
3.	LEAD ACID STORAGE BATTERY	EXIDE INDUSTRIES LIMITED	
		HBL POWER SYSTEMS LTD	
4.	NICKEL-CADMIUM BATTERY	HBL POWER SYSTEMS LTD	
		AMCO SAFT INDIA LTD.	
5.	LT MOTORS (SAFE AREA)	SIEMENS INDIA LTD SECBAD.	
		ALSTOM T&D INDIA LIMITED	
		ABB LIMITED, HYD	
		KIRLOSKAR ELEC.CO.LTD	
		BHARAT BIJLEE LTD, MUMBAI	
		CROMPTON GREAVES	
6.	H.T. MOTORS (SAFE/HAZARDOUS AREA)	SIEMENS INDIA LTD SECBAD.	
		ABB LIMITED, HYD	
		BHARAT HEAVY ELECTRICALS LTD	
		JYOTHI LIMITED.	
		KIRLOSKAR ELEC.CO.LTD	
		CROMPTON GREAVES	
7.	DIRECT ON LINE STARTERS	CROMPTON GREAVES LTD. SECBAD	
		LARSEN & TOUBRO LIMITED, HYD	
		C AND S ELECTRIC LIMITED	
		SIEMENS INDIA LIMITED	
8.	DIRECT ON LINE STARTERS (EXPLOSION PROOF)	FLAMEPROOF EQUIPMENTS PVT.LTD.	
		FCG FLAMEPROOF CONTROL GEARS	
		BALIGA LIGHTING EQUIPMENT PVT. LTD.	
9.	HT CABLE JOINTING / TERMINATING KITS	YAMUNA POWER & INFRASTRUCTURE LTD.	
		BIRLA 3 M LTD	
		RAYCHEM RPG LIMITED	
10.	CABLE LUGS & CRIMPING TOOLS	DOWELLS ELEKTRO WERKE	
		POWER ENGG. CO.	
		ELECTROMAC INDUSTRIES	
11.	LIGHTING FIXTURES, LUMINIAIRS (FOR SAFE AREA APPLICATIONS)	SQUARE A ENTERPRISES	
		BAJAJ ELECTRICALS LTD., HYD.	
		CROMPTON GREAVES	
12.	LIGHTING FIXTURES & LUMINIAIRS (EXPLOSION PROOF AREA APPLICATIONS)	SQUARE A ENTERPRISES	
		BAJAJ ELECTRICALS LTD., HYD.	
		SAFEX FLAMEPROOF CONTROLS (P) LTD	
		PROMPT ENGINEERING WORKS, MUMBAI	

SL. NO.	ITEMS	MAKES	REMARKS
		FLAMEPROOF EQUIPMENTS PVT.LTD.	
		CROMPTON GREAVES	
		FCG FLAMEPROOF CONTROL GEARS	
13.	LT.MOTOR CONTROL CENTRES, POWER CONTROL CENTRES, A C & D C DISTRIBUTION BOARDS.	SCHNEIDER ELECTRIC INDIA	
		BCH ELECTRIC LTD.	
		LARSEN & TOUBRO LIMITED, HYD	
		C AND S ELECTRIC LIMITED	
		SPACEAGE SWITCHGEARS LIMITED	
		GE INDIA INDUSTRIAL PRIVATE LTD,	
		ABB LIMITED	
14.	UPS SYSTEM	EMERSON NETWORK POWER	
		HITACHI HI-REL POWER	
		KERALA STATE ELECTRONICS	
		EMERSON NETWORK POWER	
		GUTOR ELECTRONICS LTD., SWITZERLAN	
		CHLORIDE POWER PROTECTION	
15.	TELECOMMUNICATION SYSTEM (LSTB / PAGING / EPABX & PA SYSTEM)	LARAON ENGINEERS AND-	
		INDUSTRONIC INDUSTRIE-ELECTRONIC	
		FEDERAL SIGNAL CORPORATION,	
		BNA TECHNOLOGY CONSULTING LTD	
		ELIXIR ELECTRONICS	
16.	ELECTRICAL CONTOLS PANELS	ELECTRONICS CORPORATION OF INDIA LT	
		PANAM CONTROLS,	
		C AND S ELECTRIC LIMITED	
		INDUSTRIAL CONTROLS &	
		BHARAT HEAVY ELECTRICALS LTD	
		SHIBSHA INSTRUMENTS (I) PVT. LTD	
17.	ELECTRICAL CONTROL SYSTEM (ECS) / POWER MANAGEMENT / ENERGY MANAGEMENT SYSTEM	SCHNEIDER ELECTRIC INDIA	
		ALSTOM T&D INDIA LIMITED	
		ABB LIMITED, HYD	
		WESTING HOUSE ELECTRIC PVT.LTD.	
		BHARAT HEAVY ELECTRICALS	
		HONEYWELL PTE LTD., SINGAPORE	
		SIEMENS INDIA LIMITED	
		SCHWEITZER ENGINEERING	
18.	RUBBER MAT	SRIDHAR ENGINEERING AND RUBBER	
		THE RUBBER PRODUCTS LTD.	
		INDIAN RUBBER PRODUCTS	
		PREMIER POLYFILM LTD.	
19.	EARTHING AND LIGHTENING PROTECTION MATERIALS	PATNY SYSTEMS PVT. LTD	
		JAMNA METAL COMPANY	
		VINFAB ENGINEERS	
		PREMIER POWER PRODUCTS	
		INDIA ELECTRICALS SYNDICATE	
20.	FLEXIBLE WIRE FOR LIGHTING	THERMO CABLES LIMITED	
		RADIANT CABLES PVT. LTD HYD	
		TECHNO CABLES PVT. LTD.	
		UNIFLEX CABLES LTD.	
		FINOLEX CABLES LTD.	
21.	CURRENT LIMITING REACTOR	CROMPTON GREAVES LTD. SECBAD	

SL. NO.	ITEMS	MAKES	REMARKS
		SUDHIR INTRA VIDYUT LIMITED	
		SHRIHANS ELECTRICALS PVT LTD.	
		BHARAT BIJLEE LIMITED	
		M/S.PS ELECTRICALS PVT. LTD.	
22.	DC STARTER CUBICLES	BCH ELECTRIC LTD.	
		LARSEN & TOUBRO LIMITED, HYD	
		C AND S ELECTRIC LIMITED	
		INDUSTRIAL CONTROLS &	
23.	LOCAL CONTROL STATIONS (SAFE / HAZARDOUS AREA)	FLEXPRO ELECTRICALS PVT. LTD.,	
		PROMPT ENGINEERING WORKS, MUMBAI	
		FLAMEPROOF EQUIPMENTS PVT.LTD.	
		FCG FLAMEPROOF CONTROL GEARS	
24.	LT POWER CABLES	UNIVERSAL CABLES LTD	
		THERMO CABLES LIMITED	
		KEC INTERNATIONAL LIMITED	
		RADIANT CABLES PVT. LTD HYD	
		NICCO CORPORATION LTD HYD	
		POLYCAB INDUSTRIES PVT.LTD.	
		CORDS CABLE INDUSTRIES LTD.	
		KEI INDUSTRIES LIMITED	
		DELTON CABLES LIMITED NEW DELHI	
		SPECIAL CABLES PVT. LTD.	
		SRIRAM CABLES PVT. LTD.	
		TORRENT CABLES LTD	
		SUYOG ELECTRICALS LTD	
		UNIFLEX CABLES LTD.	
25.	CONTROL CABLES	RAVIN CABLES LTD	
		UNIVERSAL CABLES LTD	
		THERMO CABLES LIMITED	
		KEC INTERNATIONAL LIMITED	
		RADIANT CABLES PVT. LTD HYD	
		NICCO CORPORATION LTD HYD	
		POLYCAB INDUSTRIES PVT.LTD.	
		CORDS CABLE INDUSTRIES LTD.	
		KEI INDUSTRIES LIMITED	
		DELTON CABLES LIMITED NEW DELHI	
		SPECIAL CABLES PVT. LTD.	
		SRIRAM CABLES PVT. LTD.	
		SUYOG ELECTRICALS LTD	
		RAVIN CABLES LTD	
26.	HT POWER CABLES	UNIVERSAL CABLES LTD	
		KEC INTERNATIONAL LIMITED	
		RADIANT CABLES PVT. LTD HYD	
		NICCO CORPORATION LTD HYD	
		KEI INDUSTRIES LIMITED	
		SRIRAM CABLES PVT. LTD.	
		POLYCAB WIRES PVT.LTD	
		TORRENT CABLES LTD	
		UNIFLEX CABLES LTD.	
		RAVIN CABLES LTD	

SL. NO.	ITEMS	MAKES	REMARKS
27.	CABLE TRAYS	PATNY SYSTEMS PVT. LTD	
		JAMNA METAL COMPANY	
		PARMAR METALS PVT. LTD	
		METALEMMS BOMBAY PVT. LTD.	
		VINFAB ENGINEERS	
		PREMIER POWER PRODUCTS	
		INDIA ELECTRICALS SYNDICATE	
28.	JUNCTION BOXES FOR WEATHER PROOF AND EXPLOSION PROOF FOR LIGHTING AND OTHER APPLICATION	PANAM CONTROLS,	
		FLEXPRO ELECTRICALS PVT. LTD.,	
		PROMPT ENGINEERING WORKS, MUMBAI	
		FLAMEPROOF EQUIPMENTS PVT.LTD.	
		FCG FLAMEPROOF CONTROL GEARS	
		ELECTROMAC INDUSTRIES	
29.	CABLE GLANDS (WEATHER PROOF/EX.PROOF)	UNITED AGRO ENGINEERING PVT. LTD.	
		FLEXPRO ELECTRICALS PVT. LTD.,	
		FCG POWER INDUSTRIES.,	
		PROMPT ENGINEERING WORKS, MUMBAI	
		FLAMEPROOF EQUIPMENTS PVT.LTD.	
		FCG FLAMEPROOF CONTROL GEARS	
		ELECTROMAC INDUSTRIES	
30.	SIGNAL CABLE, THERMOCOUPLE, EXTN. COMP. CABLES	THERMO CABLES LIMITED	
		RADIANT CABLES PVT. LTD HYD	
		CORDS CABLE INDUSTRIES LTD.	
		KEI INDUSTRIES LIMITED	
		DELTON CABLES LIMITED NEW DELHI	
		PARAMOUNT COMMUNICATIONS LTD	
		SPECIAL CABLES PVT. LTD.	
		SUYOG ELECTRICALS LTD	
31.	JBS FOR LIGHTING (EXPLOSION PROOF)	SAFEX FLAMEPROOF CONTROLS (P) LTD	
		FLAMEPROOF EQUIPMENTS PVT.LTD.	
		FCG FLAMEPROOF CONTROL GEARS	
32.	AC VARIABLE SPEED DRIVES	SCHNEIDER ELECTRIC INDIA	
		ALSTOM T&D INDIA LIMITED	
		LARSEN & TOUBRO LIMITED, HYD	
		HITACHI HI-REL POWER	
		BHARAT HEAVY ELECTRICALSLTD.	
		SIEMENS INDIA LIMITED	
		ROCKWELL AUTOMATION INDIA LTD.,	
33.	LIGHTING TRS. DRY TYPE (AIR NATURAL) UP TO 150 KVA	SOUTH EASTERN EQUIPMENT CO.	
		SUDHIR INTRA VIDYUT LIMITED	
		CHHABI ELECTRICALS P LTD.	
		AUTOMATIC ELECTRIC LTD.	
		RAYCHEM RPG LIMITED.,	
		M/S.PS ELECTRICALS PVT. LTD.	
34.	LIGHTING PANELS HAZARDOUS AREA	SAFEX FLAMEPROOF CONTROLS (P) LTD	
		FLAMEPROOF EQUIPMENTS PVT.LTD.	
		FCG FLAMEPROOF CONTROL GEARS	
35.	ELECTRICAL RELAY PANELS	ALSTOM T&D INDIA LIMITED	

SL. NO.	ITEMS	MAKES	REMARKS
		ABB LIMITED, HYD	
		EASUN REY ROLLE LTD.	
36.	ELECTRIC ACTUATORS	LIMITORQUE INDIA LTD,	
		AUMA (INDIA) LTD;	
		ROTORK CONTROLS INDIA LTD.	
37.	L.T MOTORS (FLAME PROOF)	ALSTOM T&D INDIA LIMITED	
		KIRLOSKAR ELEC.CO.LTD	
		ABG MOTORS LIMITED	
		BHARAT BIJLEE LTD, MUMBAI	
		CROMPTON GREAVES	
38.	ILLUMINATION ITEMS PACKAGE	SQUARE A ENTERPRISES	
		BAJAJ ELECTRICALS LTD., HYD.	
		SPACEAGE SWITCHGEARS LIMITED	
		CROMPTON GREAVES	
		WIPRO LIMITED	
39.	FIRE PROOF SEALING SYSTEM FOR CABLE PENETRATIONS & FIRE BREAK COATING FOR ELECTRICAL CABLES	LLOYD INSULATIONS (INDIA) LTD.,	
		MULTI KILFIRE PVT. LTD	
		VIJAY SYSTEMS ENGINEERS PVT. LTD.	
		AGP PASSIVE FIRE SAFETY (P) LTD	
40.	FRP CABLE TRAYS AND ACCESSORIES	PATNY SYSTEMS PVT. LTD	
		SUMIP COMPOSITES PVT. LTD.	
		GENERAL COMPOSITES PVT. LTD.	
		ERCON COMPOSITES	
41.	CLOSED CIRCUIT TV (CCTV)	ELECTRONICS CORPORATION OF INDIA LT	
42.	OPTICAL FIBRE CABLES & ACCESSORIES	UNIFLEX CABLES LTD.	
		RPG CABLES LIMITED,	
		FINOLEX CABLES LTD.	
		BIRLA ELRICSSON OPTICAL LTD.	
		OPTEL COMMUNICATIONS LTD.	
43.	FIELD BUS CABLES	LAPP INDIA PVT. LTD.	
		UL ELECTRODEVICES PVT. LTD.	
44.	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	WALCHANDNAGAR INDUSTRIES LIMITED	
		BAUMER TECHNOLOGIES	
		HIRLEKAR PRECISION ENGG. PVT. LTD.	
		SAMSON CONTROLS PVT LTD.,	
		SWITZER INSTRUMENT LTD.,	
		GENERAL INSTRUMENTS CONSORTIUM	
		A.N. INSTRUMENTS PVT. LTD.,	
45.	FLOW ORIFICES	MICRO PRECISION PRODUCTS (P) LTD.	
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT	
		GENERAL INSTRUMENTS CONSORTIUM	
		ASIAN INDUSTRIAL VALVES AND	
46.	FLOW SWITCHES	V AUTOMAT AND INSTRUMENTS PVT LTD	
		SWITZER INSTRUMENT LTD.,	
		LEVCON INSTRUMENTS(P) LTD	
		D.K.INSTRUMENTS (P) LTD.,	
47.	JUNCTION BOXES (WEATHER PROOF)	PANAM CONTROLS,	
		FLEXPRO ELECTRICALS PVT. LTD.,	
		FLAMEPROOF EQUIPMENTS PVT.LTD.	

