

ESP-001- 2A Rev.00		PROJECT ENGINEERING & SYSTEMS DIVISION		Std. / Doc. Number	
				PY51483	
				Rev. No.	01

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TECHNICAL SPECIFICATION FOR FOAM PUMPS WITH DRIVES

PROJECT :	2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH
CUSTOMER :	BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED (BIFPCL)
OWNER CONSULTANT:	FICHTNER GmbH & Co KG

Revisions:	Prepared by :	Checked by :	Approved by :	Date :
Refer to record of revisions	 RATISH KUMAR	 GIRISH PRASAD PALO	 M. SIVA PRASAD BABU	18.07.2019

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DOCUMENTS TO BE SUBMITTED WITH THE BID:

The bidder must submit the following documents along with their bid to enable BHEL to evaluate their offer.

- i. Duly filled in Pump-Motor-Diesel Engine datasheet (**Annexure-2**)
- ii. Tentative GA Drawings for all variants Pump & Drive assembly
- iii. Performance curve of Pump
- iv. Un-priced copy of price in attached BHEL price bid formats (**Annexure-3**) indicating quoted/ not quoted against each row & column.
- v. Checklist as per (**Annexure-4**)
- vi. Equipment qualification criteria / PTR / Reference Lists as per (**Annexure-6**)
- vii. Bidder shall submit **NO DEVIATION certificate** along with their offer. Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-11 before submission of Techno Commercial offer.

In case the above-mentioned documents are not submitted with the offer, the offer of the bidder may be liable for technical rejection.

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1. INTENT OF SPECIFICATION

This specification specifies the requirement of Design, Engineering, Manufacturing, Assembling, Inspection, Testing at manufacturer's works and Delivery of properly packed and painted **Foam pumps including Drive assembly** with all accessories as specified in the scope of work and as required for the safe and trouble-free operation of equipment to be installed at site.

2. SPECIAL NOTES TO BIDDERS

- 2.1 This specification shall be read in conjunction with its enclosures. In case of any discrepancy arising between this specification & its enclosures, the most stringent of all shall be followed and shall over-ride others. Further, if a requirement in this specification or its enclosures, calls for decision of owner/BHEL, it shall be bidder's sole responsibility to clearly bring out the same distinctively in his technical tender offer, so as to enable owner/BHEL to furnish their decision. If such a requirement is not duly addressed by bidder during tender stage and same comes out during order execution stage, it shall be binding on the bidder to comply with the decision furnished by owner/BHEL then, without any cost, delivery, or any other commercial implications.
- 2.2 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 covered under the scope of this specification.
- 2.3 The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipment's. 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 Pump unit 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.
- 2.4 Bidder shall quote strictly as per the scope of supply and requirements of this specification.
- 2.5 Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.
- 2.6 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.
- 2.7 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.

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3. PROJECT INFORMATION

Sl. No.	Owner	Bangladesh-India friendship power company (Pvt.) Limited (BIFPCL)
1.	Project	2 X 660 MW Maitree Super Thermal Power Project, Rampal, Bangladesh
2.	Owner's consultant	Fichtner GmbH & Co KG
3.	Location	Rampal, Division: Khulna, District: Bagerhat, Bangladesh
4.	Nearest Airport	105 km from Jessore Airport, 12 kms from proposed Khan Jahan Ali Airport
5.	Nearest Railway Station	36 km from Khulna Junction Railway Station
6.	Co-ordinates	The site is geographically located between 22° 37'0"N to 22°34'30"N and 89°32'0" E to 89°34'5" E
7.	Elevation	+5.00 meters above sea level
8.	Maximum Ambient Temperature (deg. C)	36.9
9.	Minimum Ambient Temperature (deg. C)	12.2
10.	Design Ambient for Electrical equipment / system (deg. C)	50
11.	Relative Humidity	The relative humidity varies drastically during the Monsoon Season with 80% to 90% and the lowest levels of 20% to 30% during the Summer Season.
12.	Other details	Refer enclosed specification [Annexure-2 A]

Note: Any data required for designing the equipment, bidder may ask prior to the submission of bid.

4. APPLICATION OF SYSTEM

1 No. of Electric motor driven and 1 No of Diesel Engine driven Foam Pump (Gear Pump) is envisaged for supplying foam to foam system from foam storage tank.

5. TECHNICAL DETAILS/REQUIREMENTS

5.1. Design Parameters of the Foam Pump

Sl. No.	Description	Unit	Rated Condition
1	Temperature of Fluid	Deg. C	Ambient
3	Capacity of each pump	m ³ /hr	11.5
4	Pump discharge Pressure	Kg/cm ² (g)	12.1
5	Available Pressure at Pump suction nozzle	Kg/cm ² (a)	1.0

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6. SCOPE OF SUPPLY

Scope of supply shall be as per FM standard (FM 1313) / UL standard.

Please refer to the enclosed P&ID for Foam Pumps (Annexure-1) for general clarity on scope of supply. The system shall be provided as per Annexure-1 taking into all requirements including for testing, painting, documentation, sub vendor list, equipment specifications etc., specified in this specification and enclosures [Annexure- 1 to 12].

Quantity of Pump & Drive Assembly

2 Nos. of Foam Pumps (Gear Pump) [1 No Motor Driven +1 No Engine Driven].

The scope of supply or each Pump & Motor/ Diesel Engine drive assembly is as given below:

6.1. Pump

Gear Pump complete with all accessories as per specification.

Gear pumps shall be FM approved [Class Number: 1313] / UL listed. Scope of supply shall be as per FM / UL standard, Annexure-1 & subsequent clause of this specification.

6.2. Drives for pumps [Motor/Diesel Engine]

6.2.1. Motor

Voltage levels for Motors:

Motor for Pump: 415 V

Electric motors designed as per NEMA MG 1, IEC 60034-1 & NFPA.

The manufacturer shall specify which standard is to be referenced, and certify that the motor used is in compliance with said standard, providing any supporting documentation requested by FM Approvals / UL listed to verify compliance.

6.2.2. Diesel Engine

The Diesel Engines shall be FM approved / UL listed. The scope of supply shall be as per FM standard [Class Number: 1333] / UL standard, Annexure-1 & subsequent clause of this specification.

6.2.3. Controller

Each driver shall have its own dedicated controller.

Electric-Drive Controllers and Engine-Drive Controllers shall be FM [Class Number 1321/1323] approved / UL listed. The scope of supply shall be as mentioned in FM/UL standard.

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Controllers for electric motor driven pumps are designed for three phase NEMA Design “B” motors or equivalent.

Controllers for diesel engine driven pumps are used with FM /UL approved diesel engine drivers as per FM Approvals (standard Class 1333) / UL standard.

All cabling [control/signal/power] from Controller to Motor, Controller to Engine-Battery-Battery charger etc shall be in bidder scope of supply. Bidder to furnish cable BOQ & electrical loads.

Notes:

1. All wiring on the engine, including starting circuitry, shall be sized on a continuous-duty basis. Battery cables shall be sized in accordance with the engine manufacturer’s recommendations considering the cable length required for the specific battery location.
2. The controller for the motor shall be DOL type.

Software:

Bidder to submit Soft copy and hard copy of logics executed in Controllers for uploading the same by end customer later.

6.2.3.1. Terminal point for power supply

BHEL shall provide 1 no of feeder [415 V, (+/-) 10%, 3 phase, 50 Hz] for each Controller for Motor driven Foam Pump. Further distribution shall be in bidder scope of supply. Required cable glands, lugs shall be in bidder scope of supply

BHEL shall provide 1 no of feeder [240 V, (+/-) 10%, 3 phase 50 Hz] for each Controller for Engine driven Foam Pump. Further distribution shall be in bidder scope of supply.

6.2.3.2. Diesel Engine Fuel Tank

Fuel supply tank shall have a capacity at least equal to 1 gal per hp (5.07 L per kW), plus 5 percent volume for expansion and 5 percent volume for sump.

An overfill protection for the tank shall be provided. Level indicator and Level Transmitter, required piping [5 m length minimum], valves [from tank to engine and engine to tank] etc as per Annexure-1 shall be included in bidder scope. Valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position. Fuel piping shall be as per NFPA. Please refer Annexure 1-B for layout of various equipment’s of Pump skid.

Tanks shall be securely mounted on noncombustible supports. Accordingly, bidder to supply Fuel Tank mounting structure, all fixing accessories. Bidder to ensure sufficient leg height for flow of fuel from tank to Engine up to minimum level of fuel and ensuring engine manufacturer’s fuel pump static head pressure limits not be exceeded when the level of fuel in the tank is at a maximum. .

For details [such as pipe size, fill-drain-vent connections etc.] pl refer Annexure-1 & NFPA.

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6.2.3.3. Diesel Engine Exhaust System

The exhaust system shall be gas tight throughout the operating range of exhaust temperatures and pressures. It shall be designed with an outlet connection to readily duct exhaust gases outside the engine room and away from air-intake systems. The system shall be sized in accordance with the manufacturer's recommendations, and arranged to preclude the entry of water into the pump room. The exhaust manifold and turbocharger housing (when provided by the drive manufacturer) shall be suitably guarded, insulated, or cooled to prevent fire hazards and injury to operators. Each diesel engine fire pump driver in a multiple engine room shall have an independent exhaust system.

Based on layout enclosed [refer Annexure 1-B], bidder to consider suitable length of exhaust piping with silencer, SS metal expansion below & insulation with required no of bends.

6.2.3.4. Starting & Charging System

Starting & charging system shall be as per FM-1333 / UL standard.

Starting system:

- i. Two (2) sets (1 working & 1 standby, 100% capacity) of 24 or 12 Volt (as applicable) Automotive type battery with charger for each diesel engine driven fire water pumps shall be provided. Batteries shall be sized considering the maximum parasitic loads allowed by NFPA20 for the engine, controller, and other skid equipments.
- ii. Each engine shall be provided with 2 Nos. of Ni-Cd or Lead-acid plante battery units as per IS. Battery shall be sized as per FM-1333 / UL standard.
- iii. The starting system shall be compatible with FM Approved/ UL listed controllers..
- iv. Storage batteries shall be rack supported above the floor, secured against displacement, and located where they will not be subject to excessive temperature, vibration, mechanical injury, or flooding with water. Accordingly, bidder to provide suitable stand/structure for mounting the battery.

Charging system:

All starting systems shall be rechargeable by both engine-driven and auxiliary devices. The systems shall be arranged so that a FM approved/UL listed controller maintains fully charged starting energy reservoirs by means of the auxiliary recharging device.

Controllers shall provide alternate starts on alternate batteries, so a design using battery starting shall include all necessary contactors and wiring. Alternatively, the monitoring system shall note the level of charge on both batteries, and select the battery with the highest level of charge remaining. Accordingly, each diesel engine shall be provided with two (2) battery charger units. Each charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be kept so that any of the charger units of a particular engine can be utilised for charging any one of the two (2) batteries of that engine.

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6.3. Coupling Between Pump and Drives [motor/engine]

Coupling between pump and drive shall be as per FM standard (FM-1313) / UL standard.

6.4. Mechanical Seal

Sealing arrangement shall be as per FM standard (FM-1313)/UL standard.

6.5. Baseplate

The baseplate with fixing bolts shall be suitably designed to support the pump and driver without excessive vibration or visible distortion at all variations of load.

6.6. Interconnecting Piping & Instrumentation

Interconnecting piping and instrumentation as per P&ID [Annexure-1] & relevant standards as mentioned in this specification.

Reducer/expander, Flanges & Counter flanges with necessary gaskets & bolts at all terminal points as per annexure-1. Suction Reducer/expander shall be eccentric type. All counter flanges shall be of weld neck type.

6.7. Necessary Foundation Bolts, Nuts, Shims/Grouting Pads Etc.

6.8. First Fill of Lubricant & Consumables

Excluded from bidder scope of supply. However, bidder to furnish detailed requirement of first fill of lubricants and consumables.

6.9. All other items necessary for safe and smooth running of Pump & accessories required to make the supplied equipment complete in all respect.

6.10. Commissioning Spares

- i. One set of commissioning spares for Pump with drive motor shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain minimum 1 Set of O rings & gaskets for each Pump & 1 Set of Commissioning Spares for Motor, Controller etc as per Manufacturer recommendation.
- ii. One set of commissioning spares for Pump with Diesel Engine shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain Minimum 1 Set of O rings & gaskets for each Pump & 1 Set of Commissioning Spares for Engine, Controller, Battery etc as per Manufacturer recommendation.

1 set stands for requirement for one no. of skid. Bidder to furnish the list along with the offer. Bidder shall include all the required commissioning spares in their scope of supply and ensure that the erection and commissioning of the plant is not delayed for want of Commissioning spares.



Prices for the commissioning spares shall be part of main scope of supply. No separate price shall be offered for the same.

Any leftover (unused) spares after commissioning, out of those included by vendor, shall be handed over to the owner.

Note: Any commissioning spare consumed over and above the recommended commissioning Spares, during commissioning shall be supplied free of cost by the equipment vendor.

6.11. Mandatory Spares foam pump drive assembly:

i) Pump

Sl no	Description	Quantity
1	Impeller/Gear	1 Set of each size/type
2	Shaft	1 No. of each size/type

ii) Engine

Sl no	Description	Quantity
1	Sprayers/Injector	0
2	Piston rings & sealing rings	1 Set
3	Exhaust valve assembly	1 Set
4	Springs	1 Set
5	Packings and gaskets	1 Set
6	Fuel oil filter elements with seals	2 Sets
7	Fuel oil filter assy	1 Set
8	Lub. oil filter elements with seals	2 Sets
9	Scrapper rings	1 Set
10	Solenoid coil for fuel valve	1 No
11	Corrosion inhibitor (if provided)	1 Set
12	Big end & small end bearing of connecting rod	1 Set
13	Speedometer	1 No
14	Speedometer wire	1 No
15	Rubber hoses of water line with mounting clamps	1 Set
16	Cranking starter assembly complete	1 Set
17	Lub. oil and fuel oil hoses with end connectors	1 Set
18	Water pump belts	2 Sets

iii) Control & Instrumentation

Sl no	Description	Quantity
1	All type of local indicators	2 Nos of each make, model & type
2	Process actuated switch devices: [All type of Pressure, Diff Pressure, Flow, temperature, Level switch devises]	2 Nos of each type & model

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3	All type of Electronic Transmitters and Ultrasonic Transmitters including sensors.	10% or 1 No. of each type and model whichever is more.
4	Limit switches for isolation valves	2 Nos. of each type
PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)		
1	Valves	1 No. of each type, class, size and model.
2	2 way, 3 way, 5 way valve manifolds	1 No. of each type, class, size and model.
3	Fittings	5% or 1 No. of each type, class, size and model whichever is more.

Special notes for Mandatory spares:

- The word "set" means the quantity required for full replacement of that part in one machine.
- The word "TYPE" means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
- Wherever % age is identified, bidder shall supply next rounded figure.
- Part Description is the commonly used name of the part and may vary from manufacturer to manufacturer.
- Mandatory spares as indicated above do not cover commissioning spares.
- Mandatory spares as indicated above do not cover two year O&M spares.
- All Mandatory spares should be supplied separately with green color painted box.
- Loose items sent by Vendor to sites shall be quantified/numbered/tagged and not merely mentioned as ONE lot of loose items.
- A packing list covering items having shelf life are to be intimated to site. In addition, shelf life items shall be packed separately in black color painted box for easy identification at site.
- Spare rotors shall be boxed in a metal containers for vertical storage with nitrogen purging. Storage container shall be property of the owner.

6.12. Special Tools And Tackles for foam pump

2 Sets of Special tools and tackles for Pump & Drive assembly. [1 set each for Pumps with Motor assembly & Pumps with Diesel Engine assembly]

One set (1 Set) of Special tools and tackles comprises of special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance (disassemble, assemble, or maintaining the unit) of the Pump and Drive [Motor/Engine] assembly shall be quoted as per manufacturer's recommendation.

1 set stands for requirement for one no. of skid. Bidder to furnish the list along with the offer.

Prices for Special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same.

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6.12.1. Conflicts in Specification Requirement:

In case of any conflict between this specification and Annexures stringent of the requirement will govern.

6.13. Supervision of Erection & Commissioning

Supervision of erection, commissioning of the supplied system shall be included in bidder's scope of service.

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.

Per diem charges shall be applicable from the day bidder's representative reports to site, up to the day certified by BHEL's site.

For the purpose of tender following to be considered: [for details pls price bid format]

Foam Pump (Gear Pump) with Drives:

2 days for Pump
2 days for Motor & Controller
2 days for Engine & Controller
1 visit for Pump
1 visit for Motor & Controller
1 visit for Engine & Controller

Notes:

1. 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.
2. All payments towards supervision of E&C shall be made only after BHEL-site certification.
3. 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.
4. Bidder to quote supervision of erection and commissioning activities strictly as per BHEL's price format

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7. OPTIONAL PRICES

Please Refer to Attached Price Bid Format. Bidder to furnish the following as optional prices:

Bidder to furnish optional prices for 2 year recommended spares as per equipment manufacturer's recommendations. [The Bidder shall quote separately with optional price for the recommended list of spare parts for operation, with recommended quantities for the equipment covered under this specification. Bidder shall furnish such a list along with offer. The list of spares shall be as per Bidder's experience.]

Engine Revalidation spares:

Revalidation spares are those spares, which are required at the time of commissioning of Engine, in case the scheduled commissioning of engine is delayed beyond the permissible duration as recommended OEM.

Bidder to quote revalidation spares required for Engine as per OEM practice under optional prices as indicated in price bid format, sl no II-A.

Bidder shall furnish list of revalidation spares along with their offer.

8. EQUIPMENT QUALIFICATION CRITERIA (EQC)

Qualification requirement for Packager/Dealer/OEM:

The bidder shall have engineered, packaged, supplied, installed, commissioned and tested in the last Ten (10) years, at least Two (02) nos. FM approved/UL listed Foam Pump package [1 no Motor driven & 1 no Diesel Engine Driven] of identical or similar packages (or higher capacity packages) in terms of Flow, Discharge Pressure, Material of construction (CS/CI/SS), speed in the last Ten years and same shall have commissioned and kept in trouble free operation. Vendor to give documentary evidence for the same. The ten years time period mentioned above shall be reckoned from the Intial bid due date.

As a proof for the same, Date of Supply/ Commissioning report/Customer Satisfaction report will be considered and same to be provided by Bidder.

Bidder to furnish dully filled in proforma as per Annexure-6.

9. QUALITY PLAN & INSPECTION AGENCY & TESTING

For details, refer Annexure 5-I.

9.1. Quality Plan

Quality plan will be reviewed during detailed Engineering stage with respect to inspection, standard Engineering practices & specification requirements and various tests and stages of inspection and appropriate agencies for Inspection will be Intimated. Bidder to abide by the same.

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Pl refer Annexure: 7, ITPs for Pump, Motor, Engine etc. In addition, Annexure-7 & enclosed datasheets, specifications and applicable FM /UL standards shall be referred.

9.2. Inspection

BHEL/ FICHTNER/Third Party appointed by BHEL. Bidder to appoint TPI agency from the following on behalf of BHEL for inspection of items sourced from outside India:

i. Lloyds Register of Industrial Services (LRIS), ii. Bureau Veritas (BV), iii. Det Norske Veritas (DNV), iv. Certification Engineers International Ltd. (CEIL), v. TUV)

The various review/witness/observation stages by individual agencies (or) Group of Agencies as above will be in line with approved quality plan.

Pl refer Annexure: 7, ITPs for Pump, Motor, Engine etc. In addition, annexure-7 & enclosed datasheets, specifications and applicable FM/UL standards shall be referred.