SL. NO.	ITEMS	MAKES	REMARKS
		FCG FLAMEPROOF CONTROL GEARS	
48.	JUNCTION BOXES (EXPLOSION PROOF)	FLEXPOR ELECTRICALS PVT. LTD.,	
		SAFEX FLAMEPROOF CONTROLS (P) LTD	
		FLAMEPROOF EQUIPMENTS PVT.LTD.	
		FCG FLAMEPROOF CONTROL GEARS	
49.	LEVEL GUAGES (MAGNETIC TYPE)	V AUTOMAT AND INSTRUMENTS PVT LTD	
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT	
		J.N.MARSHALL LTD	
		D.K.INSTRUMENTS (P) LTD.,	
50.	LIQUID LEVEL FLOAT SWITCH	MAGNETROL INTERNATIONAL, INC.	
		V AUTOMAT AND INSTRUMENTS PVT LTD	
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT	
		CHEMTROLS INDUSTRIES LTD.,	
		PUNE TECHTROL PVT LTD	
		LEVCON INSTRUMENTS(P) LTD	
		D.K.INSTRUMENTS (P) LTD.,	
51.	LIQUID LEVEL GAUGES	V AUTOMAT AND INSTRUMENTS PVT LTD	
		BLISS ANAND PVT. LTD.,	
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT	
		TECNOMATIC (INDIA) PRIVATE LIMITED,	
		PRATOLINA INSTRUMENTS PVT.LTD.	
		CHEMTROLS INDUSTRIES LTD.,	
		PUNE TECHTROL PVT LTD	
		LEVCON INSTRUMENTS(P) LTD	
52.	LEVEL TRANSMITTER (ELECTRONIC - SMART)	D.K.INSTRUMENTS (P) LTD.,	
		V AUTOMAT AND INSTRUMENTS PVT LTD	
		CHEMTROLS INDUSTRIES LTD.,	
53.	PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES	DRESSER VALVE INDIA PVT.LTD.	
		INDFOS INDUSTRIES LIMITED,	
		BAUMER TECHNOLOGIES	
		HIRLEKAR PRECISION ENGG. PVT. LTD.	
		KAUSTUBHA UDYOG	
		SWITZER INSTRUMENT LTD.,	
54.	PROGRAMMABLE LOGIC CONTROLLERS (PLC - TRIPLE MODULAR REDUNDANT)	TRAFAG CONTROLS INDIA PVT. LTD.	
		FANUC INDIA LIMITED	
		TRICONEX SINGAPORE PTE LTD.,	
		AUGUST SYSTEMS LTD.	
55.	PRESSURE GAUGES	INDUSTRIAL CONTROL SERVICES	
		FORBES MARSHALL (HYD) PVT LIMITED,	
		H.GURU INSTRUMENTS(S.I)PVT.LTD	
		WALCHANDNAGAR INDUSTRIES LIMITED	
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT	
		BAUMER TECHNOLOGIES	
		GENERAL INSTRUMENTS CONSORTIUM	
		A.N. INSTRUMENTS PVT. LTD.,	
56.	PROGRAMMABLE LOGIC CONTROLLERS (PLC - SIMPLEX / DUAL REDUNDANT)	PROTECH CONTROL INSTRUMENTS	
		SCHNEIDER ELECTRIC INDIA	
		SIEMENS INDIA LTD SECBAD.	
		FANUC INDIA LIMITED	

SL. NO.	ITEMS	MAKES	REMARKS
		HONEYWELL AUTOMATION INDIA LIMITED	
		ROCKWELL AUTOMATION INDIA LTD.,	
57.	PR. & DIFF. PR. TRANSMITTERS (ELECTRONIC - SMART)	EMERSON PROCESS MGT (I) PVT LTD	
		ABB LIMITED, HYD	
		YOKOGAWA INDIA LIMITED	
		ENDRESS + HAUSER (INDIA) PVT. LTD.,	
		HONEYWELL AUTOMATION INDIA LIMITED	
58.	SAFETY RELIEF VALVES (NOT COVERED IN BHEL (T) RANGE)	FORBES MARSHALL LTD.,	
		TYCO SANMAR LIMITED.	
59.	SAFETY RELIEF VALVES	BHARAT HEAVY ELECTRICALS LTD	
60.	THERMOMETERS	FORBES MARSHALL (HYD) PVT LIMITED,	
		GOA INSTRUMENTS INDUSTRIES	
		H.GURU INSTRUMENTS(S.I)PVT.LTD	
		WALCHANDNAGAR INDUSTRIES LIMITED	
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT	
		BAUMER TECHNOLOGIES	
		GENERAL INSTRUMENTS CONSORTIUM	
		A.N. INSTRUMENTS PVT. LTD.,	
		PROTECH CONTROL INSTRUMENTS	
61.	THERMOWELLS	VALUE TREK ENGINEERS,	
		CARLO DYNATECH INDUSTRIES,	
		GOA INSTRUMENTS INDUSTRIES	
		MICRO PRECISION PRODUCTS (P) LTD.	
		H.GURU INSTRUMENTS(S.I)PVT.LTD	
		WALCHANDNAGAR INDUSTRIES LIMITED	
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT	
		BAUMER TECHNOLOGIES	
		PRECISION ENGINEERING INDS.,	
		TEMPSENS INSTRUMENTS (I) PVT.LTD.	
		GENERAL INSTRUMENTS CONSORTIUM	
		PROTECH CONTROL INSTRUMENTS	
62.	TEMPERATURE TRANSMITTER	EMERSON PROCESS MGT (I) PVT LTD	
		ABB LIMITED, HYD	
		YOKOGAWA INDIA LIMITED	
		HONEYWELL AUTOMATION INDIA LIMITED	
63.	INSTRUMENT HOOK UP MATERIAL PACKAGE	S.S.PIPE FITTINGS & FORGINGS	
		KWALITY FORGED FITTINGS	
		UNIQUE ENGINEERING ENTPS. P. LTD.	
		PRESHZINGER ENGINEERING	
		FLASH FORGE PVT LTD	
		VALUE TREK ENGINEERS,	
		CARLO DYNATECH INDUSTRIES,	
		U I PIPE FITTINGS PVT. LTD.	
		TRUE FORGE PVT.LTD.,	
		TRUE FAB ENGINEER (P) LTD.	
		P.K. TUBES & FITTINGS PVT. LTD.	
		PANAM ENGINEERS PVT. LTD.	
		PRECISION ENGINEERING INDS.,	
64.	FIELD INSTRUMENTATION PACKAGE	EMERSON PROCESS MGT (I) PVT LTD	

SL. NO.	ITEMS	MAKES	REMARKS
		ABB LIMITED, HYD	
		YOKOGAWA INDIA LIMITED	
		ENDRESS + HAUSER (INDIA) PVT. LTD.,	
		HONEYWELL AUTOMATION INDIA LIMITED	
65.	ATMOSPHERIC FIXED/FLOATING ROOF STORAGE TANKS FOR LIQUID FUELS AND DM WATER, CAPACITY OF 1000M3 AND ABOVE	THERMOSYSTEMS PRIVATE LIMITED.	
		RUKSAN ENGINEERS PVT.LTD.	
		TECHNOFAB ENGINEERING LIMITED	
		INDIA TUBE MILLS & METAL INDS LTD	
		BRIDGE AND ROOF CO.(INDIA)LTD	
66.	RAW WATER, CONDENSOR /AUXILLARY COOLING WATER PUMPS (HORIZONTAL)	KIRLOSKAR BROTHERS LTD,	
		KSB PUMPS LIMITED,	
		SULZER PUMPS INDIA LTD.,	
		MATHER & PLATT PUMPS LTD.	
		JYOTHI LIMITED.	
		FLOWMORE LIMITED	
		BHARAT PUMPS & COMPRESSORS LTD.	
67.	HORIZONTAL CENTRIFUGAL PUMPS, (NON API) FOR DM WATER, CONDENSATE, SERVICE WATER, POTABLE WATER, COOLING WATER ETC.	GRUNDFOS PUMPS INDIA PVT. LTD.	
		KIRLOSKAR BROTHERS LTD,	
		KSB PUMPS LIMITED,	
		SULZER PUMPS INDIA LTD.,	
		MATHER & PLATT PUMPS LTD.	
		FLOWMORE LIMITED	
		KISHOR PUMPS PRIVATE LTD	
68.	HORIZONTAL CENTRIFUGAL PUMPS (API)- FOR DM WATER, CONDENSATE, SREVICE WATER, POTABLE WATER, COOLING WATER ETC	KSB PUMPS LIMITED,	
		SULZER PUMPS INDIA LTD.,	
		KIRLOSKAR EBARA PUMPS LIMITED,	
		FLOWSERVE INDIA CONTROLS	
		BHARAT PUMPS & COMPRESSORS LTD.	
69.	FIRE PROTECTION, FIRE DETECTION AND ALARAM SYSTEM PACKAGE	THERMOSYSTEMS PRIVATE LIMITED.	
		FIREPRO SYSTEMS PVT. LTD.	
		TYCO FIRE & SECURITY INDIA	
		NEW FIRE ENGRS. PVT. LTD.	
		UTC FIRE & SECURITY INDIA LIMITED.	
		AGNICE FIRE PROTECTION LTD	
		DE S TECHNICO PRIVATE LIMITED	
70.	SURGE/PRESSURE VESSELS	EXCEL INDUSTRIES,	
		RUKSAN ENGINEERS PVT.LTD.	
		INDCON PROJECTS & EQUIPMENT - P S A NITROGEN LIMITED.	
		INOX AIR PRODUCTS LIMITED.	
		FABTECH PROJECTS & ENGINEERS	
		RAVI INDUSTRIES	
71.	SILENCERS	INDIRA INDUSTRIES	
		BHARAT HEAVY ELECTRICALS LTD	
		ACOUSTICS INDIA PVT LTD.,	
		P.R. ACOUSTICAL AND ENGG WORKS P LT	

SL. NO.	ITEMS	MAKES	REMARKS
72.	FLOOR GRATINGS	PERFECT ENGINEERING WORKS,	
		GEI GODAVARI ENGINEERING LTD.	
		EXCEL INDUSTRIES,	
		ASTRO ENGG. PVT. LIMITED	
		INDIANA ENGINEERING WORKS	
		PMS GRATE FLOORINGS PVT.LTD.	
73.	ACCUMULATORS	EPE PROCESS FILTERS &	
		PARKER HANNIFIN INDIA PVT.LTD.	
		HYDAC (INDIA) PVT. LTD.,	
		FAWCETT CHRISTIE-	
74.	GASKETS	JYOTHI INDUSTRIES ,	
		STARFLEX SEALING INDIA	
		JAMES WALKER INMARCO	
		SPENTA GASKETS & SEAL	
		UNIQUE INDUSTRIAL PACKINGS	
		I G P ENGINEERS LIMITED,	
		MADRAS INDUSTRIAL PRODUCTS,	
		PACKINGS & JOINTINGS GASKETS	
		SPIRASEAL GASKETS PVT.LTD.	
75.	FLANGES	PRESHZINGER ENGINEERING	
		THE PUNJAB STEEL WORKS,	
		J.K.FORGINGS,	
		METAL FORGINGS P. LTD.	
		TUBE PRODUCTS INCORPORATE,	
		CHW FORGE PRIVATE LIMITED	
		KISAAN STEELS (PVT) LTD.,	
76.	HANGER AND SUPPORT PACKAGE FOR MULTIPLE UNITS STG & GTG PROJECTS	SARATHI ENGINEERING	
		BHARAT HEAVY ELECTRICALS	
		PIPE HANGERS & SUPPORTS PVT LTD	
		PIPE SUPPORTS ASIA LIMITED	
		SPRING SUPPORTS	
77.	FLEXI GLASS RINGS	PRECISE ENGINEERING PLASTICS,	
		PETER KUMPEL & SOHN	
78.	METTALIC BELLOWS	ATHULYA BELLOWS & ENGINEERING	
		THE ANUP ENGINEERING LTD.	
		FLEXICAN BELLOWS&HOSES PVT.LTD	
		B D ENGINEERS	
		LONESTAR INDUSTRIES,	
		FLUIDYNE ENGINEERS(I) LTD	
		MADRAS HUDRAULIC HOSE (P.) LTD	
		MB METALLIC BELLOWS PVT. LTD.	
		SUR INDUSTRIES PRIVATE LIMITED	
79.	RUBBER EXPANSION JOINTS	SIMPLEX RUBBER PRODUCTS PVT. LTD.	
		CORI ENGINEERS PRIVATE LTD.	
		D.WREN INDUSTRIES PVT LTD.	
80.	BALL VALVES (CS.SS)	BOTELI VALVE GROUP COMPANY LTD.	
		FLOW CHEM INDUSTRIES,	
		AKAY INDUSTRIES PVT LTD	
		MICRO FINISH VALVES PVT.LTD.,	