9.3. Testing

The design and Testing Standards, Performance tolerances of the Pumps, Motor, Diesel Engines shall be as per FM standards/UL standard.

10. PAINTING

Painting for Pump, Motor, Engine and all other accessories shall be as per Annexure 5-J & 12.

11. PACKING AND FORWARDING

Packing and Forwarding shall be as Annexure 12. For imported items enclosed seaworthy packing shall be followed. In addition to annexure-12, equivalent or superior seaworthy packing for imported items, packing for other items is also acceptable to us.

12. SUB VENDORS

Bidder shall follow approved sub vendors list as per Annexure 5-K & 8.

In case of any specific practical difficulty, bidder is requested to bring out the same with proper reason for not following vendor list [Annexure 5-K] and to furnish Proven Track record , credentials for the proposed vendors for BHEL approval.

For other items for which sub vendors are not specified, bidder can follow their standard vendors with due intimation to BHEL during detailed engg stage. Also they have to ensure the Proven Track record of the sub vendors and Bidder to take prior approval of BHEL for the same.

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13. INSTRUCTIONS ON PRICE BID FORMAT

Bidder to indicate his offer as per Price Bid format enclosed as Annexure 3.

All the items included in the price bid format shall be quoted as per tender specification and pre-bid clarifications as per Annexure 10, if any. Responsibility of ensuring correctness & completeness of scope of supply as per specification requirement solely lies with bidder.

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. Main offer consists of those items which will be part of main order after successful bidder is identified. Optional Items consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under Main offer and Optional items as per the prescribed format. Prices quoted by the bidder shall remain firm till the successful handing over of the entire package to end customer. Any request for upward revision of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL.

14. PRE-BID CLARIFICATIONS & DEVIATIONS:

Bidders shall comply with various requirements of this specification. It may please be noted that the requirements specified here in this specification are the standard practices being followed by the bidders. However, same things are presented in a structured form so that it can be ensured that the requirements of ultimate customer are complied with.

Bidders can bring out only those deviations which are impractical to meet, for our review in pre bid clarification only.

Bidders may also please note that the data sheets for valves, instruments etc., submitted along with the offer will be considered as indicative only, as the requirements specified in the specification are standard in nature. These will not be reviewed by BHEL before award of contract. Same will be reviewed during order execution stage in line with the requirements of specification and agreed deviations.

All pre-bid clarifications & deviations shall be clear bring as per Annexure 11 only.

In case bidder doesn't bring any clarification/deviation in prebid stage, the same shall be brought in their offer with following conditions:

- a) Any deviations to Customer specifications, same are acceptable provided these deviations are also regularly accepted by Customer for their direct orders on bidders. In such cases, proof of the same shall be furnished along with the offer.

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- b) Bidders may please note that unless the deviations are specifically brought out under deviations clause, it will be considered that no deviations are taken, even if they are mentioned elsewhere directly/indirectly in the offer.
- c) Price implication due to non-acceptance [by BHEL/Customer] of the deviations considered by bidder will not be permitted.
- d) Deviations [if any] shall be clear bring as per Annexure 10 only.

15. DOCUMENTATIONS

Please refer to enclosed Master Documentation List [MDL] for the list of DOCUMENTS / DRAWINGS to be submitted by the bidder as part of documentation. Bidder shall ensure submission of all documentation as per the MDL, Annexure 9.

Bidder to note that the dates of submission of all the documents shall be finalized based on PO date. It shall be solely bidder's responsibility to get approval on the entire document from purchaser to meet project schedule.

DEFINITION OF VENDOR DOCUMENT REVIEW STATUS ASSIGNED BY BHEL

The guidelines listed below are followed in assigning the document status code to the vendor documents: Final submittal of vendor documents will not be required as long as the document status code is 1 or 4 and the "AS-BUILT" condition of the component agrees with the current document.

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the vendor and does not relieve the vendor from full compliance with contractual obligations.

Code-1: Work may proceed

The document conforms to procurement document requirements. The document requires no changes or additions. Matters remaining to be resolved do not require document change and will be handled by correspondence. Where it is known that the design information on a vendor document is not complete and re-submittals will be required, e.g., due to "hold" areas, the document is assigned another status code.

Code-2: Revise and resubmit

Work may proceed subject to resolution of indicated comments. The document is in basic conformance with procurement document requirements. Minor deviations from procurement document requirements have been noted or other minor technical or physical changes in the equipment are required. The vendor shall resolve comments and resubmit documents prior to shipment of commodity.

Code-3: Rejected. Revise and resubmit

The document:

- Does not conform to the procurement requirements,
- Is of a design that is technically unacceptable without significant changes,
- Does not meet project requirements, i.e., orientation of equipment, nozzles, conduit connections, etc.,
- Does not conform to project criteria or with proposal documents or data, or

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- Does not meet minimum submittal requirements.

This submittal rejection does not relieve vendor of any schedule commitments.

Code-4: Review not required

The document is not subject to BHEL review. Typical uses for this status are in the review of items that are vendor standard products, small internal parts of major equipment, or vendor standardized data.

DRAWINGS REVIEW & APPROVALS:

Each drawing submitted by the bidder shall be with a title block furnished by BHEL during detailed engg stage.

All drawings / documents shall be thoroughly checked, duly signed, and stamped by the vendor including drawing /documents of sub-vendor, before submission to BHEL. Documents, which are unchecked, unsigned, and without revisions marked clearly, shall be returned without review. Any delay on account of this shall be to the vendor's account. After first review of documents, vendor to submit all the further revisions of documents along with comment resolution sheet. Successive documents submitted without comment resolution sheet shall be returned without review.

The approval and /or review by BHEL /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.

Documents once reviewed in Code-1 shall not be submitted (incorporating some changes) again for review, however if some change is really necessary, the same shall be brought to the notice of BHEL separately through design change note for review / information. Finally, As – built drawings, duly updated, shall be submitted.

During detailed engg stage, BHEL shall furnish check list reg minimum contents in GA drawing. Bidder to submit GAD [duly incorporating all requirements as per the check list] along with signed checklist. GAD shall not be reviewed without duly filled in checklist signed by the bidder.

NO. OF COPIES OF EACH DOCUMENT TO BE FURNISHED:

All the documents shall be submitted as given below:

SL NO.	DESCRIPTION	NO. OF COPIES / PIECES TO BE SUBMITTED	WHEN TO SUBMIT
1)	Initial drawings/documents under approval and information category.	Soft copy only	Within 2 weeks of placement of order
2)	BHEL shall furnish their observation on submitted documents	Soft copy only	Within 2 weeks of document submission

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3)	*Revised drawings/documents along with compliance sheet incorporating all BHEL comments. <i>*Vendor to incorporate all BHEL comments so that further revisions can be</i>	Soft copy only	Within 1 weeks of receipt of commented Drawings from BHEL
4)	BHEL shall furnish their observation on submitted documents	Soft copy only	Within 2 weeks of document submission
5)	Final Drawings/documents	12	Within 2 months of placement of order.
6)	Erection Documentation	5	1 month before dispatch of equipment. The list of documents identified under master document list for erection to be furnished in 5 no's of folders
7)	Draft O & M Manuals for BHEL review. <i>Note: Bidder to furnish final hard copy of O&M only after getting concurrence on</i>	Soft copy	At least 2 months before the delivery date of equipment
8)	Revised O & M Manuals with Test Certificates to be submitted to BHEL (Hyderabad)	12	Within one month before the delivery date of equipment
9)	Final O&M manuals in a CD	4	Within one month after dispatch of equipment after BHEL concurrence on soft copy.

Notes:

The O&M manuals shall contain the following as minimum:

- The identification details of the equipment like BHEL P.O. No., Vendor's Job Identification No., full contact address with telephone, fax, & e-mail details.
- Brief description of the system.
- All approved documents [Drawings, documents & test procedures as per MDL]
- Bill of material, BBU, LO schedule, sub vendor list, Mandatory & commissioning spares list etc.
- Operation, Instruction & maintenance manuals of all equipments / items fo the complete package
- System unloading, storage erection, start up, commissioning, shut down requirements.
- Operational & environmental safety instructions.
- Test reports and certificates.
- Catalogues of the equipment & instrumentation

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				Rev. No.	01

16. VARIANT TABLE:

Variant	Item	Material Code
01	Foam Pump Motor Driven with CS and ST	PY9751483018
02	Foam Pump engine driven with CM and ST	PY9751483026
03	Supervision of E& C of Foam Pump assembly	PY9851483036
04	Travel expenses from / to vendor works to site for Engineer	PY9851483044
05	Foam Pump mandatory spare	PY9751483050

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			PY51483	
			Rev. No.	01

RECORD OF REVISIONS				
Rev. No.	Date	Revision Details	Revised By	Approved By
00	18.07.19	First Issue	Girish	M.Siva Prasad Babu

ESP-001- 2A Rev.00	 	BHARAT HEAVY ELECTRICALS LIMITED PROJECT ENGINEERING & SYSTEMS DIVISION RAMACHANDRAPURAM: HYDERABAD - 502 032	Std. / Doc. Number	
			Annexure-1	
			Rev. No.	00

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Annexure-1

Revisions:	Prepared by :	Checked by :	Approved by :	Date :
Refer to record of revisions	Girish Prasad Palo	Siva Prasad Babu	Siva Prasad Babu	18.07.19



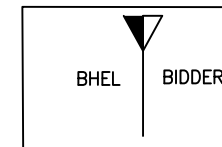
- Notes:**
1. For scope of supply specification shall be referred.
 2. This is typical schematic of Foam Pumps.
 3. Suitable Reducer/Expander to meet BHEL pipe sizes shall be in bidder scope of supply.
 4. Following standards shall be applicable:

Pipe: SS
Pipe Fitting: SS
Flanges/Companion Flanges: SS
In case of HE cooled Diesel Engine, required Piping, valves etc shall be bidder scope of supply
 5. Layout shall be referred for deciding BOQ for fuel piping, Exhaust piping, cabling etc. which are in bidder scope of supply.



TYP. FOR ENGINE DRIVEN FOAM PUMP

SCOPE DEMARCATION

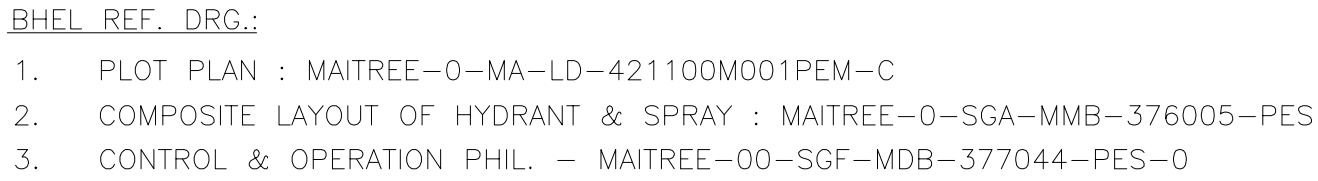


CUSTOMER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED (BIFPCL)

PROJECT: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH

 BHARAT HEAVY ELECTRICALS LTD. HYDERABAD		NAME	SIGN.	DATE	NO. OF VAR.
	DRN.	GIRISH	-SD-	18.07.19	N.A.
	CHD.	GIRISH	-SD-	18.07.19	
	APPD.	MSPB	-SD-	18.07.19	

DEPT. PE&SD	UNTOL. DIMS. OR 9/14/1		SCALE N.T.S	WEIGHT (KGS) N.A.	REF. TO ASSY. DRG. N.A.	ITEM NO. N.A.	NO. OF ITEMS N.A.
TITLE SCHEME FOR FOAM PUMPS					CARD CODE NA	DRG. NO. PESD/MAT/002 CUST. DRG. NO. 00	
					SHT. No 01	NO. OF SHT. 01	



LEGEND: -			
——	FOAM SOLUTION LINE—GI		DELUGE VALVE
---	FOAM LINE— STAINLESS STEEL		SAFETY RELIEF VALVE
- - -	WATER LINE		DRAIN
	GATE VALVE(NORMALLY OPEN)		PROBE TYPE HEAT DETECTOR
	GATE VALVE(NORMALLY CLOSED)		FOAM PUMP
	NON RETURN VALVE		MOTOR
	LEVEL SWITCH		DIESEL ENGINE
	LEVEL INDICATOR		SOLENOID VALVE(N/C)
	PRESSURE GAUGE		FOAM HYDRANT VALVE
	PRESSURE SWITCH		FIRE ALARM PANEL
			FOAM MONITOR

S. NO.	EQUIPMENT	QTY	TAG NO.	CAPACITY/SIZE
1	FOAM PUMP (MOTOR DRIVEN)	1	00SGF03AP001	11.5 CMH @ 12.1KG/CM2
2	FOAM PUMP (DIESEL ENGINE DRIVEN)	1	00SGF04AP001	11.5 CMH @ 12.1KG/CM2
3	FOAM STORAGE TANK	2 (1W+1S)	00SGF01BB001 00SGF02BB001	6500 LIT.
4	DELUGE VALVE	3	00SGF06AA501 00SGF07AA501 00SGF08AA501	80NB 80NB 100NB
5	FOAM PROPORTIONER	3	00SGF06AA502 00SGF07AA502 00SGF08AA502	80NB 80NB 100NB
6	FOAM CHAMBER WITH DEFLECTOR	2	00SGF09AA501 00SGF09AA502	100NB 100NB
7	FOAM HYDRANT VALVE WITH ACCESSORIES	2	00SGF09AA701 00SGF09AA702	--
8	FOAM MONITOR	2	00SGF09AA703 00SGF09AA704	--

05	12.07.19	AMIT	KD	M.N.S.R.	REVISED AS PER CUSTOMER COMEMNTS
04	16.03.19	AMIT	KD	M.N.S.R.	REVISED AS PER CUSTOMER COMEMNTS
03	17.01.19	AMIT	KD	M.N.S.R.	REVISED AS PER M/S IFEC OBS
02	19.11.18	AMIT	KD	M.N.S.R.	REVISED AS PER TCS-488 DTD. 20.12.17
01	27.02.18	ANUPAM	A.K./V.K.	P.C./M.N.S.R.	REVISED AS PER TCS-488 DTD. 20.12.17
	DATE	ALTERED	CHECKED	APPROVED	NOTE

PROJECT 2x660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH									
OWNER CONSULTANT:				OWNER:					
FICTHNER M/S FICTHNER GmbH & Co KG, Stuttgart,GERMANY						BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH			
						BHARAT HEAVY ELECTRICALS LTD PROJECTS ENGINEERING AND SYSTEM DIVISION HYDERABAD			
DRAWN BY		DATE		NAME		SCALE			
DESIGN BY		21.10.17		KAMAL		1			
CHECKED BY		21.10.17		P.C.S.		SHEET			
APPROVED BY		21.10.17		M.N.S.R.		01 OF			
SUPERSEDES:				TITLE					
SUPERSEDED BY:				P&ID FOR FOAM SYSTEM					
SYSTEM:				SIZE:		PROJECT NO.:		FILE:	
				ANNEX:		DRAWING NO.:		MAITREE-0-SGF-MFB-377001-PE5-1	
11				12		13		SIZE	

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INVENTORY NO
SIGN. AND DATE
REF. DRG. NO.
COMPUTER FILE NAME
13831600005-500-R01

GENERAL DIMENSIONAL LIMITS, FITS & TOLERANCES AS PER HY0230261

FIRST ANGLE PROJECTION

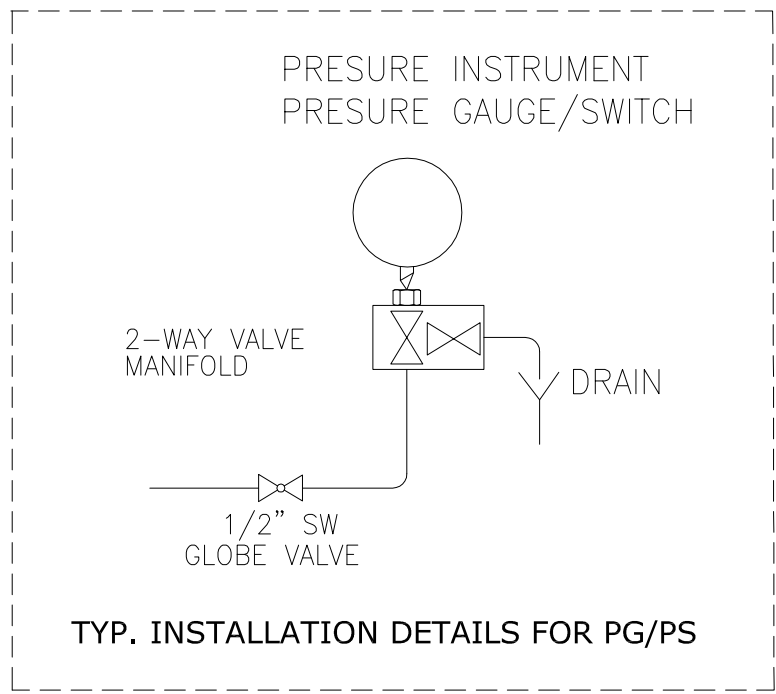
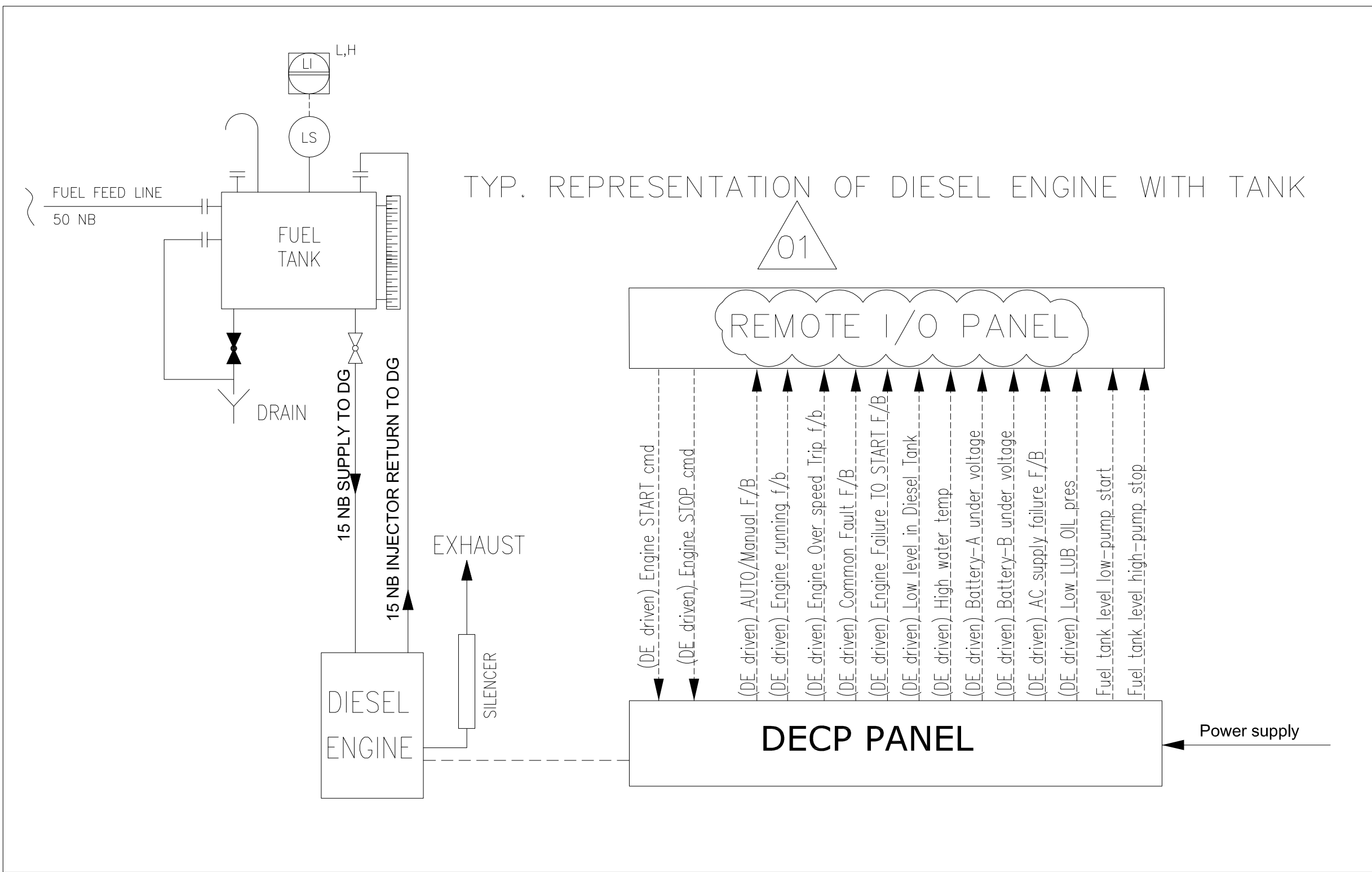
(ALL DIMENSIONS ARE IN mm)

DRG. NO.
MAITREE-0-SGF-MFB-377001-PES-1

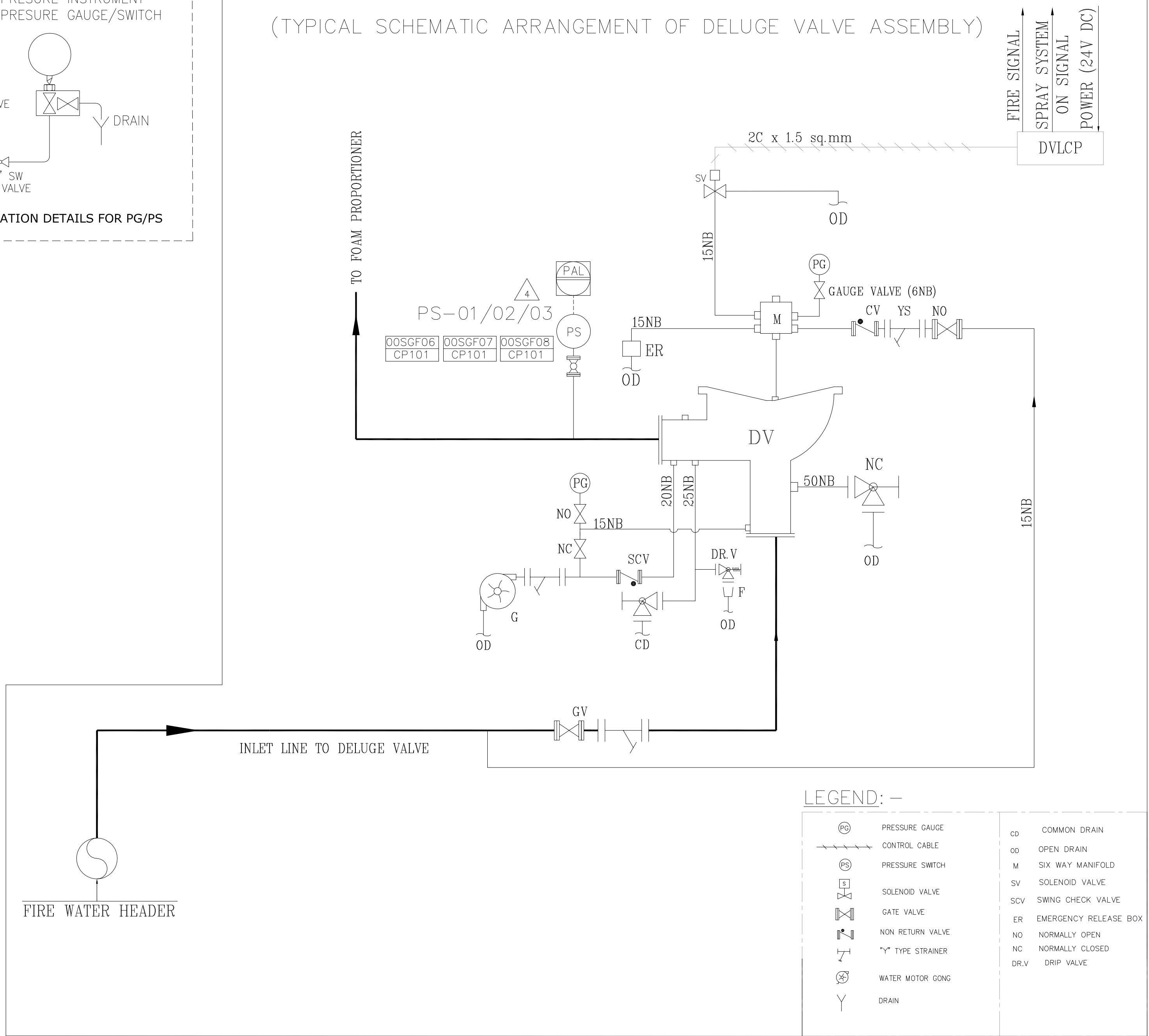
SHT. 2 OF 2

DETAIL "C"

DETAIL "A"



(TYPICAL SCHEMATIC ARRANGEMENT OF DELUGE VALVE ASSEMBLY)



SCHEDULE OF INSTRUMENT

TAG	KKS TAG NO.	INSTRUMENT	SET PRESS/LEVEL	INTERLOCK NO.	ANNUNCIATION
PT-01	00SGF01CP001	PRESS TRANSMITTER	6.0 KG/CM2	IS-01	STAND-BY FOAM PUMP STAR (WITH DELAY OF 60 SEC)
PT-02	00SGF01CP002	PRESS TRANSMITTER	6.0 KG/CM2	IS-01	STAND-BY FOAM PUMP STAR (WITH DELAY OF 60 SEC)
PT-03	00SGF05CP001	PRESS TRANSMITTER	3.5 KG/CM2		FOAM CONCENTRATE BYPASS IN OPERATION
PT-04	00SGF05CP002	PRESS TRANSMITTER	3.5 KG/CM2		FOAM CONCENTRATE BYPASS IN OPERATION
PS-01	00SGF06CP101	PRESS SWITCH	3.0 KG/CM2	IS-02	MAIN FOAM PUMP STAR SIGNAL TO MCC
PS-02	00SGF07CP101	PRESS SWITCH	3.0 KG/CM2	IS-03	MAIN FOAM PUMP START SIGNAL TO MCC
PS-03	00SGF08CP101	PRESS SWITCH	3.0 KG/CM2	IS-04	MAIN FOAM PUMP START SIGNAL TO MCC
PT-05	00SGF06CP001	PRESS TRANSMITTER	3.5 KG/CM2		FOAM SYSTEM IN OPERATIO AT HSD TANK-1
PT-06	00SGF07CP001	PRESS TRANSMITTER	3.5 KG/CM2		FOAM SYSTEM IN OPERATIO AT HSD TANK-2
PT-07	00SGF08CP001	PRESS TRANSMITTER	3.5 KG/CM2		FOAM SYSTEM IN OPERATIO AT FUEL DYKE
LT-01	00SGF01CL001A	LEVEL SWITCH	1/3 OF TANK HT.		FOAM TANK LOW LEVEL
LT-02	00SGF02CL001A	LEVEL SWITCH	1/3 OF TANK HT.		FOAM TANK LOW LEVEL

12. PUMP RUNNING/ FAIL TO START ANNUNCIATION SHALL BE TAKEN FROM MCC.

05	12.07.19	AMIT	KD	M.N.S.R.	REVISED AS PER CUSTOMER COMMENTS
04	16.03.19	AMIT	KD	M.N.S.R.	REVISED AS PER CUSTOMER COMMENTS
03	17.01.19	AMIT	KD	M.N.S.R.	REVISED AS PER M/S IFEC OBS
02	19.11.18	AMIT	KD	M.N.S.R.	REVISED AS PER TCS-488 DTD. 20.12.17
01	27.02.18	ANUPAM	A.K./V.K.	P.C./M.N.S.R.	REVISED AS PER TCS-488 DTD. 20.12.17
	DATE	ALTERED	CHECKED	APPROVED	NOTE
PROJECT 2x660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH					
OWNER CONSULTANT: FICHTNER M/s FICHTNER GmbH & Co KG, Stuttgart,GERMANY			OWNER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH Bharat Heavy Electricals Ltd PROJECTS ENGINEERING AND SYSTEM DIVISION HYDERABAD		
DRAWN BY	DATE	NAME	TITLE		
DESIGN BY	21.10.17	KAMAL	P&ID FOR FOAM SYSTEM		
CHECKED BY	21.10.17	P.C.S.	SCALE:		
APPROVED BY	21.10.17	M.N.S.R.	SHEET 02 OF 02		
SUPERSEDED BY:			SIZE:	PROJECT NO.:	FILE:
SYSTEM:			ANNEX:	DRAWING NO.:	REV 05

VALVE SCHEDULE FOR FOAM SYSTEM

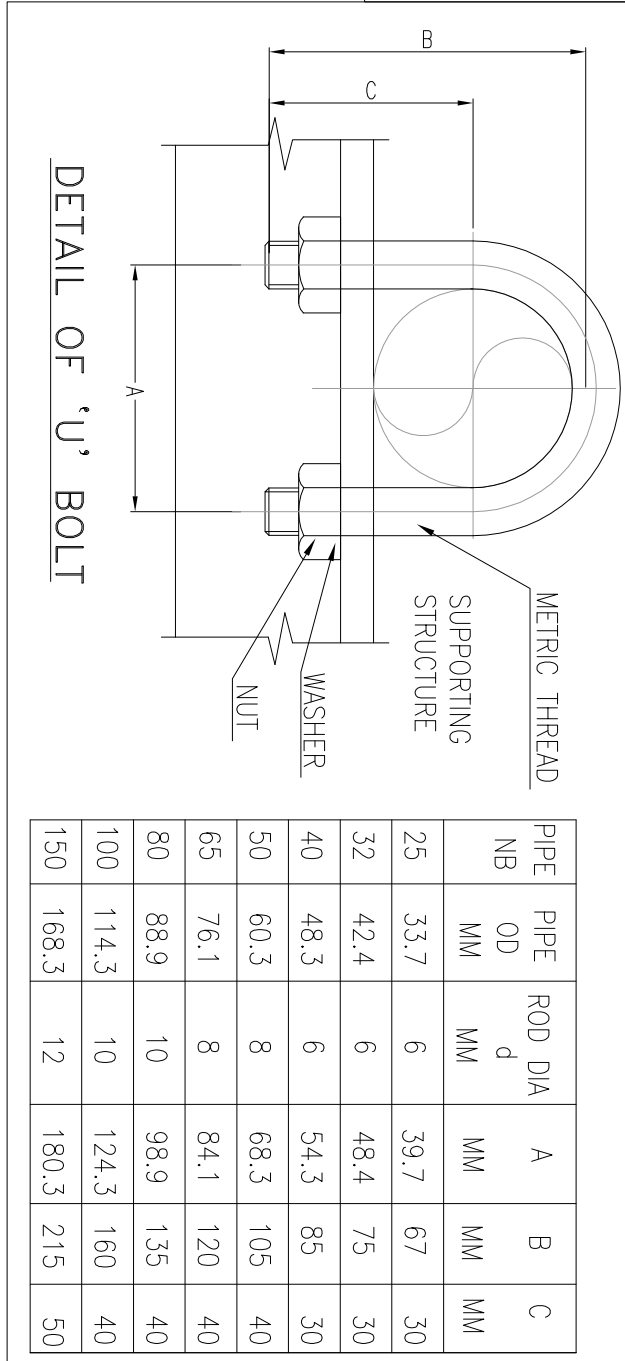
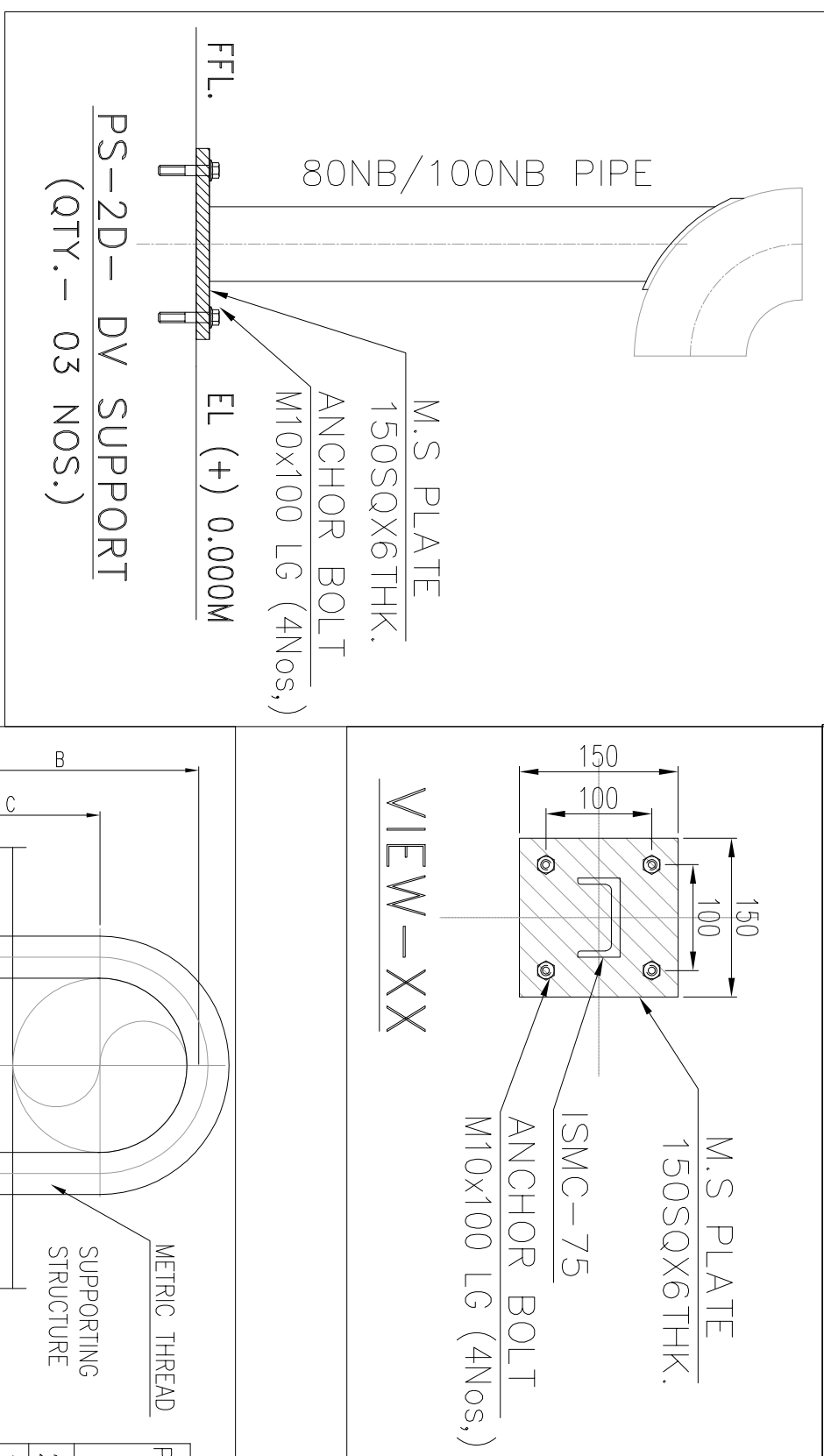
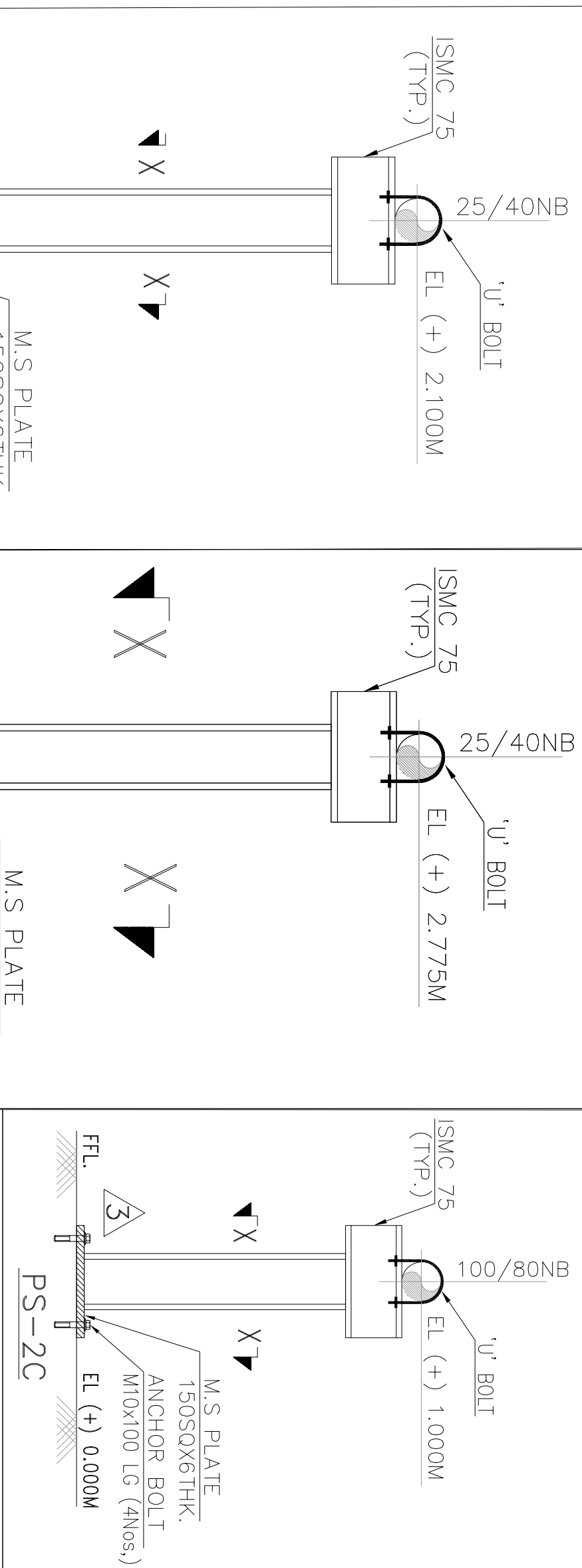
03	16.0.19	AMIT	KD	MNSR	REVISED AS PER COMMENTS
02	06.02.19	AMIT	KD	MNSR	REVISED AS PER COMMENTS
01	20.11.18	AMIT	KD	MNSR	REVISED AS PER COMMENTS
	DATE	ALTERED	CHECKED	APPROVED	NOTE
PROJECT 2x660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH (EPC MAIN PLANT PACKAGE)					
OWNER CONSULTANT: FICHTNER M/s FICHTNER GmbH & Co KG, Stuttgart,GERMANY			OWNER:  BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH		
DRAWN BY		DATE	NAME	BHARAT HEAVY ELECTRICALS LTD PROJECTS ENGINEERING & SYSTEMS DIVISION HYDERABAD	
DESIGN BY		07.06.18	AMIT KUMAR	SCALE:	
CHECKED BY		07.06.18	KAMALUDDIN	SHEET 01 OF 02	
APPROVED BY		07.06.18	M.N.S.R.		
SUPERSEDES:					
SUPERSEDED BY:			PROJECT NO.:		
SYSTEM:			DRAWING NO.: MAITREE-00-SGF-MDA-377046-PES		
			REV 03		