SL. NO.	ITEMS	MAKES	REMARKS
		WEIR BDK VALVES	
		MICON VALVES (I) PVT. LTD.	
		LEADER VALVES LIMITED	
		ASIAN INDUSTRIAL VALVES AND	
		UNIFLOW	
81.	Y- TYPE STRAINER- (OPEN LOOP & CIRCULATING CW SYSTEMS)	SCIENTIFIC DEVICES (BOMBAY) PVT. LT	
		JAY-EESH ENGINEERING COMPANY	
		SKILT FABRICATORS PVT.LTD,	
		SPIRAX MARSHALL LIMITED	
		NISAN SCIENTIFIC PROCESS	
		ASIAN INDUSTRIAL VALVES AND	
		SUNGOV ENGINEERING PVT LTD,	
82.	SLUICE GATE VALVE	DURGA ENGINEERING COMPANY	
		JASH ENGINEERING (PVT)LIMITED.	
		BHARATMATA ENGINEERING WORKS	
		JUPITER ENGINEERING CO	
		KAMALA VALVES & ENGINEERING	
83.	AIR RELEASE VALVE	DURGA ENGINEERING COMPANY	
		BHARATMATA ENGINEERING WORKS	
		JUPITER ENGINEERING CO	
		KAMALA VALVES & ENGINEERING	
84.	VALVES- GATE/GLOBE/REG.GLOBE/NON- RETURN; PR.CL.:#150 & #300; MAT.CS/AS/SS; FL/BW ENDS-FOR SIZES-2" & ABOVE & SW ENDS:#800 CLASS	FOURESS ENGINEERING (I)PVT.LTD	
		FLOSTEER ENGINEERS PVT. LTD.,	
		WEIR BDK VALVES	
		NSSL LIMITED	
		MICON VALVES (I) PVT. LTD.	
		NITON VALVE INDUSTRIES LTD	
		SKILT FABRICATORS PVT.LTD,	
		LEADER VALVES LIMITED	
		K.S.B PUMPS LTD.	
		BHARAT HEAVY ELECTRICALS LTD	
85.	VALVES- GATE/GLOBE/REG.GLOBE/NON- RETURN; PR.CL.:#600; MAT.CS/AS/SS;FL/BW ENDS-FOR ALL SIZES-2" & ABOVE	FOURESS ENGINEERING (I)PVT.LTD	
		WEIR BDK VALVES	
		NSSL LIMITED	
		MICON VALVES (I) PVT. LTD.	
		NITON VALVE INDUSTRIES LTD	
		SKILT FABRICATORS PVT.LTD,	
		LEADER VALVES LIMITED	
		K.S.B PUMPS LTD.	
		BHARAT HEAVY ELECTRICALS LTD	
86.	VALVES- GATE/GLOBE/REG.GLOBE/NON- RETURN; PR.CL.:#900; MAT.CS/AS/SS, FL/BW ENDS-FOR ALL SIZES-2" & ABOVE	FOURESS ENGINEERING (I)PVT.LTD	
		WEIR BDK VALVES	
		NSSL LIMITED	
		MICON VALVES (I) PVT. LTD.	
		NITON VALVE INDUSTRIES LTD	
		LEADER VALVES LIMITED	

SL. NO.	ITEMS	MAKES	REMARKS
87.	VALVES- GATE/GLOBE/REG.GLOBE/NON- RETURN; PR.CL.:#1500; MAT.CS/AS/SS, SW ENDS-FOR SIZES 1/2" TO 1-1/2"; FL ENDS - FOR SIZES 2-1/2"	K.S.B PUMPS LTD.	
		BHARAT HEAVY ELECTRICALS LTD	
		FOURESS ENGINEERING (I)PVT.LTD	
		WEIR BDK VALVES	
		NSSL LIMITED	
		MICON VALVES (I) PVT. LTD.	
		NITON VALVE INDUSTRIES LTD	
		LEADER VALVES LIMITED	
		K.S.B PUMPS LTD.	
88.	VALVES- GATE/GLOBE/REG.GLOBE/NON- RETURN; PR.CL.:#2500;MAT.CS/AS/SS;SW ENDS - FOR SIZES 1/2" TO 1-1/2"; FL. ENDS- FOR SIZES 2-1/2"	BHARAT HEAVY ELECTRICALS LTD	
		FOURESS ENGINEERING (I)PVT.LTD	
		WEIR BDK VALVES	
		NSSL LIMITED	
		MICON VALVES (I) PVT. LTD.	
		NITON VALVE INDUSTRIES LTD	
		LEADER VALVES LIMITED	
		K.S.B PUMPS LTD.	
		BHARAT HEAVY ELECTRICALS LTD	
89.	VALVE-BUTTERFLY; ;S-#150-WITH SOFT SEAT- FLANGED/WAFER TYPE- FOR ALL SIZES	DURGA ENGINEERING COMPANY	
		BOTELI VALVE GROUP COMPANY LTD.	
		INSTRUMENTATION LTD	
		FOURESS ENGINEERS (INDIA)	
		WEIR BDK VALVES	
		UNIQUE VALVES LIMITED,	
		INTER VALVE (INDIA) PVT.LTD.	
		LEADER VALVES LIMITED	
		GALAXY CONTROLS PVT LTD.,	
		ADVANCE VALVES PVT.LTD.	
		KAMALA VALVES & ENGINEERING	
90.	PIPE FITTINGS	FLASH FORGE PVT LTD	
		U I PIPE FITTINGS PVT. LTD.	
		TUBE PRODUCTS INCORPORATE,	
		GUJARAT INFRAPIPES PVT.LTD.,	
		SAWAN ENGINEERS PVT. LTD.	
		TOPAZ PIPING INDUSTRIES	
		TRUE FORGE PVT.LTD.,	
		DEE DEVELOPMENT ENGINEERS LTD.,	
		TRUE FAB ENGINEER (P) LTD.	
		P.K. TUBES & FITTINGS PVT. LTD.	
		K. S. PIPE FITTINGS PVT. LTD.	
		TUBE TURN (INDIA) P. LTD.	
91.	BOLTING MATERIAL	JAI FASTENERS (P) LIMITED	
		ATLAS FASTENERS	
		RATNESH METAL INDUSTRIES	
		BOLTMASTER (INDIA)PVT.LTD.	

SL. NO.	ITEMS	MAKES	REMARKS
		PRESIDENT ENGINEERING WORKS	
		MEGA ENGINEERING PVT. LTD.	
		PIONEER NUTS AND BOLTS PVT.LTD	
		MORNING STAR INDUSTRIES,	
		UDEHRA FASTENERS LIMITED	
		SREE PAVITHRA INDUSTRIES,	
92.	PASSENGER ELEVATOR	CITY LIFTS (INDIA) LTD.	
		OTIS ELEVATOR CO.(INDIA) LTD.	
93.	FIRE PROTECTION SYSTEM FOR TRANSFORMER AND ELECTRICAL EQUIPMENT	THERMOSYSTEMS PRIVATE LIMITED.	
		FIREPRO SYSTEMS PVT. LTD.	
		TYCO FIRE & SECURITY INDIA	
		NEW FIRE ENGRS. PVT. LTD.	
		UTC FIRE & SECURITY INDIA LIMITED.	
		AGNICE FIRE PROTECTION LTD	
		SAFETY CONTROLS & DEVICES	
		DE S TECHNICO PRIVATE LIMITED	
94.	SPRING HANGER	SARATHI ENGINEERING	
		BHARAT HEAVY ELECTRICALS	
		PIPE HANGERS & SUPPORTS PVT LTD	
		SPRING SUPPORTS	
95.	HOSE RUBBER (STEAM/GAS/AIR/WATER/CHEMICAL)	DEWAS HYDROQUIP PVT LTD	
		GAYTRI INDUSTRIAL CORPORATION	
		PIX TRANSMISSIONS LIMITED	
		SONI RUBBER PRODUCTS LTD	
		SRIDHAR ENGG. & RUBER PRODUCTS PVT LTD.	INDIA/USA
		SWAGELOK CO.	INDIA / USA
96.	HOSE METALLIC FLEXIBLE SS	AEROFLEX INDUSTRIES PVT LTD	
		BENGAL INDUSTRIES PVT LTD	
		DEWAS HYDROQUIP PVT LTD	
		GAYTRI INDUSTRIAL CORPORATION	
		INSAP FLEXIBLES & ENGINEERS PVT. LTD.	
		SENIOR PRIVATE LIMITED	
		SWAGELOK CO.	INDIA / USA
97.	FASTNERS	AEP COMPANY	
		BEA SRL	ITALY
		BOLTMASTER PVT LTD	
		DEEPAK FASTENERS LIMITED	
		FASTENERS & ALLIED PRODUCTS PVT LTD.	
		FIX FIT FASTENERS MFG. PVT.LTD.	
		HARDWIN FASTENERS PVT LTD.	
		INDUSTRIAL ENGINEERING CORPORATION	
		J.J.INDUSTRIES	
		KUNDAN INDUSTRIES LTD.	
		MEGA ENGINEERING PVT. LTD.	
		MULTI FASTENERS PVT LTD	
		MULTI THREAD FASTENERS	
		NEXO INDUSTRIES	
		OME METALLURGICA ERBESE S.r.l.	ITALY

SL. NO.	ITEMS	MAKES	REMARKS
		PACIFIC FORGING & FASTENERS PVT LTD	
		PIONEER NUTS & BOLTS PVT LTD	
		PRECISION AUTO ENGINEERS	
		PRECISION ENGG. INDUSTRIES	
		PRESIDENT ENGINEERING WORKS	
		SANDEEP ENGINEERING WORKS	
		SYNDICATE ENGINEERING INDUSTRIES	
		UDEHRA FASTNERS LTD	
98.	PIPES	A.S.T. PIPES PVT. LTD.(AST GROUP)	
		ADVANCE STEEL TUBE LTD.	
		ASIAN MILLS PVT LTD	
		ASRANI TUBES LIMITED	
		BIHAR TUBES LIMITED	
		DADU PIPES (P) LTD	
		GAURANG PRODUCTS PVT LTD (AST GROUP)	
		GOODLUCK STEEL TUBES LTD	
		HAZIRA PIPE MILL LTD	
		HI-TECH PIPES LIMITED	
		INDUS TUBE LIMITED	
		JINDAL INDUSTRIES LTD	
		JINDAL PIPES LTD	
		JINDAL SAW LTD (KOSI WORKS)	
		JOTINDRA STEEL & TUBES LTD	
		LALIT PIPES AND PIPES LTD.	
		LLOYDS METALS & ENGINEERS LTD	
		MAHARASHTRA SEAMLESS LTD	
		MAN INDUSTRIES (I) LTD	
		MUKAT PIPES LTD	
		MUKAT TANKS & VESSELS LTD	
		NEZONE TUBES LIMITED	
		NORTH EASTERN TUBES LIMITED	
		PRATIBHA INDUSTRIES LIMITED	
		PRATIBHA PIPES & STRUCTURAL LTD	
		PSL LIMITED (NANI CHIRAI)	
		PSL LIMITED- (CHENNAI)	
		RAMA STEEL TUBES LTD.	
		RATNAMANI METALS AND TUBES LTD	
		RAVINDRA TUBES LIMITED	
		SAMSHI PIPE INDUSTRIES LIMITED	
		SRI SARBATI STEEL TUBES LTD	
		STEEL AUTHORITY OF LTD	
		SURINDRA ENGINEERING CO LTD	
		SURINDRA ENGINEERING CO LTD	
		SURINDRA ENGINEERING CO LTD	
		SURYA ROSHNI LTD	
		SWASTIK PIPES LTD	
		THE TATA IRON & STEEL CO LTD	
		UTKARSH TUBES & PIPES LTD (FORMLY. BMW)	
		WELSPUN GUJARAT STAHL ROHREN LTD	

SL. NO.	ITEMS	MAKES	REMARKS
		ZENITH BIRLA () LIMITED	
99.	PIPE-CARBON STEEL(WELDED)TO ASTM STDS	JINDAL SAW LTD (KOSI WORKS)	
		LALIT PIPES AND PIPES LTD	
		MAN INDUSTRIES (I) LTD	
		MUKAT PIPES LTD	
		MUKAT TANKS & VESSELS LTD	
		RATNAMANI METALS AND TUBES LTD	
		RATNAMANI METALS AND TUBES LTD	
		SURINDRA ENGINEERING CO LTD	
100.	CABLES – FIRE ALARM AND COMMN.	CMI LIMITED	
		CORDS CABLE INDUSTRIES LTD	
		DELTON CABLES LIMITED	
		ELKAY TELELINKS LTD.	
		K E I INDUSTRIES LIMITED	
101.	PUSH BUTTONS & INDICATING LAMPS	BCH ELECTRIC LTD	
		C & S ELECTRIC LTD	
		ESSEN DEINKI	
		HOTLINE SWITCHGEAR & CONTROLS	
		LARSEN & TOUBRO LTD	
		PRECIFINE PRODUCTS PVT. LTD.	
		SCHNEIDER ELECTRIC PVT LTD	
		SHRI TULSI SWITCHGEARS PVT LTD	
		SIEMENS LIMITED	
		TEKNIC CONTROLS	
102.	MCBs	DATAR SWITCHGEAR PVT LTD.	
		HAVELL'S LTD	
		NA CURRENT CONTROL LTD	
		INDO ASIAN FUSEGEAR LTD	
		LEGRAND () PVT. LTD	
		SCHNEIDER ELECTRIC PVT LTD	
		STANDARD ELECTRICALS LTD	
103.	SOLENOID VALVES	ALCON ALEXANDER CONTROLS LIMITED	UK
		ASCO () LIMITED	
		ASCO JOUCOMATIC LTD	INDIA / UK
		ASCO JOUCOMATIC SA	FRANCE
		AVCON CONTROLS PVT. LTD.	
		HERION WERKE	GERMANY
		PRECISION INSTRUMENT COMPANY	
		ROTEX AUTOMATION LTD.	
		SCHRADER DUNCAN LIMITED	
		THOMPSON VALVES LTD	UK
		VERSA BV	NETHERLANDS
104.	FIRE EXTINGUISHERS (PORTABLE)	BHARAT ENGG. WORKS	
		BRIJBASI HI-TECH UDYOG	
		GUNNEBO LIMITED	
		KANADIA FYR FYTER PVT. LTD.	
		MINIMAX GmbH & Co.KG	
		NITIN FIRE PROTECTION INDUSTRIES LTD	
		SAFEX FIRE SERVICES LTD.	
		SUPREMEX EQUIPMENTS	

SL. NO.	ITEMS	MAKES	REMARKS
		VIMAL FIRE CONTROLS PVT LTD	
		ZENITH FIRE SERVICES () PVT. LTD	
105.	FOAM MONITOR	AKRON BRASS COMPANY	
		BRIJBASI HI-TECH UDYOG	
		FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	
		SHAH BHOGILAL JETHALAL & BROTHERS	
106.	FOAM NOZZLE	AKRON BRASS COMPANY	
		BRIJBASI HI-TECH UDYOG	
		SHAH BHOGILAL JETHALAL & BROTHERS	
		ZENITH FIRE SERVICES (INDIA) PVT. LTD	
107.	WATER MONITOR	AKRON BRASS COMPANY	
		BRIJBASI HI-TECH UDYOG	
		FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	
		GUNNEBO INDIA LIMITED	
		HD FIREPROTECT PVT. LTD	
		MINIMAX GmbH & Co.KG	
		NEW AGE INDUSTRIES	
		SHAH BHOGILAL JETHALAL & BROTHERS	
		SUPREMEX EQUIPMENTS	
		VIMAL FIRE CONTROLS PVT LTD	
108.	WATER CUM FOAM MONITOR	AKRON BRASS COMPANY	
		FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	
		NEW AGE INDUSTRIES	
		VIMAL FIRE CONTROLS PVT LTD	
109.	HV/MV SPRAY SYSTEMS	NEW FIRE ENGINEERS (P) LTD	
110.	FIRE HOSE ACCESSORIES	ASCO STRUMECH PVT.LTD.	
		BRIJBASI HI-TECH UDYOG	
		GUNNEBO INDIA LIMITED	
		SHAH BHOGILAL JETHALAL & BROTHERS	
		VIMAL FIRE CONTROLS PVT LTD	
111.	SPRAY NOZZLE - FIRE FIGHTING	AKRON BRASS COMPANY	
		ELKHART BRASS MANUFACTURING INC.	
		FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	
		FLOW CONTROL TECHNOLOGIES	
		HD FIREPROTECT PVT. LTD.	
		KIDDE INDIA LTD (FMLY VIJAY FIRE-IND)	
		SPRAYING SYSTEMS CO.	
		STRAHMAN VALVES INC	
112.	LONG RANGE MONITOR	AKRON BRASS COMPANY	
		VIMAL FIRE CONTROLS PVT LTD	
		VISHAL FIRE PROTECTION EQUIPMENT	
113.	HOSE DELIVERY	CHHATARYA RUBBER & CHEMICAL INDUSTRIES	
		DEWAS HYDROQUIP PVT LTD	
		NITIN FIRE PROTECTION INDUSTRIES LTD	
114.	WATER SPRINKLER	HD FIREPROTECT PVT. LTD.	
		MATHER & PLATT PUMPS LTD.	
		MINIMAX GmbH & Co.KG	
		TYCO FIRE & SECURITY INDIA PVT. LTD	
115.	BRANCH PIPES	BRIJBASI HI-TECH UDYOG	

SL. NO.	ITEMS	MAKES	REMARKS
		GUNNEBO INDIA LIMITED	
		NITIN FIRE PROTECTION INDUSTRIES LTD	
		SHAH BHOGILAL JETHALAL & BROTHERS	
		SUPREMEX EQUIP	
		VIMAL FIRE CONTROLS PVT LTD	
		ZENITH FIRE SERVICES (INDIA) PVT. LTD.	
116.	SELF OSCILLATING FIRE MONITOR	VIMAL FIRE CONTROLS PVT LTD	
		VISHAL FIRE PROTECTION EQUIPMENT INDIA	
117.	HOSE DELIVERY	CHHATARYA RUBBER & CHEMICAL INDUSTRIES	
		DEWAS HYDROQUIP PVT LTD	
		NITIN FIRE PROTECTION INDUSTRIES LTD	
118.	WATER SPRINKLER	HD FIREPROTECT PVT. LTD.	
		MATHER & PLATT PUMPS LTD.	
		MINIMAX GmbH & Co.KG	GERMANY
		TYCO FIRE & SECURITY INDIA PVT. LTD	
119.	BRANCH PIPES	BRIJBASI HI-TECH UDYOG	
		GUNNEBO INDIA LIMITED	
		NITIN FIRE PROTECTION INDUSTRIES LTD	
		SHAH BHOGILAL JETHALAL & BROTHERS	
		SUPREMEX EQUIP	
		VIMAL FIRE CONTROLS PVT LTD	
		ZENITH FIRE SERVICES (INDIA) PVT. LTD.	
120.	SELF OSCILLATING FIRE MONITOR	VIMAL FIRE CONTROLS PVT LTD	
121.	LONG RANGE MONITOR	AKRON BRASS COMPANY	USA
		VIMAL FIRE CONTROLS PVT LTD	
122.	SYNTHETIC ENAMEL PAINT	ASIAN PAINT/BERGER OR EQUIVALENT	
123.	A3 LASER JET PRINTER	HP	
124.	SOFTWARE AND HARDWARE FOR THE SCADA SYSTEM	CIMCON SOFTWARE (INDIA) PVT. LTD. (AHMADABAD)	
		RAYCHEM RPG LTD., MUMBAI,	
		SIEMENS,	
		ALLEN-BRADLEY,	
		SIEMENS,	
		SCHNEIDER ELECTRIC,	
		KRISTRON SYSTEMS MUMBAI OR EQUIVALENT	
125.	MIXED METAL OXIDE ANODES (WIRE ANODES)	MATCOR (USA)	
		COVALENCE (USA)	
		TYCO ADHESIVES	USA OR EQUIVALENT
126.	TUBULAR ANODES	TITANOR COMPONENTS LTD., GOA, INDIA	
		ORANZIO DE NORA,	ITALY
		MAGNETOCHEMIE,	HOLLAND
		ACTEL LTD.,	U.K.
		ELTECH SYSTEMS CORPORATION	USA
		CERANODE TECHNOLOGIES,	USA
		MATCOR	USA
127.	AIR COMPRESSOR	ELGI EQUIPMENTS LIMITED	
		ATLAS CAPCO INDIA LTD.	

SL. NO.	ITEMS	MAKES	REMARKS
		INDCON PROJECTS & EQUIPMENT -	
		P S A NITROGEN LIMITED.	
		CONSOLIDATED PNEUMATIC	
		INOX AIR PRODUCTS LIMITED.	
		INGERSOLL-RAND (INDIA) LIMITED	

VOLUME – III
ANNEXURE- II
PAINTING SCHEDULE

	TITLE PAINTING SCHEDULE 2X250 MW BARAUNI TPS	DOCUMENT NO. PE-DC-374-100-A001	
		REV.NO. 00	DATE 05/01/2012
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1.0

GENERAL PAINTING REQUIREMENTS

1.1

Painting of equipment shall be carried out as per the specifications indicated below and attached annexures and shall conform to the relevant IS specification/ international standards for the material and workmanship.

1.2

The following Indian Standards may be referred to for carrying out the painting job :

IS:5

:

Colours for ready mixed paints and enamels

IS:1303

:

Glossary of terms relating to paints

IS:2379

:

Colour code for identification of pipelines

IS:1477

:

Code of practice for painting of ferrous metals in buildings (Parts I & II)

IS:2524

:

Code of practice for painting of non-ferrous metals in buildings (Parts I & II)

IS:2395

:

Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)

IS:2338

:

Code of practice for finishing of wood and wood based materials (Parts I & II)

IS:6278

:

Code of practice for white washing and colour Washing

IS:158

:

Ready mixed paint, brushing, bituminous, black, leadfree, acid, alkali, water and heat resisting

IS:2074

:

Ready mixed paint, air drying, red Oxide Zinc Chrome, priming

IS:104

:

Ready mixed paint, brushing, Zinc Chrome, priming

IS: 2932

:

Enamel , synthetic, exterior (a) undercoating (b) Finishing

	TITLE PAINTING SCHEDULE 2X250 MW BARAUNI TPS	DOCUMENT NO. PE-DC-374-100-A001	
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1.3

Preparation of Surfaces

All surfaces to be painted shall be thoroughly cleaned of all grease , oil, loose mill scale , dust , rust and any other foreign matter. 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 sand 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/OWNER REPRESENTATIVE. The sheet steel of electrical and instrumentation panels shall be pre-treated through chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphating and rinsing. However, in case mechanical cleaning is also required the Contractor shall carry out the same to get a smooth finish.

1.4

Primer Paint

After the surface is prepared one coat of Zinc Phosphate primer conforming to IS 2074 shall be applied. After this first coat is dried up completely, second coat of primer shall be applied. Primer shall be applied by brushing, spray, roller as per manufacture recommendation to ensure a continuous film. The dry film thickness of each coat shall be as indicated in Ann-I & II enclosed. Insulated surfaces will have only primer coating and no finish painting.

1.5

Finish Paint

Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade shall be as approved by the OWNER. After cleaning the dust on the dried up primer, first coat of synthetic enamel 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 allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.

1.6

Painting and Corrosion Protection for Pipes & Fittings

1.6.1

All uninsulated piping systems, hangers and supports shall have two coats of Zinc Phosphate Primer (conforming to IS 2074) and finish paint using synthetic enamel paint to give a finish coat. Shades shall be as per IS 5 or as indicated by PURCHASER/OWNER. Service of the pipeline designations shall be painted on all pipes at visible locations.

1.6.2

Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot grease, rust etc.,

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1.6.3

All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.

1.6.4

Shop fabricated equipment/items shall be dispatched with final paint. Necessary touch up shall be done at site. Site fabricated equipment/items shall be dispatched with primer painting only and final painting shall be applied at site.

1.7

Painting and Corrosion Protection for Valves & Specialties

Two coats of primer of thickness as indicated in Ann-It shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion before dispatch. The use of grease or oil, other than light grade mineral oil, for corrosion protection is prohibited. Bores of all vales shall be covered immediately after testing, draining and drying with suitable plastic end covers to avoid ingress of foreign materials.

1.8

Suggested Colour Codes for Painting

Suggested colour codes shall be furnished by the successful bidder after award of contract. Colour codes for piping shall be as per IS 2379 with necessary modifications. Where band colour is specified for piping, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.

1.9

Approved Paint Makes

i) Asian Paints (I) Ltd.

ii) Berger Paints India Ltd

iii) Goodlass Nerolac

iv) Jenson & Nicholson (I) Ltd

v) CDC carboline (I) Ltd.

vi) Shalimar Paints Ltd.

vii) Addison Paints Ltd.

viii) Grand Polycoat

ix) Bombay Paints

2.0

PAINTING SCHEDULES

2.1

Painting schedules for various systems/ items are furnished as per enclosed Annexures-I and II . Vendors of different packages/ items will furnish detailed painting schedule for customer approval during detail engineering as per this guide specification.



TITLE

PAINTING SCHEDULE

2X250 MW BARAUNI TPS

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Annexure-I

Paint Reference Scheme	Surface Preparation Grade / Surface Profile	Primer Coat			Intermediate Coat			Finish Coat			Total DFT in microns
		Premier Paint	No. of Coats	DFT in Microns	Intermediate Paint	No. of Coats	DFT in Microns	Finish Paint (See Note)	No. of Coats	DFT in Microns	
Various type of equipment/v alve, etc. (Temp. upto 90°C)	Degreasing and Mech. Cleaning with wire brushing/hand tool (Sa1/St2/St3 as applicable)	HB Zinc Phosphate (alkyd Medium) as per IS:2074	2	35-45 per coat	- NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140
LP Piping/structurals/ Vessels, etc. (Temp. upto 90°)	- do -	HB Zinc Phosphate as per IS:2074 (alkyd medium)	2	35 – 45 per coat	- NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110- 140
Equipment with (Temp. upto 250°)	- do -	Heat resistant Al – paint	2	20 per coat	- NA	-	-	NA	Insulated	NA	40
Equipment in corrosive areas like CPU (regeneration) Dosing skid, etc.	Blast clean to Sa 2 ^{1/2}	HB Epoxy resin based zinc phosphate primer	1	50 per coat	Epoxy based MIO pigmented paint	1	50 per coat	Polyamide cured Epoxy finish coat	2	25 – 35 per coat	150 - 170
Elect. / Control Panels, etc.	Seven tank process	HB Zinc phosphate (alkyd Medium) as per IS:2074	2	35 – 45 per coat	-NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140



TITLE

PAINTING SCHEDULE**2X250 MW BARAUNI TPS**

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Notes:

1. Surface preparation shown is as per Swedish Standards SIS 05-5900 or equivalent Indian std. Degreasing will be as per Standard SSPC-SP1.
2. In case of insulated surfaces, only primer coats shall be applied.
3. GM/SS items with piping and G.I. pipes will not be painted. However these items carrying under Fire Fighting System shall be painted Fire Red as per TAC guidelines. Further SS/GI piping shall be given necessary colour banding for identification as per colour scheme.
4. All instruments shall be painted as per manufacturer standard practice.
5. All structural steel items shall be painted at site. Piping shall go with primer coating & finish paint shall be applied at site. Equipment shall be finish painted at shop.
6. Method of painting application shall be as per paint manufacturer's recommendation.
7. Based on above painting schedule, detailed painting schedule will be prepared by respective package supplier and these be submitted to Customer for their approval.
8. This painting schedule is applicable for bought out equipment/packages of PEM. Painting specification for various piping/ equipment in scope of various other BHEL units like Power cycle piping, CW piping, LP piping, R.E. joints, Butterfly valves, Power cycle valve etc., shall be furnished by unit separately.