BHARAT HEAVY ELECTRICALS LIMITED PROJECT ENGINEERING & SYSTEMS DIVISION R C PURAM, HYDERABAD 502032							REV-02 DATE: 06.02.19
VALVE SCHEDULE OF FOAM SYSTEM							REFERENCE DWG.
S. NO.	TAG NO.	TYPE OF VALVE	SIZE	Rating	MOC	LOCATION	
1	SGF01 AA001	GATE VALVE	50 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	RETURN LINE TO FOAM TANK-1	
2	SGF01 AA002	GLOBE VALVE	15 NB	Class 800 as per API 602	SS316	INSTRUMENT ROOT VALVE IN FOAM TANK-1	
3	SGF01 AA003	GATE VALVE	25 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	DRAIN VALVE IN FOAM TANK-1	
4	SGF01 AA004	GATE VALVE	65 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	FOAM TANK-1 DISCHARGE LINE	
5	SGF02 AA001	GATE VALVE	50 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	RETURN LINE TO FOAM TANK-2	
6	SGF02 AA002	GLOBE VALVE	15 NB	Class 800 as per API 602	SS316	INSTRUMENT ROOT VALVE IN FOAM TANK-2	
7	SGF02 AA003	GATE VALVE	25 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	DRAIN VALVE IN FOAM TANK-2	
8	SGF02 AA004	GATE VALVE	65 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	FOAM TANK-2 DISCHARGE LINE	
9	SGF03 AA001	GLOBE VALVE	15 NB	Class 800 as per API 602	SS316	INSTRUMENT ROOT VALVE IN FOAM PUMP (MAIN)	
10	SGF03 AA002	NON RETURN VALVE	50 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8	DISCHARGE LINE OF FOAM PUMP (MAIN)	
11	SGF03 AA003	GLOBE VALVE	15 NB	Class 800 as per API 602	SS316	INSTRUMENT ROOT VALVE IN FOAM PUMP (MAIN)	
12	SGF03 AA004	GATE VALVE	50 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	DISCHARGE LINE OF FOAM PUMP (MAIN)	
13	SGF03 AA005	GATE VALVE	65 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	SUCTION LINE OF FOAM PUMP (MAIN)	
14	SGF04 AA001	GLOBE VALVE	15 NB	Class 800 as per API 602	SS316	INSTRUMENT ROOT VALVE IN FOAM PUMP (STANDBY)	
15	SGF04 AA002	NON RETURN VALVE	50 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8	DISCHARGE LINE OF FOAM PUMP (STANDBY)	
16	SGF04 AA003	GLOBE VALVE	15 NB	Class 800 as per API 602	SS316	INSTRUMENT ROOT VALVE IN FOAM PUMP (STANDBY)	
17	SGF04 AA004	GATE VALVE	50 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	DISCHARGE LINE OF FOAM PUMP (STANDBY)	
18	SGF04 AA005	GATE VALVE	65 NB	Class 150 as per ASME B 16.34	ASTM A351 Gr.CF8/CF8M	SUCTION LINE OF FOAM PUMP (STANDBY)	
19	SGF05 AA001	GLOBE VALVE	15 NB	Class 800 as per API 602	SS316	INSTRUMENT ROOT VALVE IN COMMON DISCHARGE HEADER FOAM PUMP	
20	SGF06 AA001	GATE VALVE	80 NB	Class 150 as per ASME B 16.34	ASTM A216 Gr.WCB	UPSTREAM OF DELUGE VALVE FOR HSD-1	
21	SGF06 AA002	GATE VALVE	80 NB	Class 150 as per ASME B 16.34	ASTM A216 Gr.WCB	DOWNSTREAM OF DELUGE VALVE FOR HSD-1	
22	SGF06 AA004	-	-	-	-	NOT USED	
23	SGF06 AA005	-	-	-	-	NOT USED	
24	SGF07 AA001	GATE VALVE	80 NB	Class 150 as per ASME B 16.34	ASTM A216 Gr.WCB	UPSTREAM OF DELUGE VALVE FOR HSD-2	
25	SGF07 AA002	GATE VALVE	80 NB	Class 150 as per ASME B 16.34	ASTM A216 Gr.WCB	DOWNSTREAM OF DELUGE VALVE FOR HSD-2	
26	SGF08 AA001	GATE VALVE	100 NB	Class 150 as per ASME B 16.34	ASTM A216 Gr.WCB	UPSTREAM OF DELUGE VALVE FOR DYKE	
27	SGF08 AA002	GATE VALVE	100 NB	Class 150 as per ASME B 16.34	ASTM A216 Gr.WCB	DOWNSTREAM OF DELUGE VALVE FOR DYKE	
28	SGF08 AA003	GATE / GLOBE VALVE	25 NB	PN 16	GUN METAL	ISOLATION VALVE FOR ARV	

Note:

- All valves shall be Manual type.
- Design Temp shall be "Ambient".
- Flow shall be as per P&ID FOR FOAM SYSTEM # MAITREE-0-SGF-FB-377001-PES





PIPE NB	PIPE OD	ROD DIA	A	B	C
MM	MM	MM	MM	MM	MM
25	33.7	6	39.7	67	30
32	42.4	6	48.4	75	30
40	48.3	6	54.3	85	30
50	60.3	8	68.3	105	40
65	76.1	8	84.1	120	40
80	88.9	10	98.9	135	40
100	114.3	10	124.3	160	40
150	168.3	12	180.3	215	50

Technical purchase specification for Foam Pumps with Drive assembly, Doc No: PY51483, Page 29 of 231

ESP-001- 2A Rev.00	 	BHARAT HEAVY ELECTRICALS LIMITED PROJECT ENGINEERING & SYSTEMS DIVISION RAMACHANDRAPURAM: HYDERABAD - 502 032	Std. / Doc. Number	
			Annexure-2	
			Rev. No.	00

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Annexure-2

Revisions:	Prepared by :	Checked by :	Approved by :	Date :
Refer to record of revisions	Girish Prasad Palo	Siva Prasad Babu	Siva Prasad Babu	18.07.19

PROJECT: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH
CUSTOMER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED (BIFPCL)
CONSULTANT: FICHTNER GmbH Co KG

DATA SHEET FOR FOAM PUMPS (GEAR PUMPS)			
Sl.no>Description		BHEL Requirement	DETAILS
GENERAL DATA			
1	Service	Foam Pump (Gear Pump) is envisaged for supplying foam to foam system from the foam storage tank.	
2	Number of Pumps	Total : 2 Nos.[1W+1S] [1 Motor driven & 1 Engine driven]	
3	Location	Indoor	
4	Duty	Continuous or Intermittent as demanded by system	
5	Drives	Motor & Diesel Engine	
6	Pumping fluid	Aqueous Film Forming Foam Concentrate Concentration ratio: 3% pH: 8.0 +/- 1.0 Specific Gravity: 1.02 +/- 0.02 Viscosity: Less than 5 cst Pour Point: Flows at 0 Deg C	
7	Fluid temp Deg C	Ambient	
PUMP PERFORMANCE & OTHER DETAILS			
8	Pump Type	Gear Pump	
9	Design Standard of pump	As per FM [Class Number: 1313] standard/UL standard	
10	Rated Flow (m³/hr)	11.5	
11	Rated Differential Head (kg/cm2.)	12.1	
12	Temperature of pumping fluid	Ambient	
13	Pump Model No.	Both Motor & Engine driven pump shall be identical in design ie interchangeable. Bidder to indicate pump model	
14	Parallel operation	Yes	
15	Rated Speed of Pump (rpm)	Bidder To Furnish	
16	Rated speed of Motor (rpm)	Bidder To Furnish	
17	Rated speed of Engine (rpm)	Bidder To Furnish	
18	Pump Efficiency in %	Bidder To Furnish	
19	Available Pressure at centre line of Suction nozzle of Pump kg/cm2 (a)	Min. 1.0 kg/cm2	
20	NPSH(A) at pump suction nozzle (mlc)	10.0 m	
21	NPSH(R) (mlc)	Bidder to furnish.	
22	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition.	
23	Pump shut off head.	As per FM [Class Number: 1313] standard/UL standard	
24	Pump shut off head/rated head.	Bidder To Furnish	
25	BEP of the offered pump, m3/Hr	Bidder To Furnish	
26	Thermal minimum flow , m3/Hr	Bidder To Furnish	
27	Stable minimum flow, m3/Hr	Bidder To Furnish	
28	Pump End of the curve flow, m3/hr	Bidder To Furnish	
PUMP CONSTRUCTION FEATURES			
29	As per FM standard (FM-1313)/UL standard. Bidder to furnish MOC of all the component of pump.		
30	Sealing arrangement	As per FM standard (FM-1313)/UL standard	
31	Type of axial thrust balancing arrangement	As per FM standard (FM-1313)/UL standard	
32	Type of main bearings for pump	As per FM standard (FM-1313)/UL standard	
33	Main bearings lubrication	As per FM standard (FM-1313)/UL standard	
34	Type of thrust bearings for pump	As per FM standard (FM-1313)/UL standard	
35	Thrust bearing lubrication	As per FM standard (FM-1313)/UL standard	
36	Direction of rotation of Pump	Bidder To Furnish	
37	Direction of rotation of Motor	Bidder To Furnish	
38	Direction of rotation of Engine	Bidder To Furnish	
COUPLING			
39	As per FM standard (FM-1313)/UL standard.		
PERFORMANCE TEST STANDARD FOR PUMPS			
40	Performance requirements	As per FM standard (FM-1313)/UL standard.	
41	Performance tolerances	As per FM standard (FM-1313)/UL standard.	
42	Maximum Allowed Working Pressure (MAWP) in Kg/cm2 g	Bidder To Indicate	
43	Hydraulic test pressure of casing Kg/cm²(g)	As per FM standard (FM-1313)/UL standard.	
44	Noise level for Pump	85 DBA at 1 m distance, in any direction	
45	Vibration for Pump	As ISO 10816 [Refer Annexure 5-H]	
46	Pump Instruments	As per FM standard (FM-1313)/UL standard.	
PUMP TERMINAL POINT DETAILS			
47	Pump Suction nozzle - Size - Rating - Standard - Facing - Location	Bidder To Indicate	
48	Pump Discharge nozzle - Size - Rating - Standard - Facing - Location	Bidder To Indicate	

PROJECT: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH
CUSTOMER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED (BIFPCL)
CONSULTANT: FICHTNER GmbH Co KG

Sl.no	Description	BHEL Requirement	DETAILS
50	Vent/Drain connection: 1.Vent with 3 way SS isolating valve 2.Drain connection with valve	Bidder To Indicate	
MOTOR DETAILS FOR MOTOR DRIVEN PUMPS [For details, Please refer enclosed specifications & relevent standards]			
51	Drive/Installation	Motor/Horizontal	
52	BKW at the rated point	Bidder To Furnish	
53	BKW at end of curve	Bidder To Furnish	
54	Slected drive rating in kW: Requirements as per FM-1313 & NFPA	Bidder to mention motor kW rating for the motor duly taking care of the requirements.	
55	Design Standard of Motor	NEMA MG 1, IEC 60034-1 & NFPA	
56	Service Factor	These service factors shall be in accordance with NEMA MG-1, Motors and Generators.	
57	Manufacturer	Bidder To Furnish	
58	Ambient Temperature	50 Deg C All motors shall be designed to operate in humid atmosphere with a maximum ambient temperature of 50 Deg C.	
59	Area classification for motor	Safe Area	
60	Rated Voltage & Frequency	415 V & 50 Hz	
61	Permissible variations in Voltage/Frequency/Combined	Voltage: (+/-)10% Frequency:(+/-)5% Combined: Any combination of the above	
62	No of poles / synchronous speed	Bidder To Furnish	
63	Energy efficient class	IE3	
64	Starting Current as % of FLC	Motor starting current must not exceed 7.0 times rated current	
65	Method of Starting	Bidder To Indicate	
66	Method of cooling	TEFC, Ventilation shall be effective irrespective of direction of rotation.	
67	Class of Insulation & Temp. rise	Class F with Temperature rise ltd. to class B	
68	Space Heater	Required for all motors 55 kW and above	
69	Degree of protection/Canopy Required	IP 55/Yes	
70	TB Short time-Current & Short time-Time	50 kA , 0.25 Sec	
71	TB To be provided on the right hand side as viewed from the drive end.	Bidder To Furnish	
72	Cable, Cable glands & Lugs	Suitable double compression Nickel plated brass cable glands and Tinned copper lugs to be provided by the bidder.	
73	No. of Starts	Refer clause no B0.6.18.7.2, f & h of Annexure 2-D	
74	Noise	85 DBA at 1 m distance, in any direction	
75	Vibration	Refer Annexure 2-D & H	
DIESEL ENGINE DETAILS FOR ENGINE DRIVEN PUMPS [For details, Please refer enclosed specifications & relevent standards]			
76	Drive	Diesel Engine	
77	Type	Bidder To Furnish	
78	Location	Indoor	
79	BKW at the rated point	Bidder To Furnish	
80	BKW at end of curve	Bidder To Furnish	
81	Slected drive rating: Requirements as per FM-1333: Horsepower rating adjustments for installation conditions are made for increased elevation and increased operating temperature in accordance with NFPA 20, Sections 11.2.2.4 and 11.2.2.5, plus Graphs A11.2.2.4 and A11.2.2.5.	Bidder to mention engine HP rating for the Diesel Engine duly taking care of the requirements.	
82	Drive Standard	As per FM [Class Number: 1333] approved/ UL listed	
83	Name of Manufacturer	Bidder to furnish.	
84	Model No	Bidder to furnish.	
85	Duty	Intermittent. However, same shall be capable of operating continuously on full load at the site elevation for a period of six hours.	
86	Speed	Bidder To Furnish	
87	Type of cooling	Bidder to Furnish	
88	Noise	105 DBA at 1 m distance, in any direction	
89	Vibration	As per IS standard	
90	Note: Individual datasheets for Pump, Motor & Diesel shall be furnished during detailed engg stage. It is mandatory for the equipment supplier to furnish in format [to be submitted during detailed engg stage] in case of placement of order.		

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			Annexure-3	
			Rev. No.	00

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Revisions:	Prepared by :	Checked by :	Approved by :	Date :
Refer to record of revisions	Girish Prasad Palo	Siva Prasad Babu	Siva Prasad Babu	18.07.19

	PROJECT ENGINEERING & SYSTEMS DIVISION BHARAT HEAVY ELECTRICALS LIMITED R.C.PURAM, HYDERABAD-502032				
	PRICE FORMAT (R00) FOR FOAM PUMPS (GEAR PUMPS) WITH DRIVES PROJECT: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH CUSTOMER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED (BIFPCL) CONSULTANT: FICHTNER GmbH & Co KG				
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. : <Bidder to indicate> BHEL Enq. No. & date : <Bidder to indicate>				
I	MAIN OFFER [Note: Prices for individual items to be quoted as indicated in the price bid format.]				
A	MATERIAL SUPPLY: FOAM PUMP WITH MOTOR [Material code: PY9751483018]				
A.1	Foam Pump with Drive Motor, Controller along with all accessories including commissioning spares, special tools & tackles as per specification.	1	Set		
A.2	MATERIAL SUPPLY: FOAM PUMP WITH ENGINE [Material code: PY9751483026]				
	Foam Pump with Diesel engine, Controller, Fuel tank, Battery, Charger etc along with all accessories including commissioning spares, special tools & tackles as per specification.	1	Set		
B	SUPERVISOR CHARGES FOR ERECTION & COMMISSIONING AT SITE, Refer Note-12				
B.1	For Pump: Per diem rate for the supervision of Erection & commissioning of Foam pump. Material Code : PY9851483036	2	Days		
B.2	For Pump: 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 Foam Pump Material Code : PY9851483044	1	Visit		
B.3	For Motor & Controller: Per diem rate for the supervision of Erection & commissioning of Motor & Controller for Foam Pump [Motor driven] Material Code: PY9851483036	2	Days		
B.4	For Motor & Controller: 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 Motor & Controller for Foam Pump [Motor driven] Material Code: PY9851483044	1	Visit		
B.5	For Engine & Controller: Per diem rate for the supervision of Erection & commissioning of Diesel engine & Controller of Foam Pump (Diesel Engine driven) Material Code: PY9851483036	2	Days		
B.6	For Engine & Controller: 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 Diesel Engine & Controller for Foam Pump (Diesel Engine driven) Material Code: PY9851483044	1	Visit		
C	MANDATORY SPARES [Material Code: PY9751483050] Refer note-8				
C.1	Pump				
C.1-i	Impellers /Gears	1	Set of each size/type		
C.1-ii	Shaft	1	No. of each size/type		
C.2	Engine				
C.2-i	Sprayers/Injector	0	0		
C.2-ii	Piston rings & sealing rings	1	Set		
C.2-iii	Exhaust valve assembly	1	Set		
C.2-iv	Springs	1	Set		
C.2-v	Packings and gaskets	1	Set		
C.2-vi	Fuel oil filter elements with seals	2	Sets		
C.2-vii	Fuel oil filter assy	1	Set		
C.2-viii	Lub. oil filter elements with seals	2	Sets		
C.2-ix	Scrapper rings	1	Set		
C.2-x	Solenoid coil for fuel valve	1	No		
C.2-xi	Corrosion inhibitor (if provided)	1	Set		
C.2-xii	Big end & small end bearing of connecting rod	1	Set		
C.2-xiii	Speedometer	1	No		
C.2-xiv	Speedometer wire	1	No		

Annexure-4

	PROJECT ENGINEERING & SYSTEMS DIVISION BHARAT HEAVY ELECTRICALS LIMITED R.C.PURAM, HYDERABAD-502032				
	PRICE FORMAT (R00) FOR FOAM PUMPS (GEAR PUMPS) WITH DRIVES PROJECT: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH CUSTOMER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED (BIFPCL) CONSULTANT: FICHTNER GmbH & Co KG				
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. : <Bidder to indicate> BHEL Enq. No. & date : <Bidder to indicate>				
C.2-xv	Rubber hoses of water line with mounting clamps	1	Set		
C.2-xvi	Cranking starter assembly complete	1	Set		
C.2-xvii	Lub. oil and fuel oil hoses with end connectors	1	Set		
C.2-xviii	Water pump belts	2	Sets		
C.3	Control & Instrumentation				
C.3-i	All type of local indicators	2 Nos of each make, model & type			
C.3-ii	Process actuated switch devices: [All type of Pressure, Diff Pressure, Flow, temperature, Level switch devices]	2 Nos of each type & model			
C.3-iii	All type of Electronic Transmitters and Ultrasonic Transmitters including sensors.	10% or 1 No. of each type and model whichever is more.			
C.3-iv	Limit switches for isolation valves	2 Nos. of each type			
C.3-v	PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable) : Valves	1 No. of each type, class, size and model.			
C.3-vi	PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable): 2 way, 3 way, 5 way valve manifolds	1 No. of each type, class, size and model.			
C.3-vii	PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable): Fittings	5% or 1 No. of each type, class, size and model whichever is more.			
II	OPTIONAL ITEMS				
A	Engine Revalidation spares	1	Set		
B	2 Years Recommended Spares: Recommended spares list for two years normal operation along with unit price breakup for Pump, Drives & other accessories. (List with price break up to be enclosed) (1 set stands for quantity required for the replacement of one pump, drive (or) accessories)	1	Set		
TOTAL					
III TAXES AND DUTIES:					
(Packing and Forwarding, Freight, Insurance, Taxes & Duties as applicable to be quoted below separately for both Supply and E&C)					
(A) For Supply:					
(i) Packing & Forwarding :					
(ii) Freight:					
(iii) Insurance:					
(iv) Taxes and Duties					
(v) Any other:					
(B) For E&C:					
(i) Tax:					
(ii) Any other:					
Notes:					
1) Bidder to quote strictly as per BHEL's NIT requirements.					
2) Bidder to note that this is a LUMP SUM Turn-Key Order. However					
(a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably.					
(b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.					
3) Main offer consists of those items which will be part of main order after successful bidder is identified. Optional Items consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under Main offer and Optional items as per the prescribed format.					