TITLE

PAINTING SCHEDULE

BARAUNI TPS (2X250 MW)

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SHEET 1

OF 2

ANNEXURE –II

Condensate/DM Water Storage Tank

	Internal	External	Underneath
Surface preparation	Blast clean to SA 2.5	Hand/Power tool cleaning/ wire brushing to ST-2	Blast clean to SA 2.5
Primer	1 coat of epoxy resin based zinc phosphate high build primer (2 pack), DFT : 50 – 70 microns	2 coats of red oxide zinc chromate primer (IS 2074) of 30 - 35 microns DFT each	1 coat of high build coal tar epoxy suitably pigmented, DFT : 80 – 100 microns
Finish	2 coats of solvent free epoxy paint, DFT – 35 microns each	2 coats of synthetic enamel (IS – 2932) paint of 20 – 25 microns DFT each	N.A
Total DFT	120 – 140 microns	100 – 120 microns	80 – 100 microns

NaOH Breather and Seal Pot

	Internal	External	Underneath
Surface preparation	Blast clean to SA 2.5	Blast clean to SA 2.5	N.A.
Primer	1 coat of epoxy resin based zinc phosphate high build primer (2 pack), DFT : 50 – 70 microns	2 coats of epoxy resin based zinc phosphate primer of 35-50 microns.	N.A.
Finish	2 coats of solvent free epoxy paint, DFT – 35 microns each	2 coats of polyamide cured epoxy finish paint of 30-35 microns each	N.A.
Total DFT	120 – 140 microns	130 – 170 microns	



TITLE

PAINTING SCHEDULE
BARAUNI TPS (2X250 MW)

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ANNEXURE –II

LDO/HFO Storage Tank			
	Internal	External	Underneath
Surface preparation	Wire bushing	ST2 (Wire Brushing/ Hand tool cleaning)	Blast clean to SA 2.5
Primer	NA	2 coats of red oxide zinc chromate primer (IS 2074) of 30 - 35 microns DFT each	1 coat of high build coal tar epoxy suitably pigmented, DFT : 80 – 100 microns
Finish	2 coats of double boiled linseed oil	2 coats of synthetic enamel (IS – 2932) paint of 20 – 25 microns (DFT) each	N.A
Total DFT		100 – 120 microns	80 – 100 microns



TITLE

PAINTING SCHEDULE

2 X 250 MW BARAUNI TPS

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ANNEXURE-III

SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.0	Fans, pumps, motors, compressors, Blowers	Light Grey	631	-	-
3.0	Tanks (without insulation and cladding)				
3.1	Outdoor, Stand pipes, vent pipes	Aluminum	-	-	-
3.2	Indoor	Aluminum	-	-	-
4.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
5.0	Switchgear	Light grey	631	-	-
6.0	Control & relay panels	Light grey	631/7078 of IS 1650	-	-
7.0	Transformers	Dark Admiralty Grey	632	-	-
8.0	Machinery guards	Signal red	537	-	-
9.0	Piping (without insulation and cladding)				



TITLE

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OF 1

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
9.1	Water System				
a)	Boiler feed	Sea green	217	-	-
b)	Condensate	Sea green	217	Light brown	410
c)	D M Water	Sea Green	217	Light orange	557
d)	Soft water	Sea green	217	French blue	166
e)	Bearing cooling water	Sea green	217	French blue	166
f)	Potable & filtered water	Sea green	217	French blue	166
g)	Service & clarified water	Sea green	217	French blue	166
h)	Raw water	Sea green	217	White	-
i)	Cooling water	Sea green	217	French blue	166
9.2	Compressed Air System				
a)	Service air	Sky Blue	101	-	-
b)	Instrument air	blue	101	White	-
9.3	Oil system				
a)	Fuel oil	Light brown	410	French	166
b)	Light oil	Dark Brown	412	Brilliant green	221
c)	Lubricating oil	Light brown	410	Light grey	631
d)	Control oil	Light brown	410	Light orange	557



TITLE

PAINTING SCHEDULE

2 X 250 MW BARAUNI TPS

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OF 1

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
e)	Transformer oil	Light brown	410	Light orange	557
9.4	Gas system				
a)	Carbon dioxide	Canary yellow	309	Light grey	631
9.5	Fire services	Fire red	536	-	-
9.6	Ash slurry pipes	Black	-	-	-
9.7	Vacuum pipes	Sky blue	101	Black	-
9.8	Fuel pipes (lignite)	Light brown	410	-	-
9.9	Drainage	Black	-	-	-
9.10	Stand pipes and all Vent pipes	Aluminum	-	-	-
9.11	Bottom Ash system	Light Grey	631	-	-

Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications.
2. Where band colour is specified, same shall be provided at 10 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.



**PRICE BID FORMAT FOR
INERT GAS EXTINGUISHING SYSTEM
PROJECT- 2 x 250 MW UNIT # 8 & 9, BARAUNI-TPS, BEGUSARAI
SPEC NO: PEMC 03842 Rev 00**

Sl. No.	Description	Qty.	Unit	PRICE in INR or US \$ (Refer notes below)	
				Unit Price (INR or US \$)	Total Price (INR or US \$)
1.	Lump sum price for complete Inert Gas Extinguishing System (IGES) as per BHEL Specification.	1	Lot		
2.	Per diem rate for the supervision of erection, testing, commissioning & performance testing for the supplied system.	50	Days		
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 supervision of erection & commissioning of IGES system.	3	Visits		
		Grand Total			

Notes:

1. Bidder to quote strictly as per BHEL's specification requirements
2. Bidder to note that the complete supply of the package (Refer Sl. No. 1) is a LUMP SUM Turn-Key Order. Any additional claim on any account, after placement of order will not be entertained under any circumstances.
3. 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.
4. Offer will be evaluated based on total price for Sl. No. 1, 2 & 3 of price format.
5. Bidder to quote the base rates only. Applicable taxes and duties to be indicated separately. (As per Split Value format Vol IIIB of price formats). Indian bidders to quote in Indian Rupees & Foreign bidders to quote in US \$.

BIDDER'S SIGNATURE
NAME:
DATE
COMPANY SEAL

Prepared by	Checked By	Approved by	Date
Amit Kumar	K Gunjan	P. Sudhir Babu	20.04.13

ANNEXURE-IV

MASTER DOCUMENT LIST (MDL)

System Name:		Supplier:		PROJECT:			Supplier Doc. No.:				
				Supplier Job No.:		BHEL P.O. No.		Rev. No.		Sh. 1	of
						Date		Date			

System: Mech./Elec. Instrum./Civil	Drg./ Doc. Name	Drg./Doc.			Cat A/I	Sumission status to BHEL				BHEL Response status	Remarks
		Number	No. of sht	Rev. No.		Rev.0	Rev.1	Rev.2	Final Rev.(R---)		
						Date	Date	Date	Date		
Mechanical											
M.01											
M.02											
M.03											
....											
....											
....											
Electrical											
E.01											
E.02											
E.03											
....											
....											
Instrumentation											
I.01											
I.02											
I.03											
Civil											
C.01											
Quality Q,01											
Q.01											
Erection											
E.01											
E.02											
E.03											
Procedures-P.01											
P.01											
B.O.M											

A-Approval				Prepared By:		Approved By:		Supplier Doc. No.:
I-Information				Sign :		Sign :		
				Date :		Date :		

ANNEXURE-V

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
 - i) Vendor signature & stamp
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 code1
12. Under 'D' please put (✓ 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

PAGE 2 OF 2

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-VI

[illegible]

VENDOR TO NOTE: THIS FORMAT IS IN MICROSOFT WORD. HEADER & FOOTER SHALL BE AVAILABLE IN EACH PAGE OF QP. QP SHALL BE IN LANDSCAPE & A4 SIZE ONLY. FONT SIZE SHALL BE MIN 10. VENDOR SHALL SIGN & STAMP IN EACH PAGE OF QP. LOI REF. & DATE ARE NOT ACCEPTABLE. P.O.NO. & DATE SHALL BE INDICATED. QP NO. SHOULD BE UNIQUE AND SHALL NOT REPEAT. ALL THE TESTS / CHECKS INDICATED IN THE BHEL SPEC. SHALL BE INDICATED IN THE QP.

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.	PREPARED BY	APPROVED BY	APPROVED BY
	VENDOR'S SIGNATURE & STAMP	BHEL OA SIGNATURE & STAMP	CUSTOMER'S SIGNATURE & STAMP

ANNEXURE-VII

BILL OF MATERIALS

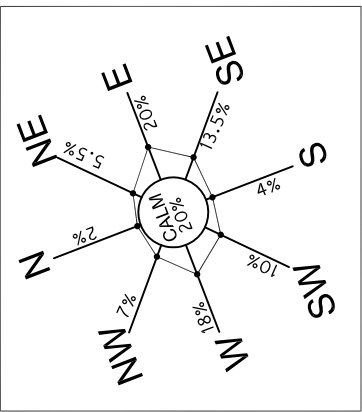
(SUB-VENDOR PACKAGES)

(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 :			