Annexure-4

	PROJECT ENGINEERING & SYSTEMS DIVISION BHARAT HEAVY ELECTRICALS LIMITED R.C.PURAM, HYDERABAD-502032				
PRICE FORMAT (R00) FOR FOAM PUMPS (GEAR PUMPS) WITH DRIVES PROJECT: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH CUSTOMER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED (BIFPCL) CONSULTANT: FICHTNER GmbH & Co KG					
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. : <Bidder to indicate> BHEL Enq. No. & date : <Bidder to indicate>					
4) Prices quoted by bidders for items under main offer : Sl. No. I [A to C] & III will be considered for evaluation of lowest bidder. However, BHEL reserves the right. (a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evaluation will be intimated to vendor during technical evaluation (before price bid opening). (b) To place PO for any of the Optional items within the contract period. Hence bidders need to mandatorily quote reasonable prices for all optional items considering such requirement and keep the validity of the prices till the end of contract period.					
5.a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection. 5.b) Bidder must not change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price. 5.c) <u>Bidder to quote for all the items as per price bid format. Incomplete/partial offer may be liable for rejection</u>					
6) Bidder to quote the base rates only. All other commercial charges for packing, freight, transportation, insurance, taxes & duties etc., shall be indicated separately.					
7 a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended (as per bidders experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum. 7.b) Commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.					
8) With respect to Mandatory Spares; A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced. B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL.					
9) Reference document: BHEL Specification PY51483 & all its annexures.					
10) Unpriced price bid format indicating as quoted against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.					
11) In case the systems are being supplied from outside India, reputed Third Party Inspection like Llyods, BV, DNV, CEIL and TUV has to be considered and the charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency. Refer clause no 9.2 reg various TPI.					
12) With respect to Supervision charges, prices quoted by bidder shall be considered for L1 bidder evaluation. Referring to Sl no B.1 TO B.2, Foam pump, For the purpose of Quotation, total no of 2 man days for Pump will be covered in 1 visits have been considered. payment against Sl.No B.1 TO B.2 above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates. Referring to Sl no B.3 TO B.4, Motor , For the purpose of Quotation, total no of 2 man days for Motor & Controller will be covered in 1 visits have been considered. Payment against Sl.No B.3 TO B.4 above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates. Referring to Sl no B.5 TO B.6, Diesel Engine , For the purpose of Quotation, total no of 2 man days for Diesel Engine & Controller will be covered in 1 visits have been considered. Payment against Sl.No B.5 TO B.6 above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates. Purchase Order for supply of main items, (A and C) shall be placed by BHEL- PE&SD Hyderabad. For Supervision of E&C, LOI shall be placed by PE&SD and PO By BHEL-Site.					

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Annexure-4

Revisions:	Prepared by :	Checked by :	Approved by :	Date :
Refer to record of revisions	Girish Prasad Palo	Siva Prasad Babu	Siva Prasad Babu	18.07.19

CHECKLIST FOR OFFER FOR FOAM PUMP WITH DRIVES (MOTOR/DIESEL ENGINE)

S.No.	Description	Bidder's Reply
1.	Bidder to confirm that Performance requirement, Design and construction of the offered Pump model shall be FM [Class Number: 1313] approved/UL listed.	
2.	Bidder to confirm that Performance requirement, Design and construction of the offered Motor shall be NEMA MG 1, IEC 60034-1 & NFPA.	
3.	Bidder to confirm that Motors make shall be as per NTPC approved vendor list.	
4.	Bidder to confirm that Performance requirement, Design and construction of the offered Diesel Engine shall be FM [Class Number: 1333] approved/UL standard.	
5.	Bidder to confirm that Performance requirement, Design and construction of the offered Electric-Drive Controllers and Engine-Drive Controllers shall be FM [Class Number 1321/1323] approved/UL standard.	
6.	Scope of supply as per Tender Specification. Bidder to Confirm. <u>Scope of supply furnished elsewhere in the offer submitted by bidders shall not be reviewed w.r.t scope.</u>	
7.	Bidder to confirm that Scope of supply shall be as per FM (FM-1313)/UL standard	
8.	Bidder to confirm that bidder has clarity on Layout [annexure 1-C] regarding requirement of Piping (fuel system, exhaust system), cabling etc as required by the skid.	
9.	Bidder to confirm that all cabling [control/signal/power] from Controller to Motor, Controller to Engine-Battery-Battery charger etc included in their scope of supply.	
10.	<u>Cable Glands & Lugs:</u> Suitable power, control and signal cable with glands & lugs shall be included in bidder scope of supply. Deviation in this is not acceptable. Bidder to Confirm.	
11.	Based on layout enclosed [refer Annexure 1-C], bidder to consider suitable length of exhaust piping with silencer, SS metal expansion below & insulation with required no of bends. Bidder to Confirm.	
12.	<u>Battery:</u> Each engine shall be provided with 2 Nos. of Ni-Cd or Lead-acid plante battery units as per IS. Battery shall be sized as per FM-1333. Bidder to Confirm.	
13.	<u>Battery Charger:</u> Each engine shall be provided with 2 sets of battery charger units as per specification. Bidder to Confirm.	

14	Suitable reducers/expanders & counter flanges along with gaskets & stud nuts at all the terminal points are considered by bidder. Deviation in this is not acceptable. Bidder to Confirm.	
15	All the list of commissioning spares indicated in price bid format are included in bidder's scope of supply. Any commissioning spare required over and above the recommended commissioning spares during commissioning shall be supplied free of cost by the equipment vendor. Deviation in this is not acceptable. Bidder to Confirm.	
16	All the special tools and tackles indicated in tender specification are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.	
17	Bidder to confirm that seaworthy packing considered for all imported items as per specification.	
18	Bidder to appoint TPI agency from the following on behalf of BHEL for inspection of items sourced from outside India: i. Lloyds Register of Industrial Services (LRIS), ii. Bureau Veritas (BV), iii. Det Norske Veritas (DNV), iv. Certification Engineers International Ltd. (CEIL), v. TUV Bidder to Confirm.	
19	Bidder to submit Soft copy and hard copy of logics executed in Controller for uploading the same by end customer later.	
20	2 year recommended spares list is enclosed with bidder's offer whose optional price is indicated in Annexure-4 (Price Bid Format). Bidder to Confirm.	
21	Bidder to meet the Equipment Qualification Criteria. All the references shall be submitted along with the offer as per Annexure-8 Deviation in this is not acceptable. Bidder to Confirm.	
22	Painting schedule shall be as per Annexure-5-J & 12 of Tender Specification, Bidder to Confirm.	
23	<u>Inspection, Testing requirements for Pump & Drive assembly:</u> Inspection, Testing requirements shall be as per BHEL QAP & specification requirement only. Bidder to note that QAP shall be as per Annexure-5-I & 7 & the same shall be discussed during detail engg. However in case of practical difficulties in meeting the quality requirement, same shall be mutually discussed & agreed during detail engg. Stage. Bidder to note & confirm.	
24	Make of all the items shall be as per Annexure-5-K (Sub-Vendor List). Bidder to confirm.	
25	Bidder to confirm compliance with Annexure-9, Master Document List enclosed with Tender Specification, wrt list of documents, schedule of submission.	
26	Bidders to comment on the instrumentation requirement as per P&ID (Annexure -1) based on their experience. If any other instruments are required as per good engg practice, bidder to highlight & Consider the same.	
27	Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-10 before submission of Techno Commercial offer. Any deviation/ queries raised during	

	technical bid submission shall not be entertained. Bidder to Confirm.	
28	Bidder to quote as per Annexure-3, Price Bid Format only. Price quoted as per the price bid format, clearly indicating all the applicable items are quoted, and not applicable items are clearly highlighted. Un priced copy of the same is enclosed with bidder's offer. Bidder to check and confirm.	
29	Bidder to furnish list of revalidation spares. Bidder to check and confirm.	
30	Bidder to quote revalidation spares as optional item, sl no II-A of price bid format. Bidder to check and confirm.	
31	Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to check and confirm.	
32	Bidder to confirm that the following documents are submitted along with their offer to enable BHEL to evaluate the offer. i. Duly filled in Pump-Motor-Diesel Engine datasheet (Annexure-2) ii. Tentative GA Drawings for Pump with Motor & Engine drives iii. Performance curves for pump iv. Un-priced copy of price in attached BHEL price bid formats (Annexure-3) indicating quoted/ not quoted against each row & column. v. Equipment qualification criteria / PTR / Reference Lists (Annexure-6) vi. Checklist as per (Annexure-4) vii. Bidder shall submit <u>NO DEVIATION certificate</u> [Annexure-10] along with their offer. Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-11 before submission of Techno Commercial offer.	
33	All-important documents such as unpriced price bid, reference list, pump performance curve, Pump & drive assembly GA drawings, CS drawings must necessarily to be furnished by bidder along with their offer for evaluation. Bidder to once again check their offer before submission and confirm.	

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Revisions:	Prepared by :	Checked by :	Approved by :	Date :
Refer to record of revisions	Girish Prasad Palo	Siva Prasad Babu	Siva Prasad Babu	18.07.19

ESP-001- 2A Rev.00		PROJECT ENGINEERING & SYSTEMS DIVISION		Std. / Doc. Number	
				Annexure-5	
				Rev. No.	00

Annexure-2

Customer Consultant Specifications:

- a) Site condition
- b) Fire Protection system details
- c) Pump details
- d) HT & LT Motor details
- e) Instrumentation details
- f) Battery & Battery Charger details
- g) Cable & Cable tray details
- h) Vibration requirement
- i) Testing requirements
- j) Painting & colour code
- k) Sub vendor list

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- **Auxiliary plant systems** (refer to Section B12)
 - Compressed air system
 - Hydrogen system
 - Workshop and store
 - Chemical laboratory
 - Fire fighting system
 - De-dusting system
 - HVAC system

B0.2.3 Interface points

For interface points see below.

B0.2.4 Site conditions

The following information on local conditions is investigated or compiled by the Employer. The Contractor is hereby in no way relieved from his duties of carrying out all investigations required for satisfactory performance of his works. The Contractor shall perform his own Site visits and investigations, prior to Contract award in order to familiarize him with the existing conditions of the Site and the surrounding area.

Location, accessibility and present condition of the Site

The site for the Maitree-STPP Project is geographically located between 22° 37'0" N to 22°34'30"N and 89°32'0"E to 89°34'5"E, approximately 14 km northeast of the Mongla Port and 14 km northwest of the Sundarbans, is infringed by the Passur and Moidara Rivers to the west and south east respectively. The project requires an area of approximately 500 acres.

The topographical survey indicates a natural ground level of +1.15 to +1.35 meters above sea level. A severe cyclone in 2009 raised the level to 4.47 meters and it was decided to raise the **Plant level to +5.00 meters.**

Politically, the site is located in Rampal Upazila of the Bagherat District in the Rajnagar Union

Currently, the Site is accessible by boat only.

The nearest inland port is Mongla port at around 14km direct distance.

The proposed Khan Jahan Ali Airport is located at a distance of approximately 12 km from the project site.

Soil conditions

First soil investigations of the Plant site and adjacent areas have been carried out. For information only the findings of these initial soil investigations are attached in Part C Annexes.



In general the subsoil conditions can be described as follows:

- top layer filled sand (with unknown silt content) in Plant area
- underlying layers of clay
- underlying fine sand.

The Contractor shall conduct soil improvement measures at site. Beside other aspects, consolidation of filling shall be incorporated in soil improvement concept.

Seismic zone

Attention shall be paid to seismic parameters. Related to soil type as identified to Soil Investigation Report, the effect of local soils on earthquake ground motion shall be determined.

For site class "S1" and "S", as expected for the Project, site specific studies shall be carried out to determine the design acceleration response spectrum. During field study minimum the following tests shall be executed:

- Seismic cross hole test; and
- Seismic refraction test.

Based on these results a site specific Response Spectra shall be established. Peak spectral acceleration shall be determined, but shall be not less than 0.12g, as mentioned in BNBC 2012, Table 2.5.2.

Site climatic conditions

The Plant site is from the climatic point of view under maritime tropical conditions. The assumed meteorological conditions for the Site are as follows:

The project site is located in the country's South Central Zone consisting of three dominant seasons:

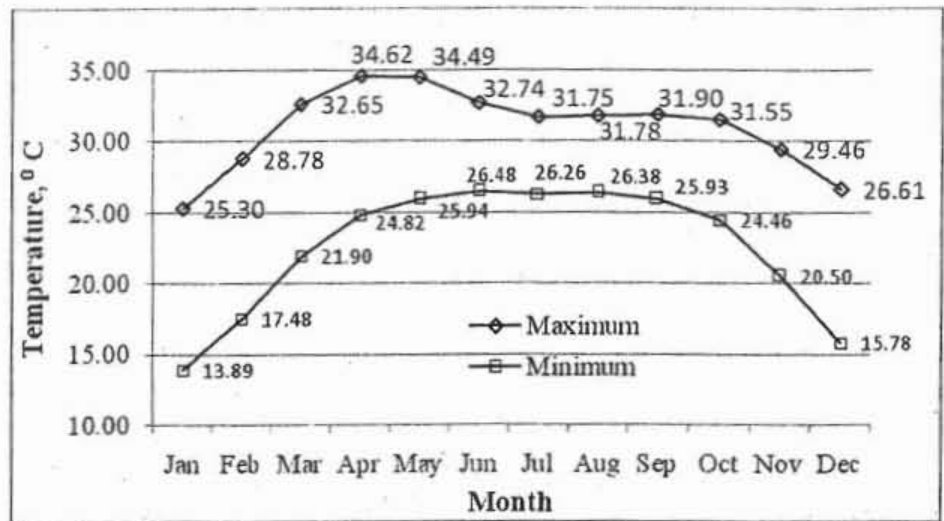
- summer season-March to May
- monsoon season-June to October
- winter season-November to February.

During the Monsoon Season occasional cyclonic storms can occur.

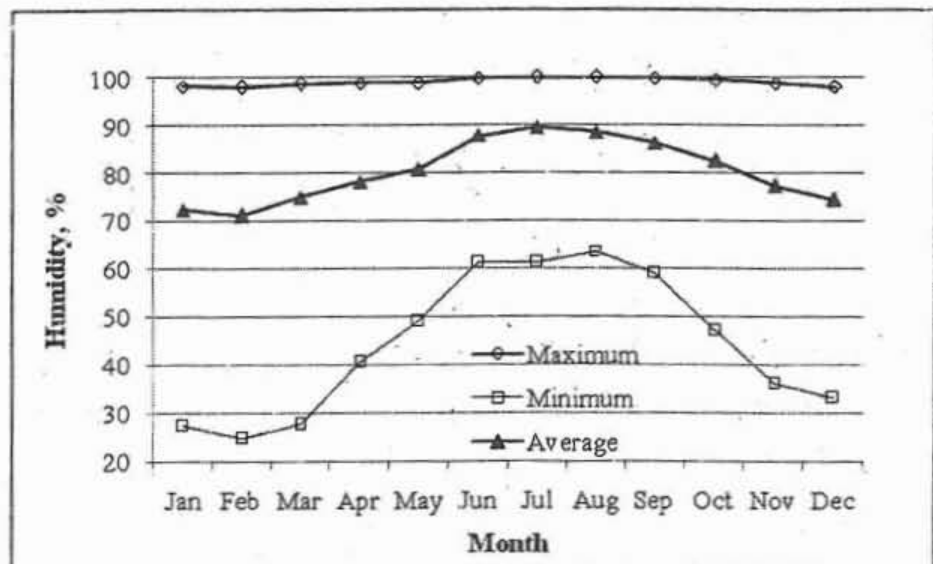
The climatic conditions in the area are continuously monitored by the Bangladesh Meteorological Department (BMD) at the Mongla Meteorological Station.

The temperature varies only slightly throughout the year with the **highest** temperature of **36.9°C** and the **lowest** temperature of **12.2°C** recorded in the period from 1989 to 2008. This distribution is depicted in figure below.





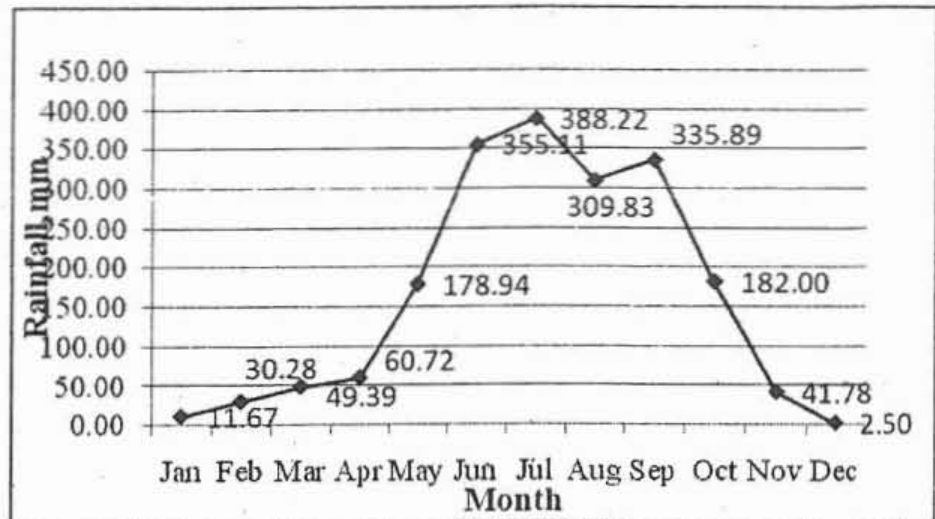
The relative humidity varies drastically during the Monsoon Season with 80% to 90% and the lowest levels of 20% to 30% during the Summer Season. The humidity profile recorded in the same period as the temperature is visualized in below figure.



The maximum rainfall occurs during the Monsoon Season by varying between 300 mm and 350 mm with almost no rainfall during the Winter Season.

The average evaporation in the project area varies between 3 - 5 mm/day with its peak of 16 mm/day during July. The average rainfall for the period between 1991 and 2008 is depicted in below figure.





Below definitions are to be used as typical data for the different climatically seasons at the site.

Average Site Condition ASC

Ambient Temperature: 27.3 °C
 Ambient Humidity 87 %
 Ambient Pressure 1007.6 mbar
 River Water Temperature: 29.8 °C

Summer Site Condition SSC

Ambient Temperature 36.9 °C
 Ambient Humidity 60 %
 Ambient Pressure 1007.9 mbar
 River Water Temperature: 33 °C

Winter Site Conditions WSC

Ambient Temperature 12.2 °C
 Ambient Humidity 100 %
 Ambient Pressure 1017.2 mbar
 River Water Temperature: 20°C

Reference Site Conditions RSC

Ambient Temperature 31 °C
 Ambient Humidity 88 %
 Ambient Pressure 1007 mbar
 River Water Temperature: 32°C

Reference Site Condition shall apply for the Guarantee Values as well as for the Guarantee Tests/Performance Test. However, Plant must cope with the Site Conditions as specified.



Wet bulb temperature shall be calculated by Bidder/Contractor based on ambient temperature (dry bulb), ambient humidity and ambient pressure for the different cases.

Bidder/Contractor shall determine the wet bulb temperature for all site conditions and not only for reference site condition.

Design ambient conditions for Electrical Systems

- | | |
|---|--------|
| • Maximum design temperature (outdoor) | 45°C |
| • Maximum daily average ambient shade temperature | 38°C |
| • Maximum monthly average temperature (in the shade) | 34.6°C |
| • Maximum annual average temperature (in the shade) | 27.3°C |
| • Maximum design temperature of the electrical equipment installed indoors in air conditioned rooms | 40°C |
| • Maximum design temperature of the electrical equipment installed indoors non in air conditioned rooms | 45°C |
| • Minimum design temperature | 0°C |

Marine conditions

Two tides (e.g. flood and ebb) are regularly observed in the Passur River, which enters into the project site through numerous connected creeks.

The tidal range varies between 1.2 and 3.1 meters. The mean water level (CD) is about 0.87 meters (PWD=CD -1.17 meters). The mean high water level varies due to spring-neap tide conditions between +1.60 m and +2.6m PWD. The Highest High Water Level (HHW) is about +3.1m PWD and the Lowest Low Water Level (LLW) is about -1.4m PWD.

The marine conditions are detailed in **Section B11**, with details about:

- water levels
- waves
- currents
- river bathymetry, topography.



The salinity of the Passur River system varies with the amount of fresh water entering the system which is highly seasonal dependent. The surface water temperature ranges between 22.9°C and 33.0°C and the different water quality parameters are tabulated in **Part C Annexes**.

The marine conditions as recorded at Mongla Port Gauge Station (approx. 14 km south-east to the site) are as follows:

- | | | |
|----------------------------|-------|-------------|
| • Highest High Water Level | (HHW) | + 2.642 MSL |
| • Lowest Low Water Level | (LWL) | - 1.858 MSL |

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The Power Plant shall be designed for 100 years flood condition based on data provided by relevant Organization in Bangladesh and taking into account the Highest Astronomical Tide (HAT), the maximum wave conditions (including storm surges) and the potential event of Cyclone. The Contractor is responsible to verify the worst conditions.

These reference data are with respect to LAT, which corresponds to the Chart Datum (CD). The site land data is however with respect to the Bangladesh Land Survey Datum (BLSD), which corresponds to approx. +1.55 m CD (hence the MLSD corresponds to MSL).

Design Wave Height 2.0 m
Design Wave Period 6.0 sec
Sedimentation and Siltation: Soft to stiff clay and alternations of very sandy and stiff clay.

The results of bathymetric investigations of the Passur River can be found in Part C Annexes.

A water analysis from the area adjacent to the site giving salinity and water quality is shown below:

Sl. No.	Date	Temp	pH	DO	Chl	T. Alkalinity	Total Hardness	Ca	Mg	Na	SO	COO	Cl	Salinity
		°C		mg/L	mg/L	meq/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	7-Jan	27.8	7.74	3010	879	36	68.7	1545	1510	55	5.1	0.8	55	16
2	7-Jan	27.1	7.72	3030	878.1	36	68.3	1570	1510	60	5.1	0.8	55	16
3	7-Jan	27.8	7.71	3030	879	36	68.8	1545	1510	55	5.1	0.8	55	16
1	11-Feb	29.8	7.66	4380	1261	36	182	2390	2180	210	4.7	1	76	23
2	11-Feb	29.2	7.63	4380	1268	36	178	2390	2190	200	4.7	1	76	23
3	11-Feb	29.1	7.65	4380	1263	36	179	2380	2180	200	4.7	1	76	23
1	9-Mar	32.6	7.56	11780	2944.4	38	176	6080	5890	190	4.7	1.2	76	67
2	9-Mar	32.6	7.57	11780	2945.2	38	178	6080	5890	190	4.7	1.2	76	67
3	9-Mar	32.1	7.55	11780	2946.4	38	177	6090	5890	200	4.7	1.2	76	67
1	17-Apr	32.6	7.59	25300	8273	36	185.6	12950	12900	250	4.6	0.7	136	15.5
2	17-Apr	32.6	7.59	25300	8273	36	186.2	12950	12700	250	4.6	0.7	136	15.5
3	17-Apr	32.6	7.59	25300	8273	36	184.8	12950	12700	250	4.6	0.7	136	15.5
1	5-May	32.6	7.59	29200	9480	36	198.6	14900	14900	300	4.5	1.2	177	17.6
2	5-May	32.9	7.54	29200	9470	36	198.6	14900	14900	300	4.4	1.2	177	17.6

Figure 1 Water quality of the Passur River at Mongla point
(Source: EIA-Report)



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Loc id m	Date	Temp P	pH	EC	Cl-	T Alkal ity	Turbid ity	TSS	TDS	SS	DO	BOD	COD	Sul fate
		°C		µS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3	5-May	33.2	7.57	29100	9470	36	199.6	14900	14600	300	4.3	1.2	177	17.6
1	13-Jun	31.6	7.69	11000	5820	36	112.6	9200	9000	200	4.7	1.1	97	10.3
2	13-Jun	31.6	7.69	11000	5800	36	113.2	9200	9000	200	4.7	1.1	97	10.3
3	13-Jun	31.6	7.69	11000	5810	36	112.4	9200	9000	200	4.7	1.1	97	10.3
1	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	63	5.2	0.8	26	-
2	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	63	5.2	0.8	26	-
3	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	63	5.2	0.8	26	-
1	5-Aug	31.6	7.69	275	15.6	36	68.6	192	137	55	5.3	0.7	22	-
2	5-Aug	31.6	7.69	275	15.6	36	68.6	192	137	55	5.3	0.7	22	-
3	5-Aug	31.6	7.69	275	15.6	36	68.6	192	137	55	5.3	0.7	22	-
1	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.3	0.7	22	-
2	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.3	0.7	22	-
3	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.3	0.7	22	-
1	13-Oct	30.6	7.79	290	26.6	36	62.6	192	145	47	5.6	0.7	22	-
2	13-Oct	30.6	7.78	290	26.6	36	62.6	192	145	47	5.6	0.7	22	-
3	13-Oct	30.6	7.78	290	26.6	36	62.6	192	145	47	5.6	0.7	22	-
1	5-Nov	24.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
2	5-Nov	24.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
3	5-Nov	25.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
1	12-Dec	21.5	7.72	320	42.6	36	72.6	300	260	60	5.1	0.9	25	0.4
2	12-Dec	20.9	7.71	320	42.6	36	73.6	300	260	60	5.1	0.9	25	0.4
3	12-Dec	21.1	7.72	320	42.6	36	71.6	300	260	60	5.1	0.9	25	0.4

Figure 2 Water quality of the Passur River at Mongla point
(Source: EIA-Report)

Additional information on water quality parameters is shown in Part C Annexes.

Wind data

The project region is characterized by southerly winds from the Bay of Bengal during the Monsoon Season and north-westerly winds from the Himalayas during the Winter Season. During the Summer Season, the wind blows from south-southwest to north-northeast. The annual average wind speed amounts to 1.7 meter/second and the wind rose for the entire year is shown in Figure 5.5.

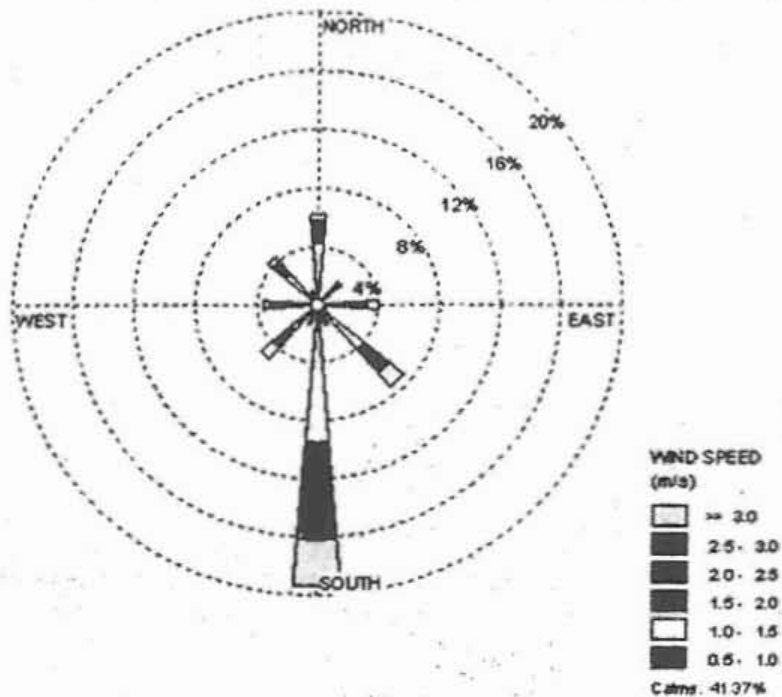
The wind load calculation for the buildings and structures shall be as per Bangladesh National Building Code -2012, Part 6, Chapter 2.4.

Basic wind Speed, V, shall be taken as 73 m/s, Three-second gust at 10 m above ground in exposure C, having a return period of 50 years.

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B0.2.5 Configuration

Two (2) Plant units mainly consisting of steam generator, steam turbine generator, flue gas treatment plants and associated equipment represent the core components of the Plant. The configuration of the power units and all of its main components shall be chosen according to proven and reliable vendor configuration. In doing so, adequate safety clearances, fire compartments, favourable layout of the Plant components for monitoring and maintenance and all other requirements such as those during Power Plant construction shall be taken into account.

The cooling requirement of the Plant shall be accomplished by induced draught cooling towers. The coal unloading facilities and the ash and gypsum loading facilities to ships shall be incorporated in a new jetty structure. Other main items are the power island, the coal yard, ash pond and other balance of plant facilities.

B0.2.6 Layout



The existing conditions at the location of the Plant are shown in the site overview as per the indicative layout in **Part C Annexes**. The Tenderer shall perform own Site visits and investigations prior to bidding in order to familiarize himself with the existing conditions. The Contractor shall propose the Plant layout deemed most practical and cost optimized for the Power Plant.



B12

Part 2: Fire Protection Systems



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B12 Fire Protection Systems

B12.1 General

The fire fighting system shall consist of Fire Protection System and Fire Detection System.

The fire protection system equipment shall be complete in every respect and suitable for safe and reliable operation.

The fire fighting system shall cover the whole area of Maitree-STPP site. Fire protection system shall cater for all potential risks from fire and provide automatic and/ or manual response to any fire detected. Automatic and manual extinguishing systems operation is anticipated.

B12.1.1 Design standards and codes

The fire fighting protection and detection system shall be designed according to NFPA/ Equiv. International Standards. All relevant NFPA standards shall apply, including but not limited to the following:

NFPA 1	Fire Prevention Code
NFPA 2	Fire Fighting Pumps
NFPA 10	Portable Fire Extinguishers
NFPA 11	Foam Extinguishing Systems
NFPA 13	Installation of Sprinklers System
NFPA 14	Standpipe and Hose System
NFPA 15	Water Spray Fixed Systems
NFPA 16	Deluge Foam-Water Systems
NFPA 20	Standard for the Installation of Centrifugal Fire Pumps
NFPA 22	Standard for Water Tanks for Private Fire Protection
NFPA 24	Private Fire Service Mains and Their Appurtenances
NFPA 25	Water Based Fire Protection Systems
NFPA 30	Flammable and Combustible Liquid Code
NFPA 31	Oil Burning Equipment
NFPA 70	National Electric Code
NFPA 71	Central Station Signaling Systems Protected Premises Unit
NFPA 72	National Fire Alarm Code
NFPA 72A	Local Protective Signaling System
NFPA 72E	Automatic Fire Detectors
NFPA 101	Life Safety Code
NFPA 231	Standard for General Storage
NFPA 291	Recommended Practice for Fire Flow Testing and Marking of Hydrants
NFPA 307	Marine Terminals, Piers and Wharves
NFPA 600	Standards on Industrial Fire Brigades
NFPA 850	Protection for Electric Generating Plants



All fire safety facilities shall be provided in accordance with the international (i.e. ICE, CEE, EN), British (i.e. BS, BSI), German (i.e. DIN, VDS, VDE) and American (i.e. NFPA) Standards, in the latest edition.

B12.1.2 Fire safety philosophy

The Maitree-STPP shall be designed and built with provision of a safe operating environment for equipment and personnel. This shall be achieved by the separation and segregation of equipment with sufficient distances and by selection of suitable equipment and materials.

Hazardous areas shall be identified and suitable equipment shall be selected for use in such areas. Different fire fighting systems shall be adopted according to the operational characteristics of the particular plant areas and buildings to be protected.

B12.2 Fire Fighting System Description

Onsite fire protection systems shall be provided for the plant as a minimum as described herein.

The fire protection system shall generally follow NFPA 850/ Equiv. International Standards. The following main areas are considered to be protected:

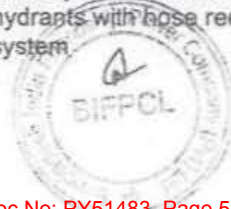
BUILDING/AREA/ EQUIPMENT TO BE PROTECTED	FIRE FIGHTING INSTALLATIONS	DETECTION SYSTEMS
Boilers	Indoor hydrants with hose reel system	Manual fire alarm
Boiler burners in the boiler area	Automatic high velocity water spray fixed system	Linear beam smoke detectors. Automatic fire alarm system.
Steam Turbine Building	Indoor hydrants with hose reel system	Smoke detectors. Automatic fire alarm system and manual fire alarm stations.
Steam Turbine lube oil tanks and system and hydraulic oil tank and systems.	Automatic foam/water spray fixed system for hydraulic storage tanks and areas. For turbine lubrication HWWS or fog system shall be used	Linear heat detectors and UV/IR flame detectors. Automatic fire alarm system
Steam Turbine / Generator bearings	Automatic water mist system	Linear heat detectors or combined heat/flame detectors. Automatic fire alarm system.
Fuel Oil Storage Tanks	Low expansion foam systems into the tanks and tank shell cooling systems	Linear heat detectors Inside* the tanks Automatic fire alarm system.



BUILDING/AREA/ EQUIPMENT TO BE PROTECTED (LDO/HSD)	FIRE FIGHTING INSTALLATIONS	DETECTION SYSTEMS
LDO/HSD Fuel Oil Pump House	for roof and shell. Automatic foam/water spray fixed system	Smoke detectors, UV/IR flame detectors. Automatic fire alarm system and manual fire alarm stations
LDO/HSD Metering Station	Automatic HWW spray system	Smoke detectors, UV/IR flame detectors. Automatic fire alarm system and manual fire alarm stations
Coal Storage	Outdoor Hydrants with hose cabinets; Water/Foam system in case of covered stock pile and enclosed areas e.g. coal bunker and Outdoor Hydrants with hose cabinets in case of open stock pile	UV/IR detectors, Automatic fire alarm system and manual fire alarm stations, in case of covered stock pile and enclosed areas e.g. coal bunker only manual fire alarm stations. Only manual fire alarm stations, in case of open stock pile.
Coal conveyor, Stacker, Reclaimer, Coal unloader.	Automatic MVW water spray fixed system	LHS cable with two numbers of IR detectors are envisaged for each conveyor. Automatic fire alarm system and manual fire alarm stations
Plant water pretreat- ment facilities	Hydrants. Mobile 30 kg CO ₂ – extinguishers and portable 5 kg CO ₂ extinguishers for the switchgears.	UV/IR flame detector, smoke detectors. Multi- sensor detector is also acceptable. Automatic fire alarm stations
Water and waste water treatment Buildings	Indoor hydrants with hose reel system	Smoke detectors. Linear heat detectors. Multi-sensor detector is also acceptable. Automatic fire alarm system and manual fire alarm stations
Chlorination Buildings	Manual water spray system and indoor hydrants with hose reel system	Smoke detectors. Linear heat detectors. Multi-sensor detector is also acceptable. Automatic fire alarm system and manual fire alarm stations. Gas detection system.
Chemical Stores	Automatic water spray fixed system and indoor hydrants with hose reel system	Smoke detectors. Linear heat detectors. Multi-sensor detector is also acceptable. Automatic fire alarm system and manual fire alarm stations



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BUILDING/AREA/ EQUIPMENT TO BE PROTECTED	FIRE FIGHTING INSTALLATIONS	DETECTION SYSTEMS
Central Control Building and its Switchgear Building	Inert gas Extinguishing system employing any of the commercially available inert gas listed in NFPA- 2001 shall be provided for fire protection of Control room, control equipment room areas etc. This system shall be actuated by automatic fire detection & alarm system comprising multisensor detectors. Switchgears shall be provided with portable fire extinguishers.	This system shall be actuated by automatic fire detection & alarm system comprising multisensor detectors. and manual fire alarm stations
Plant water Pump- house	Mobile 30 kg CO ₂ – extinguishers and portable 5 kg CO ₂ - extinguishers.	Smoke detectors. Automatic fire alarm system and manual fire alarm stations
Switchgear Building	Mobile 30 kg CO ₂ – extinguishers and portable 5 kg CO ₂ - extinguishers. Additional, fixed total flooding CO ₂ extinguishing system shall be provided.	Smoke detectors. Automatic fire alarm system and manual fire alarm stations
LV Switchgear & MV Switchgear Building	Mobile 30 kg CO ₂ – extinguishers and portable 5 kg CO ₂ -extinguishers.	Automatic fire detection & alarm system comprising multi-sensor detectors, manual call points shall be provided.
All Oil Filled Transformers	Automatic high velocity water spray fixed systems	Sprinkler head heat detectors. Automatic fire alarm system.
Dry Type Transformers	Mobile 30 kg CO ₂ extinguisher and portable 5 kg CO ₂ extinguishers	Smoke detectors. Automatic fire alarm system and manual fire alarm
Emergency Diesel Generators	Automatic foam/water spray fixed system and mobile 50 kg dry- powder extinguisher	UV/IR detectors. Smoke detectors. Automatic fire alarm system and manual fire alarm stations
Computer, Electronic And Switchgear Rooms	Mobile 30 kg CO ₂ – extinguishers and portable 5 kg CO ₂ -	Smoke detectors. Automatic fire alarm system.



BUILDING/AREA/ EQUIPMENT TO BE PROTECTED	FIRE FIGHTING INSTALLATIONS	DETECTION SYSTEMS
	Extinguishers. And also water mist system	
Cable Floors, Shafts and Tunnels	Automatic medium velocity water spray fixed systems	Combination of smoke detectors and linear heat detectors shall be used
Ventilation Systems	Automatic sprinkler system	Duct smoke detectors. Automatic fire alarm system
Administration Buildings and Service building	Indoor hydrants with hose reel system. Portable extinguishers.	Smoke detectors. Automatic fire alarm system and manual fire alarm stations
Workshop Buildings	Indoor hydrants with hose reel system. Portable extinguishers.	Smoke detectors. Automatic fire alarm system and manual fire alarm stations
Storage Buildings	Water Sprinkler system, indoor hydrants with hose reel system. Portable extinguishers.	Smoke detectors. Automatic fire alarm system and manual fire alarm stations
Canteen / Social Buildings	Indoor hydrants with hose reel system. Portable extinguishers.	Smoke detectors. Automatic fire alarm system and manual fire alarm stations
Fire Brigade Building	Indoor hydrants with hose reel system. Portable extinguishers.	Smoke detectors. Automatic fire alarm system and manual fire alarm stations
All other buildings and areas including blending plant area	Outdoor hydrants and indoor hose cabinets. Additional equipment related to the fire risk.	Smoke /heat detectors. Automatic fire alarm system and manual fire alarm stations
Coal transfer points and Crusher house	Automatic MV Water spray system	QBD; Automatic fire alarm system and manual fire alarm stations

Remarks to the schedule above:

- Gas detection is required for chlorination building and Hydrogen building.
- Fuel Oil Storage Tanks (LDO/HSD):**
The kind of selection inside the tank is dependent of the tank design if it is a floating tank roof or a fixed tank roof.
- Whether automatic system for ventilation areas shall be required or not, shall be proved by a Fire Risk Assessment from a notified body.