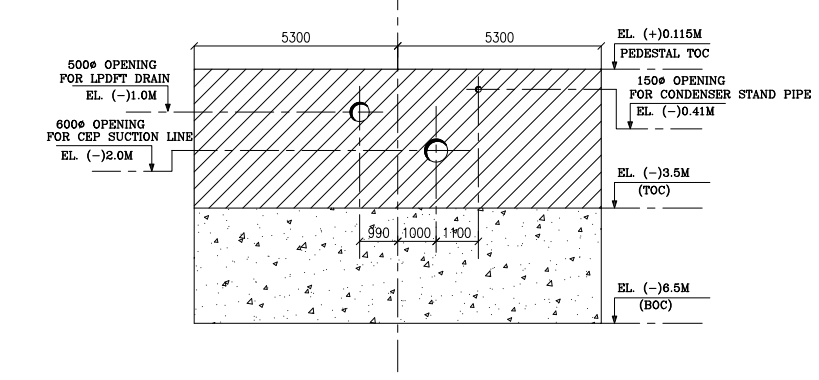
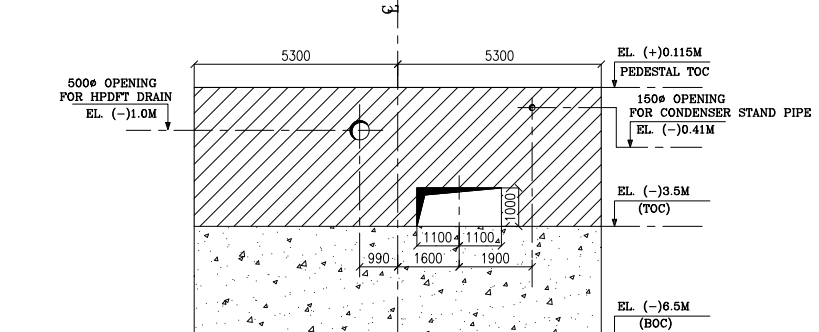
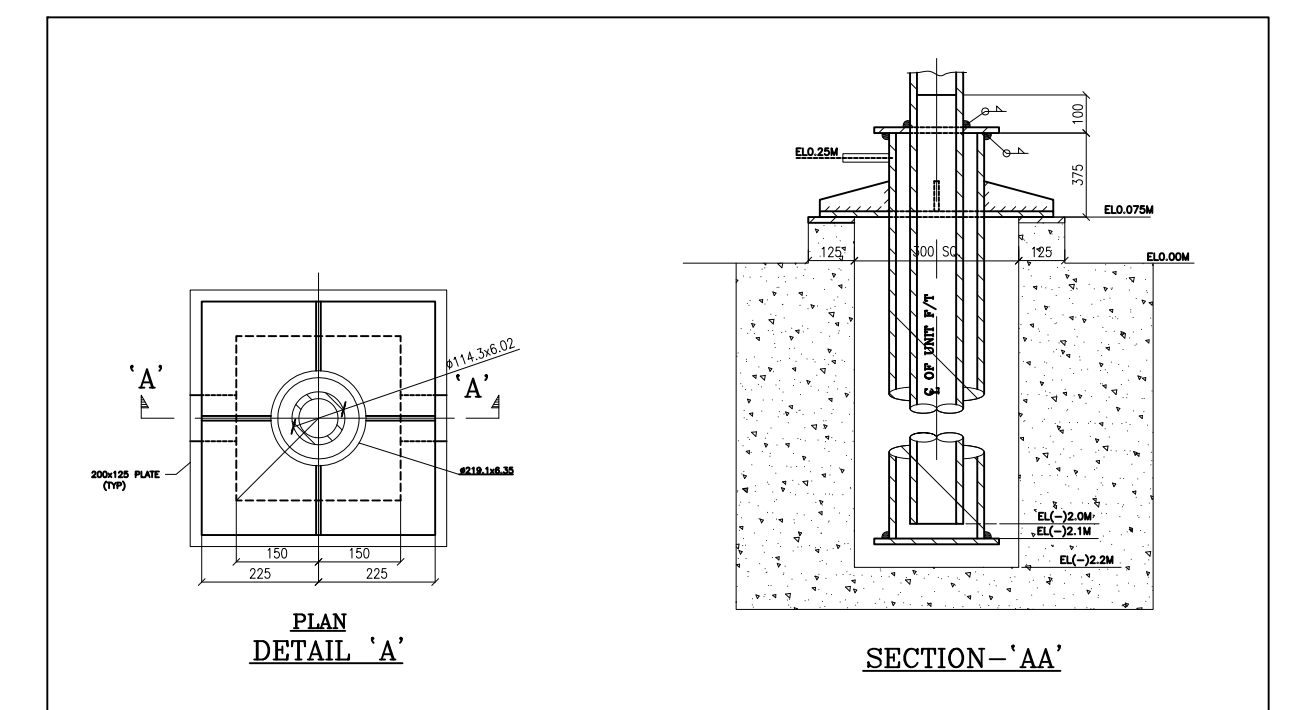
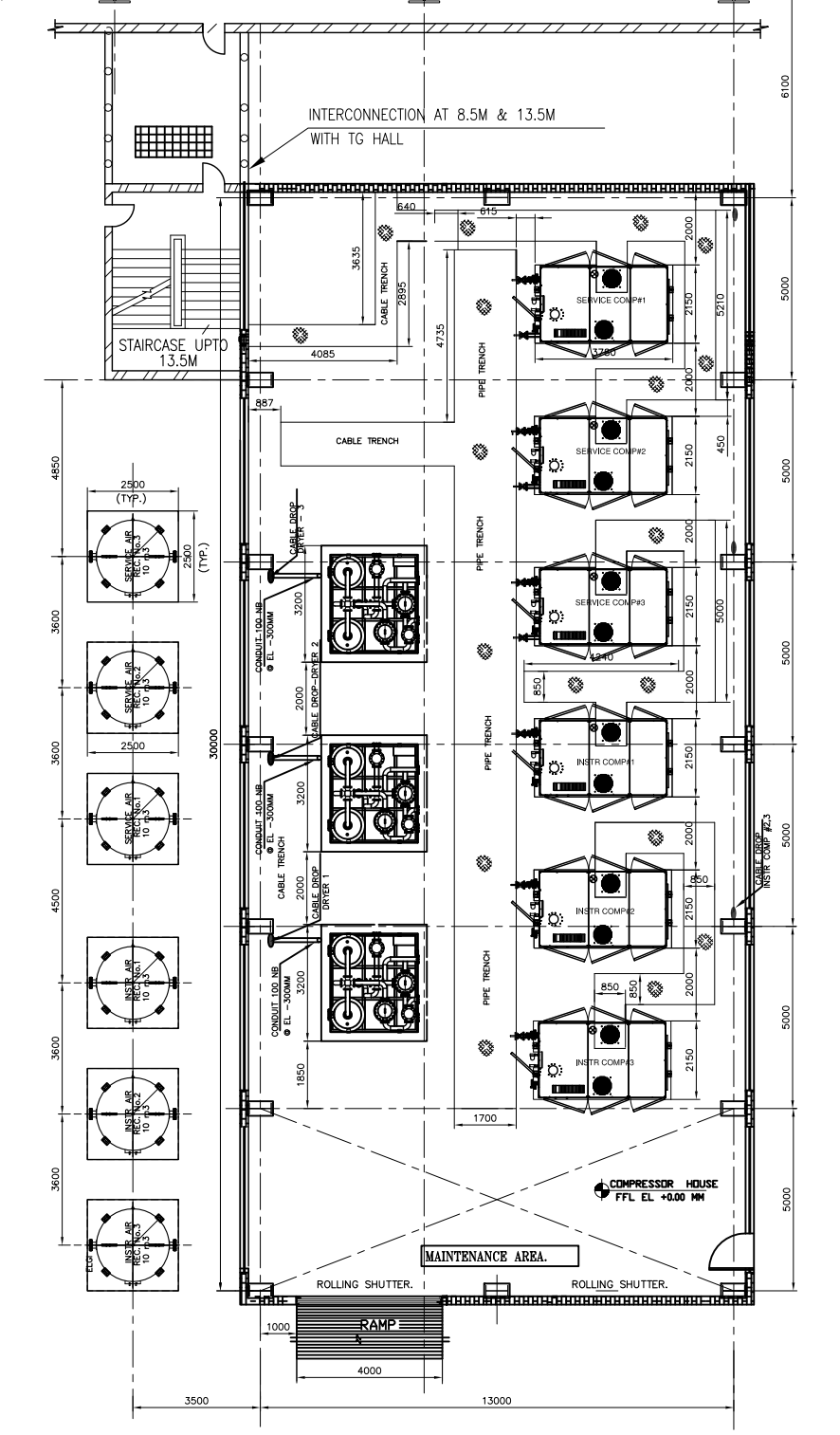
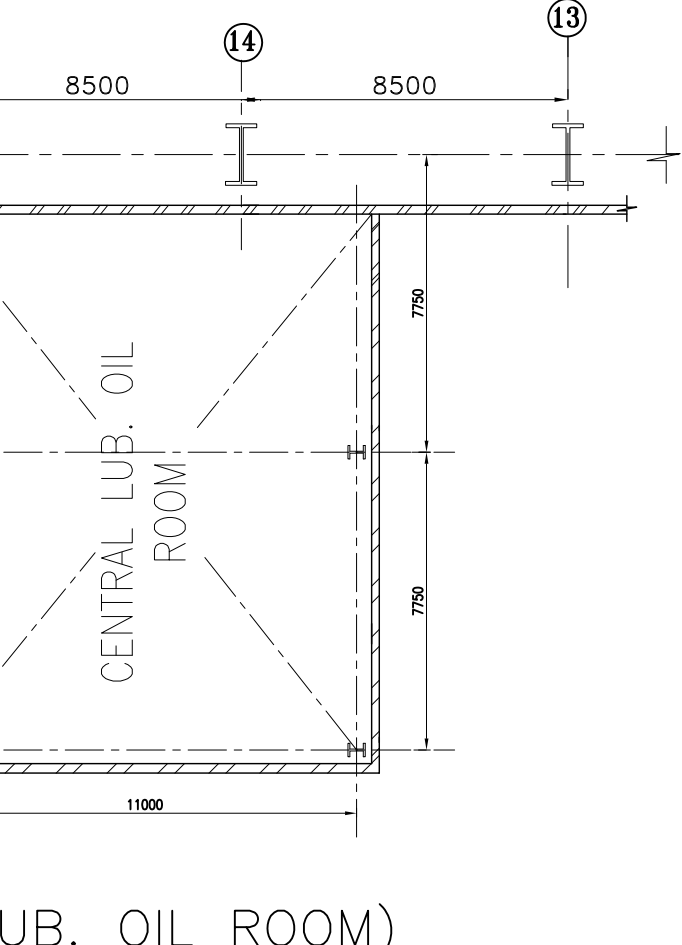
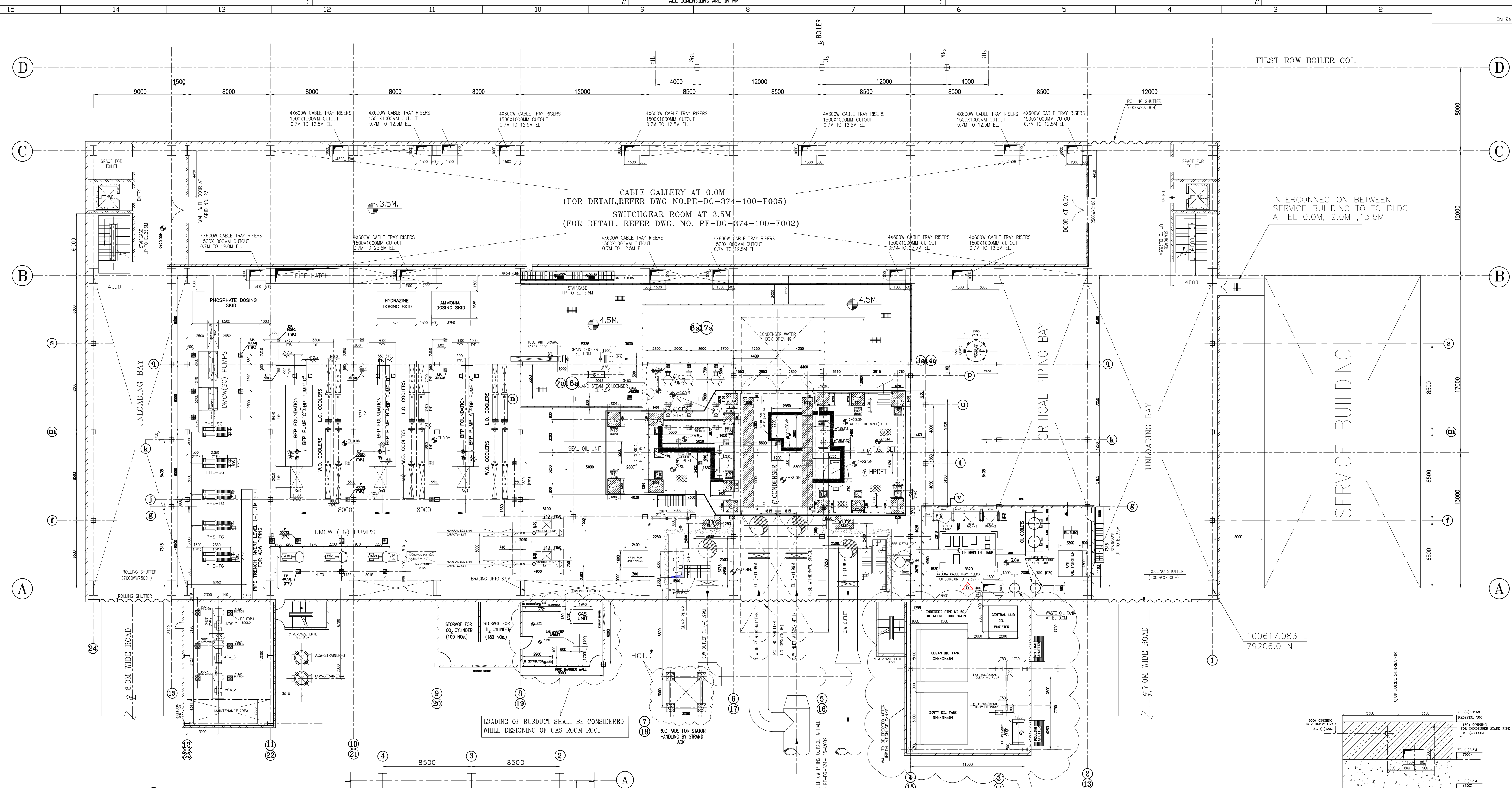
ANNEXURE-VIII

TD-106-2	Rev.No. 5 Form No.		PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, HYDERABAD –32.		PESD/HYD-776								
					Rev No.: 00								
					Page 1 of 1								
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.		<u>PRE-BID QUERRIES FROM SPECIFICATION</u> 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.											
		<table border="1"> <thead> <tr> <th>SL.No.</th> <th>Clause No.</th> <th>Description as per specification</th> <th>Queries by Bidder</th> </tr> </thead> <tbody> <tr> <td style="height: 285px;"></td> <td style="height: 285px;"></td> <td style="height: 285px;"></td> <td style="height: 285px;"></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								
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. Bidder's Signature..... Date:.....													
Doc													





NORTH



LEGEND:-

[Symbol]	REMOVABLE CHECKERED PLATE FLOOR
[Symbol]	CHECKERED PLATE FLOOR
[Symbol]	GRADED FLOOR
[Symbol]	REMOVABLE GRADED FLOOR
[Symbol]	CONCRETE FLOOR
[Symbol]	PIPE HATCH/CABLE RISER
[Symbol]	RAIL TRACK
[Symbol]	WALL
[Symbol]	HAND RAIL

REFERENCE DRGS:-

1. MAIN EQUIPMENT PLANT LAYOUT	PE-DG-374-100-M002
2. T.G. HALL EQUIPMENT LAYOUT PLAN AT 8.5M	PE-DG-374-100-M004
3. T.G. HALL EQUIPMENT LAYOUT AT 13.5M	PE-DG-374-100-M005
4. EQUIPMENT PLAN AT 19.0M & 23.5M (B-C BAY)	PE-DG-374-100-M006
5. MAIN PLANT CRISIS - SECTION	PE-DG-374-100-M007
6. GA OF CONDENSER	0-16000-40071
7. LPH/T	2-16000-40409
8. HPH/T	2-16000-40408
9. GA OF BFP	HY-DG-1-18000-57506
10. GA OF CEP	HY-DG-1-18100-57193
11. HPS(LPH VALVE)	BP-DG-374-175-0021

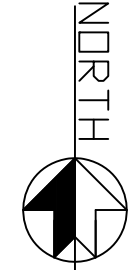
- (HOLDS)**
- PHOSPHATE DOSING SKID
- NOTES:-**
- FINISH GROUND LEVEL: RL(+45.0M)
 - ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION + 0.00M WHICH CORRESPONDS TO RL(+45.3M)
 - BOILER AREA FINISHED GRADED LEVEL IS 200MM BELOW 0.0M I.e. RL 45.3M
 - TRANSFORMER YARD FINISHED GRADED LEVEL IS 100MM BELOW 0.0M I.e. RL 45.3M
 - CONSTRUCTION OF GAS ROOM TO BE STARTED AFTER ERECTION OF GENERATOR STATOR.
 - DETAIL FOUNDATION OF BOILER PADS OP STATOR BY STRAND JACK ARRANGEMENT TO BE CONFIRMED BY PSEB.