Any building or area which is protected by a "wet" fire fighting installation must also be provided with an "external fire brigade connection".



The "Siamese Breaching inlets" shall be housed in stainless steel cabinets with "wire glass" doors, located around the perimeter of the protected area.

They must be placed to allow ready access by the fire brigade tender. Upstream of the above fire brigade connection, suitable non-return valves in the main – and branch line must be provided, in order to facilitate pressurization of the "installation" from the 2 different sources.

It shall be assured that at least two (2) hour fire water supply to cover the main system design flow rate is available for the facility in accordance to NFPA/ Equiv. International Standards. Particular attention is drawn to the requirement of the deluge system for the large fuel oil storage tanks.

The power plant shall be provided with two separate fire water sources namely:

- water from service water tank – primary source
- emergency supply shall be fed from the pre-treated plant water storage – secondary source.

The fire water demand shall be stored in two (2) 100 % above-ground storage tanks.

The capacity of the storage tanks shall be calculated by the Bidder/Contractor according to NFPA 850 after a Fire Risk Assessment and shall be subject to BIFPCL approval during basic/detail engineering. MoC of tank shall be selected with regard to the water quality and in particular for saline water and shall be subject to BIFPCL approval during basic/detail engineering

There shall be two separate in-feeds into the fire ring main from the service water tank. Each in-feed shall be equipped with 2 x 100% fire water pumps, 1 x 100% electrically driven and 1 x 100% diesel driven, as well as one jockey pump, to transfer water from the raw water tanks to the fire ring main. The two in-feeds into the fire ring main shall be separated with a manual N/O valve. The diesel engine shall start up automatically after a fire alarm, but only in an event of power failure or failure of the electrical power is supplying the required pressure to the fire fighting system. The two sets of pumping equipment shall be housed in separate fire compartments (adjacent rooms or divided by a fire rated wall so that a fire on one pump does not affect the function of the other pump).

The new fire pump house, being the main supply, shall consist of:

- two (2) 100% electric jockey pumps (1 set)
- one (1) 100% electric driven main pump set
- one (1) 100% diesel engine driven main pump set
- one (1) expansion tank arrangement



Water in the pipe network shall be kept pressurized by one expansion tank and jockey pump arrangement. To maintain the nominal pressure in the fire main during normal operation, the jockey pumps shall be installed parallel to the fire water pumps with one jockey pump on each in-feed. The jockey pumps shall be of an end suction or horizontal type with sufficient capacity to supply three hose reels at the operational conditions without bringing the main water fire pumps into operation and to overcome the leakage in the system.

For the diesel-driven pumps, a daily storage tank shall be installed. This tank shall be connected with a feed line from the fuel oil storage tank including a fuel pump to refill the daily storage tank. An overfill protection for the daily storage tank shall be provided.

The main fire pumps shall be of approved design for use in fire fighting system (horizontal, split case, single stage, centrifugal type with single entry) and shall be complete with mating flanges, air releases, drain connection and base plate.

The electric motors shall be totally enclosed fan cooled motors, which shall be equipped with sleeve bearings.

A main above ground fire header shall be provided to serve strategically placed (not more than 50 m apart) outdoor hydrants and supply water to the indoor hose reel and sprinkler/spray systems.

The fire water distribution system shall incorporate sectionalizing valves so that a failure in any part of the system can be isolated while allowing the remainder of the system to function properly. A sufficient number of drain valves at low areas, which allow a sectionalized flushing/drainage of main fire header shall be installed. Contractor's concept needs to be agreed upon and approved by the OE.

B12.2.1 Fire water demand calculation

The contractor shall provide hydraulic calculations to verify that the fire water system is sufficiently designed to provide in a worst case scenario based on NFPA 850 sufficient pressure and water flow to the most remote and biggest fire water consumers, considering for this event the simultaneous use of involved systems over the requested time. A safety factor of approximately 1.15 shall be added. The calculation has to be submitted with the Tender documents.



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B12.3 Fire water distribution system

The water distribution system is mainly an above ground system and comprises of different circuits.

The ring fire water main shall be divided by gate valves into several sections, which can be isolated in case of leakages or service, to ensure a high availability of the non-concerned main segments. The gate valves must be lockable in the open/ close position.

Connection pipelines to the buildings and structures shall branch at the main, to supply risers, spray deluge systems and hose reel stations inside the buildings with fire water. Wet risers shall be provided in each staircase, but with the tapping points outside the staircase.

B12.4 Hydrants

Along the fire water main, hydrants shall be provided, especially near objects or equipment with an increased fire hazard.

The outdoor hydrants shall have a hose and equipment cabinet situated nearby. The outdoor hydrants shall be of pillar-type with 2 hose connections. The fire hydrants shall be installed such that a 50 m fire reel will provide full coverage of the area.

The water hydrant cabinets inside the buildings shall be supplied by means of connection lines filled with water. The water hydrant cabinets shall be permanently connected to the fire fighting water system via suitable isolating valve.

The water hydrant cabinets shall be generally installed in the vicinity of the staircase exit. They shall be arranged in such a way as to ensure that any points in the building to be protected can be reached with extinguishing water from two separate hydrants from the water hydrant cabinet and/or water cabinet and/or outdoor hydrants.

Some of the water hydrant cabinets shall be equipped for using both water and foam as an extinguishing agent. Foam/water hydrants shall be used where inflammable liquids are stored in such small quantities that the use of spray deluge systems would be uneconomical.

B12.5 Automatic Water Spray Systems



The design density and area of operation shall be determined to suit the risk. The tripping temperature shall be at least 30°C above the maximum anticipated ambient temperature. Higher temperature ratings shall be used where inflammable liquids are present.



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Water mist system

The water mist system shall be used where water can cause damage on equipment e.g. Computer room, clean room, telecommunication or office rooms.

High velocity spray system

The high velocity spray system shall be used where flammable liquids with a flash point more than 65°C will be stored or handled.

Medium velocity spray system

The medium velocity spray system shall be used where flammable liquids with a flash point less than 65°C will be stored or handled.

For all other areas normal water sprinkler system has to be applied.

They shall be applied at least and among others for:

- office, workshops and storage areas
- Turbine and generator bearing (high pressure water mist system as per NFPA 750), pre-activated
- auxiliary boiler
- fire fighting pump house
- coal feeders



B12.5.1 Automatic spray water deluge systems

An automatic spray water deluge system shall be provided, e.g. for oil filled transformer, transformer-rectifier sets, and oil tanks, oil coolers, fuel packages.

Means for manual initiation shall be provided adjacent to the deluge valve for the system.

Oil tanks shall have a permanently installed top and side automatic spray water installation for cooling and fire protection as well as permanently installed foam-water extinguishing system for fire fighting (see below).

B12.5.2 Manual spray water deluge systems

A manual spray water system shall be provided to protect the rotor and stator of the regenerative air pre-heaters. The spray system shall be activated from the control room or from the air heater area.

B12.5.2.1 Foam-water extinguishing system

At least the following plant areas shall be protected with a separate and independent foam-water system:

- all fuel oil storage tanks and slop oil tanks



- fuel oil pump station
- turbine oil room
- fire fighting pump house (diesel driven fire pump area)
- black start facility (as applicable)
- emergency diesel generators.

Foam concentrate shall be pumped from the foam concentrate storage tank by 2 x 100% foam pumps to foam proportioner skids. Pressurized water connection shall be provided to the eductor of each foam proportioner skid. In the event of fire, the foam system for respective tank shall be automatically activated on detection of fire by heat detectors. Water shall start flowing through the eductor where foam concentrate is induced and mixed with the flowing water in definite proportion.

High temperature causes breaking of one or more of the sprinkler circuit bulbs; as the sprinkler circuit, which operates as control circuit, is normally under pressure. As a result pressure in this circuit falls, causing the pilot valve to open and consequently the water is delivered from the nozzles. This continues until the valve is closed. The water output may also be actuated by operating the manual emergency release.

B12.5.2.2 Inert gas system

At least, the following areas shall be provided with an inert gas system or equivalent, to the approval of the local authorities and the Employer):

- steam turbine generator and exciter
- central control room
- local control rooms
- rooms adjacent to CCR
- UPS room
- battery room.
- Switch gear Building



The inert gas system shall consist of a battery of inert gas storage cylinders of adequate capacity and 100% reserve cylinders, which shall be located suitably at a centralized location. Discharge nozzles shall be provided on the gas distribution pipe network suitably located at the areas to be protected.

In the event of fire, the fire detectors shall initiate an alarm with coincidence (double-knock) principle (to limit false alarm gas release) in the local panel and main fire alarm panel. Simultaneously, the detection signal shall open the deluge directional valve automatically and the protected area shall be filled up by rapid injection of required quantity of inert gas through the pipe network and discharge nozzles to create a homogenous air/inert gas atmosphere.

The pipe network shall be connected to a gas manifold, through the above mentioned automatic deluge valve with manual override. The manifold shall be connected to a group of inert gas cylinders.



In case of gas release, personnel alarm system by way of bells and strobe lights above doors shall be activated.

Complete design and critical Components of this system shall be approved / listed by UL/FM/VDS/LPCB or equivalent.

The type of inert gas shall be in line with environmental norms of GOB and shall be subject to approval by BIFPCL during basic/detail engineering.

The applicable fire suppressant medium will have to be coordinated/ harmonized with the local fire brigade authorities and also reviewed during the basic/detailed engineering.

B12.5.2.3 Portable and mobile fire fighting equipment

Risk commensurate manual fire fighting equipment, portable or wheeled moveable trolley units, shall be provided. It shall be sufficiently in number and size for an fast and effective first fire fighting response. Depending on the type of fire load, adequate types of equipment and extinguishing agent shall be provided, among others:

- dry chemical fire extinguisher.
- hose reel foam units
- CO2 extinguisher
- AFFF (aqueous film forming foam) portable distinguisher.

Criteria for the selection of mobile fire extinguishers are among other the fire risk assessment, the fire load, the shortening of fire attack routes, the type of fire hazard. Only standardized fire extinguishers complying with local standards shall be used. The location, capacity, type, and number of portable and mobile fire fighting equipment shall be evaluated during detail engineering in order to adequately to cover the risk, and shall follow NFPA and local standards. It shall be described in the fire protection basic design report of approval by Employer and local fire authorities.

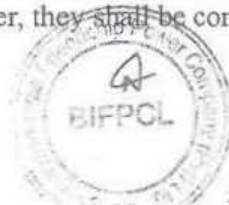
The following are typical and not necessarily the limit of those required:

1) Portable extinguishers

The following types of portable extinguishers shall be considered:

- a) Powder BC fire extinguishers, capacity
- b) Foam spray AFF fire extinguisher, capacity 10 lt
- c) Carbon dioxide fire extinguisher, capacity 5 kg.

Where extinguishers are mounted externally, or in other areas where they may be subjected to the weather, they shall be contained inside a protective cabinet.



The extinguishers shall be operated by means of a lever provided with a safety pin, which allows for the partial discharge.

2) Mobile extinguishers

The following types of wheeled extinguishers shall be considered:

- a) Powder ABC fire extinguisher, capacity 75 kg
- b) Carbon dioxide fire extinguisher, capacity 30 kg
- c) Foam spray fire extinguisher capacity 130 lt

Each powder unit consists of a powder container to which a carbon dioxide cylinder operating as propellant gas is attached; shall be provided with a 6 m hose with controlled nozzle. The powder unit shall be mounted on a metal frame with two wheels and a driving handle. Each carbon dioxide unit consists of a carbon dioxide cylinder, a hose, a control valve and a discharge nozzle. The cylinder and discharging devices shall be mounted on a metal frame with two wheels and a driving handle.

B12.5.2.4 Fire brigade and fire station equipment

The Maitree-STPP fire brigade shall be equipped with two (2) fire fighting trucks with foam/water tanks and one (1) ambulance car including all standard fire fighting and rescue equipment. The Contractor shall provide complete equipped Fire fighting trucks according to relevant national and international regulations.

The periodic inspections, checking and maintenance of the firefighting equipment until PAC shall be undertaken by the Contractor.

Description	Quantity
Portable gas indicator	3
Heavy duty handlamp	4
Breathing apparatus with cabinet	7
Dry powders transferring and refilling rig	1
Pneumatic vice for extinguishers locking	1
CO2 extinguishers filling and powder pressurization rig	1
Electric screwing-unscrewing	1
Hydraulic inspection unit	1
First aid kit	3
Paramedic standard equipment	2
Hose repair equipment	1
Fire fighting suits	5
Fire fighting blankets	10
Multipurpose nozzles	4



The vehicles shall be located in the fire brigade building which shall also house a command room, offices, staff rooms, a fully equipped medical station with a first aid room, workshops, stores, etc. and refilling units for portable fire extinguishers and breathing apparatus, as well as any other equipment required for the completion of the fire brigade building.

Fire safety instructions in the Bangladesh and English languages shall be provided in all zones.

The instructions shall clearly describe what personnel are required to do upon discovering a fire, hearing the fire warning signals or hearing the fire evacuate signals.

The fire safety instruction shall be specific to the zone in which they are located and marked with the zone number and name. Any special care required when using or maintain fire protection equipment within the zone shall also be indicated. The instructions shall be protected by glass or transparent plastic material secured in a metal frame in a prominent position within the zone.

B12.5.2.5 Fire exit signs

The fire safety sign described here shall consist of the words 'FIRE EXIT' in the Bangladesh and English languages, and where appropriate, directional symbol.

Fire safety signs shall be provided at all fire exits, entrances to stairways and all doors and corridors leading to fire exits or stairways, and shall have standby rechargeable batteries when it is installed inside the Building.

At junctions in corridors or other positions where the most direct means of escape is not clearly apparent directional signs shall be provided in addition to fire exit signs.

Directional signs shall indicate the most direct means of escape, and shall be made of the same material and affixed in a similar manner as the fire exit signs.

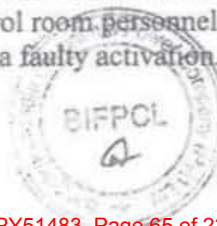
B12.5.3 Fire detection and alarm system

B12.5.3.1 Fire detection and alarm system general design



The whole plant shall be furnished with an automatic fire detection system, divided into individual alarm sections, including of Local Fire alarm control panels for each section connected to the Main Fire Alarm Control Panel. The purpose of the fire alarm system is to guarantee a reliable and fault-free early-warning system in the event of fire by means of automatically activated detectors or manual call points, so that orders for extinguishing the fire can be issued from a central point.

If the alarm is triggered by one of the installed automatic fire detectors, the alarm shall be indicated first in the control room and on the fire control panel and with delay at the control centre of the fire brigades. The delay time can be used by the control room personnel to ascertain the cause of the alarm or to reset it in case of a faulty activation.



The fire alarm system shall be designed in accordance with the relevant international standards and regulations especially NFPA 72 and DIN VDE 0833, and shall conform to the latest state-of-the-art in the field of fire alarm system engineering.

The fire detection system shall be connected to an operator station at the CCR and to the repeater stations at the security/ gatehouse and the fire brigade house. Surveillance with fire detectors shall be provided for all areas of the plant. A fire alarm shall also trigger alarm sirens and sounders.

No restrictions on the proper functioning of fire alarm by reason of movement of air, optical radiation, smoke, dust, vibration, high humidity, etc. are acceptable. Moreover, fire alarms shall be located in the outgoing airflows of air-conditioning and ventilation systems.

The alarm signal receiving units must be so designed that by use of a standardized alarm unit socket, any of the types of detector may be used with equal facility on any of the fire alarm circuits

Detectors installed in inaccessible points such as cable ducts, false floors, cable basements, etc. are to be connected in parallel to external optical alarm indicators installed close by and in readily visible positions.

Detectors installed in false floors, suspended ceilings, cable ducts, air-conditioning or ventilation systems are also to be combined to form separate alarm sections.

Fire detection and alarm systems shall be arranged such that two circuits are provided, with a minimum of two detectors on each circuit. The operation of any one detector on either circuit shall initiate local "level 1" audible and visual alarms of fire repeated at the central control room. The operation of two detectors on different circuits shall initiate "level 2" alarms of fire and the following actions:

- shut-down of ventilation systems and operation of fire dampers to seal openings
- release of fire extinguisher within the enclosure.

The detectors shall be of the addressable type.

Gas detection is required for chlorination building and Hydrogen building. The term multisensory is defined among others in NFPA 72.

B12.5.3.2 Turbine hall area

The turbine hall area shall be provided with manual and automatic fire detection and alarm system utilising manual call points and combined smoke/heat detectors



The system in the turbine hall shall be suitably arranged to cover all lubrication and control oil areas – e.g. oil room, oil channels, main stop valves and turbine bearings and shall be provided with automatic fire detection and alarm system utilising flame and heat detectors and automatic fixed fire extinguishing system with alternative manual operation.

B12.5.3.3 Manual call points

Manual call points shall be of the break-glass type and shall be established in the whole power plant at emergency exits, accesses to staircases, doorways, exits on recognized access or escape routes and at hose reel stations.

They shall be painted red, with interlocking mechanism, to be reset by key.

If the push button of a manual call point will be pressed, an alarm shall be released and indicated immediately on the panel of the fire brigade control centre and on the fire control stations in the control room of the plant and the gate house.

B12.5.4 Detectors

The fire detector system elements and the associated mountings are to be provided with sturdy, corrosion-proof plastic housings.

The fire alarm detectors are to be provided with optical means for signaling their activation (e.g. light-emitting diode), and are to be suitable for the connection of an additional optical external alarm indication.

In the central control room the necessary automatic fire detectors are to be incorporated in the luminous ceiling.

Detectors belonging to a particular alarm section are to be incorporated in alarm lines, the automatic and manual fire alarms being connected via separate alarm lines to the common fire alarm central station in the central control room.

The fire alarm detectors shall reset ready for operation following each alarm, without outside intervention, and shall plug-in and be provided with suitable means to prevent unauthorized removal or disconnection and for connection to the fire alarm central station.

B12.5.4.1 Smoke detector

Handwritten mark resembling a stylized 'S' or 'H'.



For early identification of visible smoke generation, consisting of photoelectric unit, alarm electronics, optical alarm indication, detector socket. Smoke detectors referred to in this Specification shall be of multisensor type and shall be incorporated into a probe sampling system.

Heat detectors referred to in this Specification shall be of the fixed temperature point type. The fixed temperature limit shall be 28 °C above maximum ambient temperatures.



Smoke/heat detectors referred to in this Specification shall be of optical beam type.

B12.5.4.2 Flame detector

For early identification of fire outbreaks and open flames consisting of: optical unit, alarm electronics, optical alarm indication, detector socket and variable response sensitivity.

Flame detectors referred to, in this Specification, shall be of the UV or black body immune solar-blind IR types.

B12.5.4.3 Thermo-differential and thermo-maximum detector

For early identification of fires as they break out with rapid temperature rise and little smoke generation, consisting of temperature sensor, alarm electronics, detector socket.

B12.5.4.4 Sirens and optical alarms

The personnel shall be alarmed and warned with acoustic and as far as necessary, e.g. in case of a high background noise level with optical devices.

Sirens for indoor and outdoor installation must be provided for warning the operating personnel.