CUSTOMER		BIHAR STATE ELECTRICITY BOARD	
CUSTOMER'S CONSULTANT		STEAG ENERGY SERVICES(INDIA) PVT. LTD.	
JOB NO.		374	
STATUS		CONTRACT	
DISTRIBUTION			
TITLE		TG HALL EQUIPMENT LAYOUT PLAN AT (+) 0.0M	
MPL		C	
MSE		I	
MAX		E	
DEPT.		POWER SECTOR	
SCALE		1:145	
DRAWING NO.		PE-DG-374-100-M003	
SHEET		1 OF 1	
REV.		06	

REV. 01	DATE 25.04.13	ALTD. QM	CHD. RP	APPD. KJ	REV. 02	DATE 12.02.13	ALTD. QM	CHD. RP	APPD. KJ	REV. 03	DATE 30.04.12	ALTD. QM	CHD. RP	APPD. KJ	REV. 04	DATE 22.10.12	ALTD. QM	CHD. RP	APPD. KJ	REV. 05	DATE 02.09.11	ALTD. QM	CHD. RP	APPD. KJ
01. DRAWING REVISED AS PER STEAG COMMENT/STAG REF. NO. E70025-BHEL-1-M-12-865 DATED 05/06/2012.					02. CHANGES ARE MARKED AS A					03. DRAWING REVISED AS PER STEAG COMMENT/STAG REF. NO. E70025-BHEL-1-M-12-865 DATED 05/06/2012.					04. DRAWING REVISED AS PER STEAG COMMENT/STAG REF. NO. E70025-BHEL-1-M-12-865 DATED 05/06/2012.					05. DRAWING REVISED AS PER STEAG COMMENT/STAG REF. NO. E70025-BHEL-1-M-12-865 DATED 05/06/2012.				

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CUSTOMER'S DRAWING NO.



LEGEND:-

	REMOVABLE CHEQUERED PLATE FLOOR
	CHEQUERED PLATE FLOOR
	GRATED FLOOR
	REMOVABLE GRATED FLOOR
	CONCRETE FLOOR
	PIPE HATCH/CABLE RISER
	RAIL TRACK
	WALL
	HAND RAIL

NOTES:-

1. FINISH GROUND LEVEL: RL(+) 45.0M
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION $\pm$ 0.00M WHICH CORRESPONDS TO RL(+) 45.5M
3. BOILER AREA FINISHED GRADED LEVEL IS 200MM BELOW 0.0M I.E. RL 45.3M
4. TRANSFORMER YARD FINISHED GRADED LEVEL IS 100MM BELOW 0.0M I.E. RL 45.4M
5. LAYDOWN SPACE FOR STG COMPONENT SHOWN IN DWG. NO. PE-DG-374-100-MSK02.

REFERENCE DRGS:-

- | | |
|--|---------------------------|
| 1. MAIN EQUIPMENT PLANT LAYOUT | PE-DG-374-100-M002 |
| 2. T.G. HALL EQUIPMENT LAYOUT PLAN AT 0.0M | PE-DG-311-100-M003 |
| 3. T.G. HALL EQUIPMENT LAYOUT PLAN AT 8.5M | PE-DG-311-100-M004 |
| 4. EQUIPMENT PLAN AT 19.0M & 25.5M (B-C BAY) | PE-DG-374-100-M006 |
| 5. MAIN PLANT CROSS SECTION | PE-DG-374-100-M007 |
| 6. OIL CANAL DETAIL | 0-13100-25001 |
| 7. TG DECK FOUNDATION DRAWING | PE-DG-374-613-C002 & C003 |
| 8. CRANE CLEARANCE DIAGRAM(125T/25T) | PE-DG-374-501-A001 |

HOLD:-

01. STATOR LIFTING PADS.
02. PSR TO CONFIRM THE FOUNDATION AND DETAIL OF STATOR LIFTING PADS.

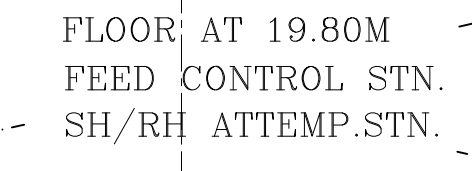
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06	25.04.13		GKM	RP	05	12.02.13		GKM	RP	04	02.11.12		GKM	RP	03	30.04.12		GKM	RP	02	28.12.11		GKM	RP
01. DRAWING REVISED AS PER STEAG COMMENT (STEAG REF. NO. ET0225-BHEL-1-M-13-1897) DT. 06.03.13 & AS PER DISCUSSION HELD AT MPL OFFICE DT. 17.04.13.					01. DRAWING REVISED AS PER STEAG COMMENT (STEAG REF. NO. ET0225-BHEL-1-M-13-1773, DT. 09.02.13 & AS PER DISCUSSION HELD AT STEAG OFFICE DATED 31.01.13.					01. DRAWING REVISED AS PER STEAG COMMENT (STEAG REF. NO. ET0225-BHEL-1-M-12-885, DATED 05/06/2012. 02. DRAWING GEARILY UPDATED.					01. DRAWING REVISED AS PER STEAG COMMENT (STEAG REF. NO. PEY02-374-88HR-IPS-105, DATED 21/02/12.					01. DRAWING REVISED AS PER STEAG COMMENT (STEAG REF. NO. ET0225-BHEL-1-M-11-199, DATED 28/10/11.				

CUSTOMER		BIHAR STATE ELECTRICITY BOARD	
CUSTOMER'S CONSULTANT		steag STEAG ENERGY SERVICES(INDIA) PVT. LTD.	
JOB NO.		374	
STATUS		CONTRACT	
DISTRIBUTION			
TITLE		TG HALL EQUIPMENT LAYOUT PLAN AT (+) 13.5M	
MPL		C	
MSE		I	
MAX		E	
DEPT.		SCALE 1:145	
SIGN		PE-DG-374-100-M005	
DATE		SHEET 1 OF 1	
		REV. 06	

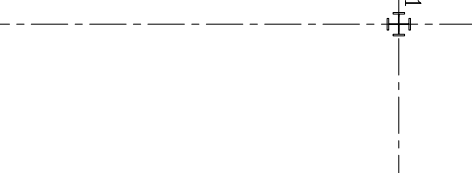
SIZE A0



FIRST ROW OF BOILER COLUMNS



FIRST ROW OF BOILER COLUMNS

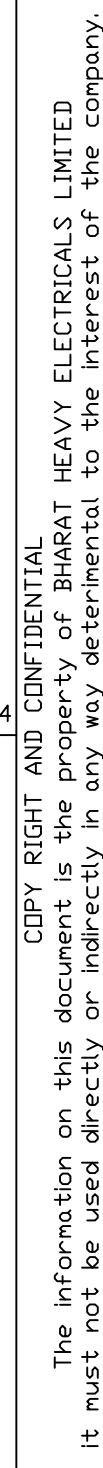


13.5M

- | | | |
|-----|---|--------------------|
| 1. | MAIN EQUIPMENT PLANT LAYOUT | PE-DG-374-100-M002 |
| 2. | T.G. HALL EQUIPMENT LAYOUT PLAN AT 0.0M | PE-DG-311-100-M003 |
| 3. | T.G.HALL EQUIPMENT LAYOUT AT 8.5M | PE-DG-374-100-M004 |
| 4. | T.G.HALL EQUIPMENT LAYOUT AT 13.5M | PE-DG-374-100-M005 |
| 5. | GA OF DEAERATOR | 1-163-10-11402 |
| 6. | GA OF O/H CST | 0-17052-40233 |
| 7. | GA OF DMCW Q/H TANK | 1-17052-40479 |
| 8. | CCR & EER ROMM LAYOUT | PE-DG-374-100-I401 |
| 9. | SWAS ROOM LAYOUT | PE-DG-374-145-I403 |
| 10. | LAYOUT OF BOILER SWITCHGEAR ROOM | PE-DG-374-100-E003 |

PE-DG-374-100-M002
PE-DG-311-100-M003
PE-DG-374-100-M004
PE-DG-374-100-M005
1-163-10-11402
0-17052-40233
1-17052-40479
PE-DG-374-100-I401
PE-DG-374-145-I403
PE-DG-374-100-E003

SIZE-A0



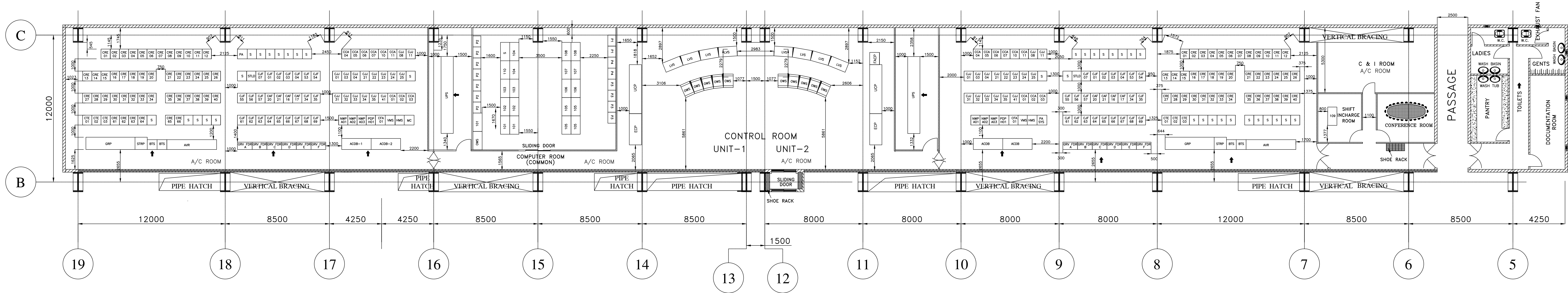
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. FINISH GROUND LEVEL: RL(+/-) 45.0M
3. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION $\pm 0.00M$ WHICH CORRESPONDS TO RL(+/-) 45.5M
4. **ROT CRANES SHALL NOT BE USED AS TANDEM OPERATION FOR STATOR LIFTING.**

1. EQUIPMENT LAYOUT AT 0.0M R05
2. EQUIPMENT LAYOUT AT 8.5M R05
3. EQUIPMENT LAYOUT AT 13.5M R05
4. CW PPING INSIDE TG HALL R00
5. CRANE CLEARANCE DIAGRAM(CCD) R02
6. GA & FOUNDATION DETAIL OF CEP R03
7. LAYOUT OF ID SYSTEM(ELEVATION) R02
8. GA OF BOILER SECTION SIDE ELEVATION R06

PE-DG-374-100-M003
PE-DG-374-100-M004
PE-DG-374-100-M005
PE-DG-374-165-M001
PE-DG-374-501-A001
HY-DG-1-18100-57193
O-00-020-75926
O-00-022-75923

REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD
05	04.02.13	GKM	RP	LKJ	04	06.11.12	GKM	RP	LKJ	03	30.04.12	GKM	RP	LKJ	02	28.12.11	GKM/RP	LKJ	AJ
01.	DRAWING REVISED AS PER STEAG COMMENT(STEAG REF. NO. ETG025=BHEL-3-M-12-1568, DATED 12/12/2012) & AS PER DISCUSSION HELD AT STEAG OFFICE B/W BHEL & STEAG DT.31.01.13.				01.	DRAWING REVISED AS PER STEAG COMMENT(STEAG REF. NO. ETG025=BHEL-1-M-12-865, DATED 05/06/12). 02. A-ROW TO CHIMNEY UPDATED.				01.	DRAWING REVISED AS PER STEAG COMMENT(STEAG REF. NO. ETG025=BHEL-3-M-12-590, DATED 12/03/12.)				01.	DRAWING REVISED AS PER STEAG COMMENT(STEAG REF. NO. ETG025=BHEL-1-M-11-199, DATED 28/10/11.)			
02.	BOILER AREA AND ID SYSTEM UPDATED AS PER THEIR LATEST REV.																		

Fold-4



EL.+13.5M

ELECTRONIC EQUIPMENT ROOM (EER)

SL NO.	DESCRIPTION	SIZE (WxDxH)	QTY (PER UNIT)	SCOPE
1	SG PANELS - (CJF01-04,CJF07,51-57,61-69 CAF16,17,20,21,34,35)	750 x 800 x 2415	25	EDN
2	TG PANELS - (CJJ01,03,04,08,11,21-25,31-35 CCA01-07,10,11)	750 x 800 x 2415	24	EDN
3	STATION C&I PANELS - (CRE01-40,CTE01,02,03,CFA01) CRE61-66 ARE COMMON FOR BOTH UNITS)	750 x 800 x 2415	40 (6 COMMON)	EDN
4	NETWORK PANELS (NWP01,A02,A03 & PDPH01)	750 x 750 x 2415	4	EDN
5	VMS PANELS-CJJ41.	750 x 800 x 2415	1	EDN
6	HART PANEL (HMS)	1200 x 800 x 2415	1	EDN
7	MASTER CLOCK PANEL (COMMON FOR BOTH UNITS)	800 x 800 x 2415	1	EDN
8	AVR PANEL	4056 x 800 x 2295	1	EDN
9	GRP (GENERATOR RELAY PANEL) (4 PANELS)	4000 x 1000 x 2295	1 SET	BPL
10	GRAVIMETRIC FEEDER PANELS	1200 x 600 x 2315	6	TRY
11	ACDB FOR UPS	2400 x900 x 2135	2	EDN
12	UPS PANEL	6280 x 1000 x 2110	1 SET	EDN
13	STRP ELECTRICALS PANEL	1000 x 1000 x 2295	1	BPL
14	BTS (BUS TRANSFER PANEL)	800 x 800 x 2355	2	BPL
15	BHEL SONIC (STLD)	800 x 800 x 2315	1	TRY
16	PA SYS PANEL (COMMON FOR BOTH UNITS)	800 x 800 x 2415	1	EDN

REFERENCE DRG.

- EQUIPMENT PLAN 13.5M, 19M, 25.5M PE-DG-374-100-M006
- OGA FOR DCS PANELS
- BOM FOR MIIPIIS (HMI SYSTEM)
- SCHEDULE OF CONTROL PANELS

ALL DIMENSION & NUMBER OF PANELS/WORK STATIONS ARE TENTATIVE.

CONTROL ROOM

SL NO.	DESCRIPTION	SIZE	QTY/UNIT	COMMON	SCOPE
LVS	LARGE VIDEO SCREEN (1 SET OF 4 LVS)	6000 x 800	1 SET		EDN
OWS	OPERATOR WORK STATION (FOR 5 OWS)	4800 x 1195	1 SET	1	EDN
ECP	ELECTRICAL CONTROL PANEL	2552 x 1000	1		EDN
UCP	UNIT CONTROL PANEL (TENTATIVE)	4000 x 1000	1		EDN
FACP	FIRE ALARM PANEL (TENTATIVE)	1000 x 800		1	PEM
109	SHIFT INCHARGE PC	1500 x 750		1	EDN

COMPUTER ROOM

SL NO.	DESCRIPTION	SIZE	QTY/UNIT	COMMON	SCOPE
1.	101 (ENGGR. WORK STN)	1500 x 750	1	1	EDN
2.	102 (MAXSTORION)	1500 x 750	1		EDN
3.	103 (TSC PC)	1500 x 750	1		EDN
4.	104 (maxLINKS PC)	1500 x 750	1		EDN
5.	105 (TSI / VMS PC)	1500 x 750	2		EDN
6.	106 (HART PC)	1500 x 750	1		EDN
7.	107 UTILITY PC	1500 x 750	1		EDN
8.	108 PERFORMANCE CALCULATION	1500 x 750	1		EDN
9.	110 MIS	1500 x 750		1	EDN
10.	P1 (COLOUR LASER PRINTER-A3)	900 x 650	1		EDN
11.	P2 (B/W LASER PRINTER-A4)	900 x 650	3	1	EDN
12.	P3 (DOT MATRIX PRINTER)	900 x 600	2		EDN
13.	P4 (A4 COLOUR LASER PRINTER)	900 x 650	1		EDN

NOTES:-

- BRICK WALL
- UPTO 1MTR BRICK, ONWARDS GLASS
- GLASS

REV.	DATE	ALTD	CHD	APPD
1.	17.07.12	RC	SK	ABS

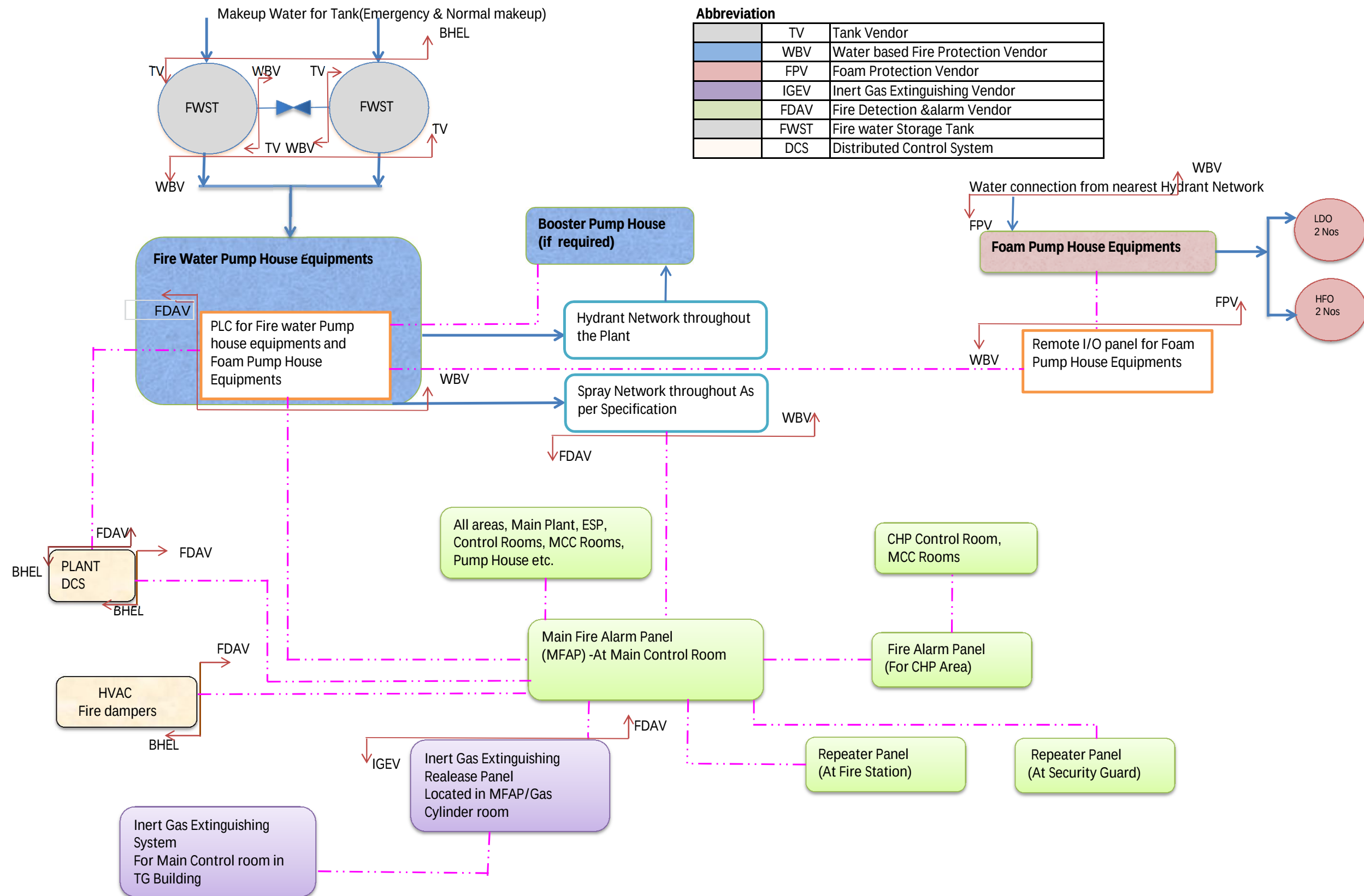
REV.	DATE	ALTD	CHD	APPD
1.	17.07.12	RC	SK	ABS

CUSTOMER		BIHAR STATE ELECTRICITY BOARD			
CUSTOMER'S CONSULTANT		STEAG ENERGY SERVICES(INDIA) PVT. LTD.			
JOB NO.		374			
STATUS		CONTRACT			
DISTRIBUTION		BARAUNI THERMAL POWER STATION 2 X 250 MW - UNIT 8 & 9			
		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA			
		TITLE CCR & EER ROOM LAYOUT			
		MPL C MSE I MAX E DEPT. SCALE SIGN DATE			
		DRAWING NO. PE-DG-374-100-1401 SHEET 1 OF 1 REV. 01			

Project: 2 X 250 MW BSEB, BARAUNI
Interface between varoius packages for Fire Protection System

Doc. No. PEMC 03892, Rev -00

Date 08.05.2013



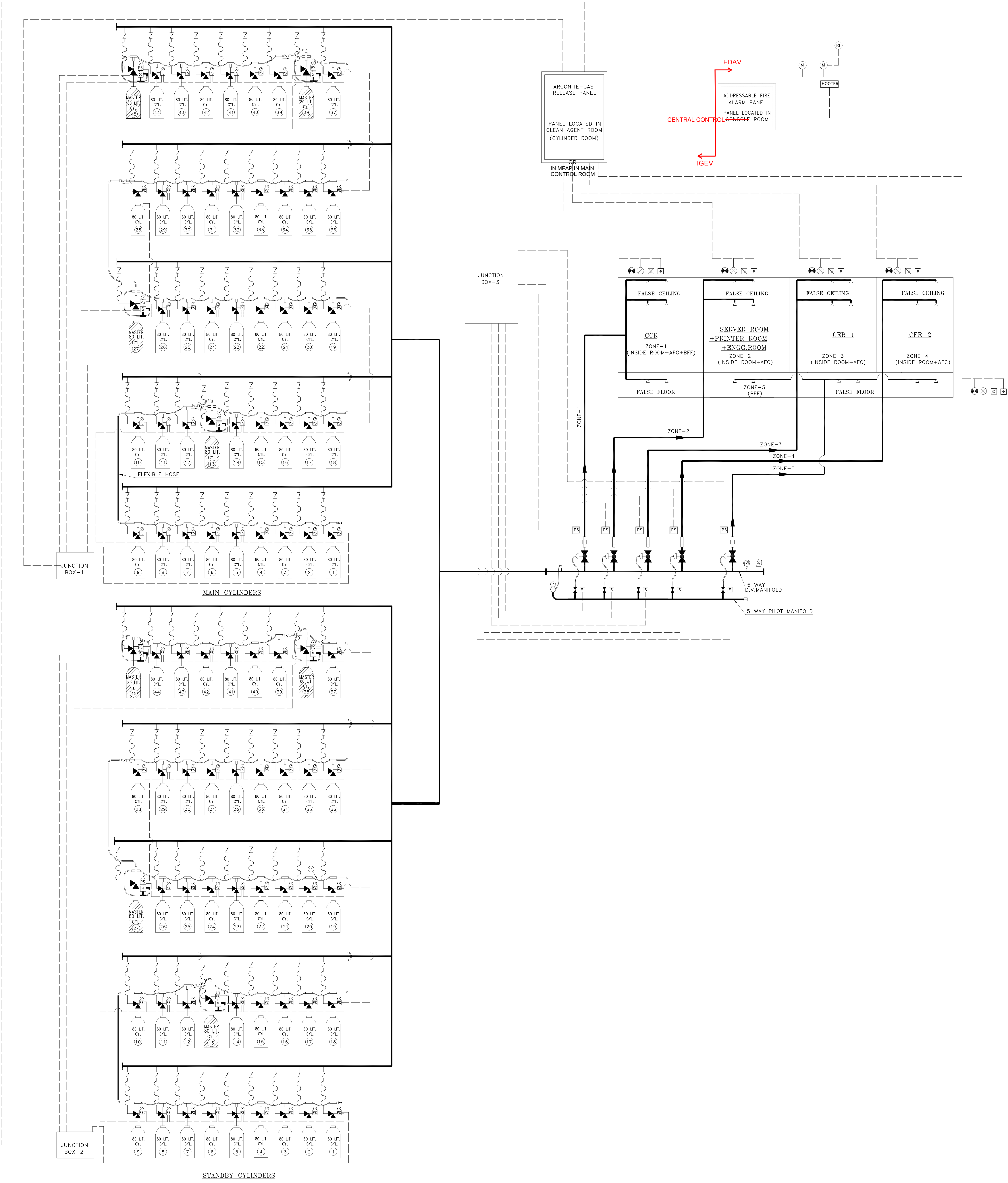
Note:

1. Signal from Pressure Switch & SOV's in all the area shall be connected to MFAP. Cabling between the PS & SOV and MFAP shall in the scope of FDA Vendor.
2. Potential free contact for HVAC fire dampers shall be provided in MFAP, numbers shall be given in detail engineering.
3. Signal from Level Switchs in the Tank area shall be connected to MFAP. Cabling between the instruments and MFAP shall in the scope of FDA Vendor.

LEGEND		
SR.NO.	SYMBOL	ITEM DESCRIPTION
1		ARGONITE CYLINDER BOL. 300 BAR WITH GAS
2		PNEUMATIC ARGONITE VALVE
3		CONTACT PRESSURE GAUGE UNIT
4		RELEASE UNIT WITH PRESSURE GAUGE, MANUAL CLOSED TYPE, SOLENOID VALVE, MANUAL RELEASE UNIT
5		CHECK VALVE
6		DISCHARGE HOSE
7		SOLENOID VALVE (N/C) 3/2 WAY MAN OVERRIDE 24V DC
8		BALL VALVE(N/C) WITH DUAL ACTION PNEUMATIC ACTUATOR (DIRECTIONAL VALVE)
9		RESTRICTOR
10		PRESSURE REGULATOR
11		PRESSURE RELIEF DEVICE
12		PRESSURE GAUGE
13		PRESSURE SWITCH
14		CONTROL CABLE
15		PRE DISCHARGE INDICATOR (INSIDE ROOM)
16		DISCHARGE INDICATOR (OUTSIDE ROOM)
17		BREAK GLASS TYPE ABORT SWITCH (INSIDE ROOM)
18		BREAK GLASS TYPE GAS RELEASE SWITCH (OUTSIDE ROOM)
19		MULTISENSOR DETECTOR (BELOW FALSE CEILING)
20		MULTISENSOR DETECTOR(ABOVE FALSE CEILING / BELOW FALSE FLOOR)
21		RESPONSE INDICATOR

- NOTES:
- INCASE OF FIRE, GAS WILL BE RELEASED IN THE RESPECTIVE ZONE. (INCLUDING FALSE CEILING & FALSE FLOOR VOID)
 - SYSTEM OPERATIONAL LOGICS ARE FACILITATED THROUGH CONTROL PANEL BY FOLLOWING MEANS:
a) AUTOMATICALLY DUE TO FIRE DETECTION IN THE PROTECTED AREA.
b) OPERATION OF MANUAL RELEASE PUSH BUTTON LOCATED ADJACENT TO THE PROTECTED AREA.
c) BY OPERATING MANUAL LEVER PROVIDED ON RELEASE UNIT.
d) OPERATION OF MANUAL RELEASE PUSH BUTTON LOCATED ON GAS RELEASE PANEL FOR EACH OF THE MASTER(PILOT) CYLINDERS
 - THE INTERCONNECTION BETWEEN GAS RELEASE PANEL AND MFAIP SHALL BE IN THE SCOPE OF VENDOR.
 - REQUIRED INPUTS FOR MFAIP SHALL BE GIVEN BY BIDDER IN THE DETAILED ENGINEERING STAGE.
 - THE SCHEME IS INDICATIVE ONLY. BIDDER HAS TO SUBMIT THE P&ID OF INERGEN SYSTEM .

IGEV : INERT GAS EXTINGUISHING SYSTEM PACKAGE VENDOR
FDAV: FIRE DETECTION AND ALARM SYSTEM VENDOR



FOR TENDER PURPOSE ONLY