The protection degree of the sirens for indoor and outdoor installation must be at least IP 54. The outdoor sirens are to be arranged on the boiler area, transformer area, tank farm etc. The arrangement of the indoor sirens must meet the requirements at site for satisfactory warning of the operating personnel, e.g. mounting in the turbine hall, pipe ducts etc. The control of the sirens shall be performed automatically by the fire alarm system, but manual operation from the central control room must also be possible.

B12.5.4.5 Central fire alarm station

The fire alarm central station must be housed in sheet-steel enclosed cabinets and located in the central control room or nearby in an appropriate location. Both optical and audible signals must be given when a fire alarm or fault alarm occurs.

Power supply for the fire alarm system shall comply with the requirements of NFPA 72 and shall be taken from the safe AC busbar. Emergency supply shall be maintained by a rectifier/battery set (1 x 100%), designed for four (4) hours discharge time.

The fire alarm central station is to be implemented in all-digital/ numerical electronic technology using plug-in units and assemblies on the modular



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construction principle, and shall be accommodated in metalclad enclosed panels with type IP 31 enclosure for wall-mounted/free standing installation.

The fire alarm and fault annunciation system shall be designed with optical and audible alarms. Whereas the audible alarm must be resettable, the optical indication shall persist until the annunciation is finally extinguished or the fault cleared. If a fault warning is followed by a fire alarm annunciation, the fault indication must be stored and suppressed until the fire alarm condition has been cancelled.

Provision shall be made for clear audible identification of the alarm/fault signal. Furthermore, fire alarm signals and fault signals shall be strictly segregated.

An automatic fire alarm signal shall be triggered and transmitted externally to the central control room, gate house and the local fire brigade via a main alarm unit, inclusive of the digital communicator. The alarm lines to the fire brigade shall be continuously monitored.

The individual fire alarm lines and function lines of the fire-fighting equipment and facilities, as well as important functional groups of the fire alarm central station shall be continuously monitored for faults and breakdowns e.g. for:

- wire breakage of each alarm line
- short-circuit of each alarm line
- earth fault of the fire alarm system
- power supply system faulty
- main fuses and MCB's failure
- alarm modules disconnected from plug-in frame.

All fault signals shall be optically and audibly indicated.

For checking out the functioning of the complete fire alarm system including the fire alarm lines and fire alarm devices, testing facilities shall be provided. When testing a circuit, initiation of fire alarm warnings in external facilities shall be prevented. After testing, the tested circuit shall automatically reset to normal operation.

Simulation (e.g. test pins) of all relevant fault signals as listed above as well as of all fire alarms shall be possible in order to check-out the externally connected fire fighting facilities.

The fire alarm central station shall be provided with potential-free change-over contacts wired to a central terminal board as follows:

- contacts to control the fire protection doors
- contacts to control the air-conditioning and ventilation equipment
- contacts for spare.



Activation of fire protection doors shall be signaled as a group annunciation to the fire alarm central station and included in the alarm annunciation system.

For recording all fire alarm and fault annunciations, control instructions and operator actions, a line printer shall be provided with the facilities for printing out the alarm line number, date and time of day in hours and minutes.

B12.5.4.6 Layout display board

For indicating fire alarm and fault annunciations from the fire alarm system, a layout display board has to be provided in the panel in the central control room. This board shall include a graphic display to show a simplified ground plan of the power plant and of the individual buildings and shall feature signal lamps for the separate optical indication of the alarm line, and shall include the annunciator with alarm test, reset and acknowledge buttons. Preferably a separate monitor with appropriate graphics etc. shall be installed. Additionally the gate house and fire brigade house shall be equipped with a display board.

For information and guidance of fire brigade a simplified graphic display board shall be installed in the power plant gate house and in the fire brigade house.

B12.5.5 Fighting and fire protection basic design report

In general, the arrangement, type and number of detectors, call points and alarms is determined by the room configuration (size, height, form of floor and roofing, etc.), the ambient conditions in the area to be monitored, the equipment to be protected and the type of combustible medium. Such details shall be determined and included in the fire fighting and fire protection basic design report.

B12.5.6 Fire water retention

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Spent fire fighting water shall be contained. The required retention volume shall cover the total water amount of the connected systems during defined operation time. This shall be achieved by respective thresholds and other up stands to form a containment of sufficient volume. Furthermore the rain water and fire fighting water retention basin shall be used to collect fire water from the drains of sealed outside areas (see also Section B9).



The total fire water retention volume shall be based on the fire fighting water demand and duration according to NFPA 850.



Tanks with flammable or hazardous content shall have a bund structure creating sufficient retention volume. In the assessment of the total fire extinguishing time where such tanks are involved in the fire, account shall

be taken of the collecting capacity present in this area including the volume of oil discharged in the event of a leakage.



Additional welding requirements for welding of civil steel structures are stated under **Section B9**.

B0.6.17 Mechanical equipment

B0.6.17.1 Pumps

General

All pumps shall be designed for continuous operation unless otherwise specified.

Pumps shall be installed in positions convenient for operation and servicing. Where multiple pump installations are required, each pump and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and pump removal without interrupting plant operation.

Pumps installed for parallel operation or as stand-by sets are to be of identical design, i.e. interchangeable.

Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the pump and its components.

General design and construction

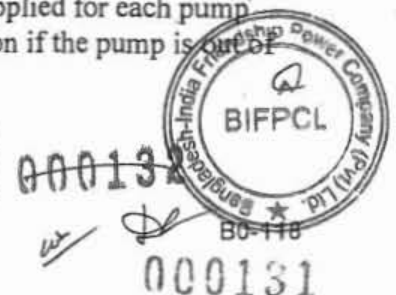
All pumps shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shutoff pressure under maximum suction pressure conditions. If a pump can operate at sub-atmospheric suction conditions, the entire pump shall be designed for full vacuum.

All pump shafts shall be of ample size to transmit the maximum possible output from the prime mover. The pump shaft and coupling are to be so dimensioned that the maximum permissible torque of the shaft is higher than the maximum transmissible torque of the coupling. Directly coupled pumps shall be used preferably.

Renewable wear rings shall be provided at points of running clearance and shall be made from appropriate materials.

All pumps and accessories in contact with the pumped fluid shall be constructed of materials specifically designed for the conditions and nature of the pumped fluid, and be resistant to erosion and corrosion.

Product water flushing lines and drains are to be supplied for each pump handling the prevailing river water to avoid corrosion if the pump is out of operation for extended periods.



The pump glands or mechanical seals shall be so arranged that repackaging or fitting of replacement seals can be carried out with the minimum of disruption to plant operation. In case of operating under vacuum conditions liquid sealing is to be provided.

The pump casing shall preferably be split for ease of maintenance and be designed such that the impeller and shaft are capable of being withdrawn from the casing without disturbing any of the main pipework and valves carrying the pumped fluid. In general, all horizontal pumps with draw-out-rotors are to be fitted with a coupling to facilitate disassembly without removing the motor. Pull-out design of the shaft shall be applied to vertical wet pit and dry pit pumps as well.

Each horizontal pump shall be mounted with its drive on a common base plate of rigid construction. Vertical pumps are to be provided with foundation frames. In case of submersible pumps suitable frames shall be provided in the pump sump. It shall however be possible to remove these pumps without entering the sump.

Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate for the type of pump employed. The NPSH values are to be referred to the least favourable operating conditions - lowest atmospheric pressure, lowest level of water on the suction side of the pump, and highest temperature of the pumped fluid. An adequate safety margin of normally greater than **1 m to the max NPSH** required shall be provided unless and otherwise specified for specific pump. Pumps shall operate smoothly throughout the speed range up to their operating speeds. The first coupled critical speed must be at least 20% higher than the maximum operating speed. The determination of the shaft diameter and the distance between two consecutive bearings must include a sufficiently large safety margin to satisfy this condition.

Where necessary, the pumps are to be fitted with devices to ensure a minimum throughput.

Bearings

For large pumps the bearings shall be of automatic oil lubricated sleeve type, unless otherwise specified. Bearings on vertical shaft pumps shall be so spaced to prevent shaft whipping or vibration under any mode of operation. Vibration sensors and temperature measurements incl. temperature transmitters for continuous monitoring shall be provided for large pumps.

Bearings housings on horizontal shaft pumps shall be designed to enable the bearings to be replaced without removing the pump or motor from its mounting. Bearing housings on horizontal shaft pumps shall be effectively protected against the ingress of water, pumped fluid and dust by suitable nonferrous deflectors.

All bearing oil wells shall be fitted with visual oil level indicators. Non-pressure-oil lubricated bearings shall be equipped with constant level oilers.

Pumps characteristics

When several pumps are installed for the same service, they shall be suitable for unrestricted parallel operation.

The pump flow/head characteristics shall be such that within the operation range the head will continuously increase with decreasing flow, maximum head (shut off head) being at least 10% higher than the duty point head.

Unless otherwise specified all pumps shall be capable of operating at 110% of the rated capacity at the rated delivery head. Maximum size impellers for the pump body in question shall not be quoted for. **By installation of a new impeller a head increase of 5% minimum shall be possible.** The performance of the drive motor is to be determined according to the above mentioned technical requirements and to the requirements as specified in the electrical part.

Fittings

All pumps shall be installed with isolating valves, a non-return valve and suction and discharge pressure gauges unless otherwise stated. Accessible couplings shall be supplied with removable type guards.

Coupling halves shall be machine matched to ensure accurate alignment.

Couplings as well as gears must have a rated capacity of at least 120% of the maximum potential power transmission requirement.

All pumps other than submersible pumps shall have temporary strainers fitted in the suction pipework during all initial running and commissioning phases. Permanent strainers shall be provided where specified.

Venting valves shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting, due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipework to facilitate the dismantling of pumps.

All positive displacement pumps shall be fitted with a discharge relief valve capable of passing the maximum pump delivery flow.

B0.6.17.2 Piping and accessories

Design criteria

The pipework shall be designed, fabricated, erected, inspected and tested on the basis of the applicable standards and codes, and the additional requirements as set out below.

For the plant water and cooling water system GRP is preferred, Bona-Pipe and coated carbon steel is acceptable. For saline water and the water treatment systems LPP piping will be accepted also. If a carbon steel system is offered, a cathodic protection system shall be employed for inside and

Coupling

The motor shaft halves of the couplings, finish-bored, balanced, and complete with key ways are to be drawn on to the motor shaft and balanced out together with the rotor.

Cooling

Air cooling for the motors is the preferred method. Where water-cooling is applied, conditioned and treated, water shall be used.

Motor air exchanger circuits should be suitable for the prevailing atmospheric conditions, i.e. ambient temperature, content of humidity and salt in the air, etc. are to be considered.

Running quality

The running quality must be within the classification of "Class C, Zone A" according to the ISO 10816-1 or equivalent, i.e. the vibration velocity must be not greater than 1.8 mm/s (rms).

Reverse speed

If reverse running, can occur in the case of equipment driven by a motor (e.g. cooling water pump), the motor must be designed for maximum, possible reverse speed.

A reverse rotation alarm and starting-circuit interlock are to be provided to ensure that the equipment cannot be started while running in reverse.

Lubrication

All MV and HV Motors shall preferably be equipped with on-line lube oil purification and auto-grease facility. These systems shall preferably be procured from one single manufacturer.

The above requirements of the specification to be considered only as a preferred solution. However OEM recommendation will be accepted.

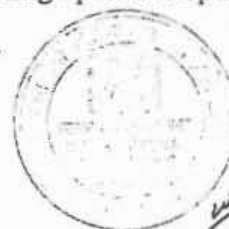
B0.6.18.8 Technical conditions for low voltage motors

If not specified otherwise all motors must be designed to meet IP 55 enclosure according IEC60034-5.

All motors with rated power (referred to 40 °C ambient temp.) less than 160 kW must be designed as LV motors with premium efficiency class IE3.

The equipments which are only operating for short period shall not be covered under IE3 such as:

- a) Sootblower Motors- operates only during sootblowing sequence
- b) Seal air fan motor for damper sealing operation-operated only during maintenance.



B0.6.18.8.1 Constructive features

The same features as for high voltage motors shall apply.

Anti-condensing heating shall be provided for motors of 55 kW and above.

B0.6.18.8.2 Electric features

All motors shall be designed as 3-phase squirrel-cage motors suitable for direct on line starting.

The motors must be capable of being switched on to a large and stable network and with phases in opposition.

The electric features a), b) and c) of high voltage motors also apply here.

Motors starting current must not exceed 7.0 times rated current (referred to the motor rating and 45 °C ambient temp).

The Starting current of LV Motor (IE3) shall be inline with IEC 60034-30. Applicable de-rating factor for design temperature of 45 Deg C shall also be applied.

B0.6.18.8.3 Protective features

An earthing clamp inside the terminal box has to be provided.

B0.6.18.8.4 Other features

Cable leads

All cable connecting boxes are to be designed to meet the requirements of IP 55 or IP 58 protection class respectively.

The cable connecting boxes are to be installed easily accessible on the motor. The connecting boxes must be capable of being turned by 90° or 180° and of being opened up longitudinally. The connection boxes are to be fitted with a terminal block.

Shafts

Where not otherwise specified, motors must be fitted with a free shaft end.

Protection against explosion hazards

Low-voltage motors, which are to be installed in areas exposed to the risk of explosion, must comply with the rules laid down in VDE 0165/0170/0171 for explosion-proof design in relation to the flash-point group classification for the particular explosive mixture.



- local control and lamps as listed above for local control cabinets, for each motor

B0.6.18.16 Terminal boxes and terminal cabinets

In order to minimize the amount of cables and distribution of signals and to centralize connections in the Plant, terminal boxes or, wherever necessary, by larger amounts of terminals, terminal cabinets shall be fitted on all the necessary

- cable crossover terminal points
- central collecting points for individual analog and binary signals and local transmitters
- signal collecting and distribution points for fire alarm, telephone, loudspeaker and clock system
- central distribution points for local signals.

Terminal boxes and cabinets must at least have class of protection IP 54 if installed indoors and IP 55W if installed outdoors and must be equipped with the necessary terminal strips, cable glands and fittings components for the connection of the cables.

The necessary earthing terminals are to be provided for the earthing of the boxes and cabinets.

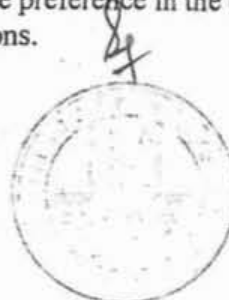
In any area subject to the danger of explosion, the necessary explosion-protected terminal boxes and cabinets are to be provided in accordance with IEC 60079 and IEC 61241 and VDE 0165/0170/0171.

B0.6.19 Instrumentation and control equipment

B0.6.19.1 Main design criteria

This Section applies to the design of the general Instrumentation and Control equipment. The following general requirements shall be strictly observed with regard to design and execution. In the event of contradictions the Contractor shall be responsible for obtaining written clarification from the Employer/Engineer.

Reference within this Section does not automatically indicate that the particular form of instrumentation is required on this project or will be acceptable for a particular application. The particular requirements for control and instrumentation shall take preference in the event of any disagreement between the two Sections.



Only requirements for technical performance of the equipment are stated herein, whilst the detailed requirements of the tasks to be performed by the control systems and the scope of delivery for each individual item of plant is stated in the relevant Sections of this specification.

This specification does not however relieve the Contractor of his responsibility for the basic design and execution of the instrumentation and control system per scope of supply in relevant Sections of this specification. The rules of good engineering practice and the relevant approved standards and regulations shall be observed.

A consistent instrumentation and control philosophy shall apply throughout the Plant and shall be implemented in terms of a range of equipment exhibiting a minimum diversity of type and manufacture. The objective shall be to standardize all measurement and control equipment throughout the Plant in order to rationalize operation, maintenance and reduce spares holding.

Generally equipment shall be supplied from one composite range of measurements and control equipment as marketed by a reputable manufacturer of international standing and shall have a minimum of two years operational use on similar projects. Where particular equipment is not included in the products of the manufacturer thus necessitating diversity of supply, this equipment shall be identified by the Contractor. The equipment shall be of modern, compact design incorporating the latest developments in proven technology. All instruments whether for local indication or remote transmission shall be of good quality and shall have an accuracy and repeatability appropriate to their duty. All fittings shall use metric threads.

Measurement and control instruments shall be matched to the main plant equipment ratings in all aspects. Instrument ranges, installation codes of practice and precautionary measures for safety of the Plant and the operating and maintaining personnel shall be observed.

Special attention shall be paid to the Plant safety. As a general rule, measuring points and measuring equipment for critical protection shall be separate from and not combined with measuring equipment for the automatic control equipment.

The material of all equipment installed in pipes, tanks, etc., shall correspond to the material of the relevant pipes, tanks etc. and shall fully meet the requirements regarding safety and operational conditions of the media to be measured. All the equipment shall be suitable for the location in which it is to be mounted and in particular all outdoor equipment shall be suitable for the prevailing climatic conditions.



The diversity of makes and types shall be kept to a minimum. The Employer/Engineer reserves the right to stipulate make and type following award of contract.

Any equipment to be installed within potentially explosives atmospheres shall comply with the requirements of international standards and codes, e.g. IEC-60079, NEC 500 etc.

The instrumentation and control equipment shall have high electro-magnetic and radio frequency interference immunity and shall not be affected by portable radio transmitters operated in the vicinity of the equipment. Any limitations shall be stated.

All instruments shall be protected by cases. The cases shall have enclosure classification not less than IP 42 according to EN 60529 when mounted indoors in totally enclosed rooms with provision for limited ingress of dust, IP 54 else in a enclosed building and IP 55W for mounting outdoors.

Electronic instruments shall not be located close to hot lines, vessels or other hot equipment. Ambient sun temperatures exceeding 80 °C shall not result in calibration difficulties or rapid deterioration of electronic components.

B0.6.19.2 Distributed Digital Control, Monitoring and Information System (DDCMIS)

The Plant will be controlled generally through a DDCMIS. The DDCMIS contains of process stations, operator workstations, engineering workstations, archiving facilities and signal exchange to management and third party systems. In general the DDCMIS will be DCS based hardware only in some exceptions PLC based systems may be applied.

For detailed technical specification and design requirements please refer to **Section B8** of this technical specification.

B0.6.19.3 Programmable logic controllers

Programmable logic controllers (PLC) shall be deployed in subsidiary installations and systems of higher complexity and shall provide a more open access for operation. Standard products of PLC manufacturers shall be used for which software developed by the process suppliers and proven for the specialized process is available.

The diversity of makes and types shall be kept to a minimum. The Employer/Engineer reserves the right to stipulate make and type following award of contract.



The use of auxiliary packages with PLCs or local controls for ancillary plants or systems shall be limited and minimized. Only some special cases can be considered subject to the Employer/Engineer's approval.

Typical and acceptable reasons for a specialized control system can be high speed of response or special safety requirements, which may require a separate safety-related system.

For signal exchange with the main DCS, PLCs shall be compatible with this system. Depending on the amount of information to be exchanged, parallel or serial interfacing shall be considered. The sequence of events signals should be directly physically connected to Sequence of Events Recording System (SER).

If only few signals are to be exchanged, parallel interfacing is preferred. Binary signals shall be exchanged via volt free signals. Analogue signals (4 - 20 mA) must be suitably decoupled.

If serial interfacing is used, the interface equipment between the PLC and the DCS must be capable of communication using an industrial standard protocol. The transmission baud rate shall be selected dependent on the application (minimum 19200 baud or higher). If commands are issued from the DCS to the PLC, the time between operator command input and PLC signal output shall not be more than 1.5 seconds. The same requirement goes for answer back signals from the PLC and updating of displays of analogue values coming from the PLC on the DCS monitor displays.

As a minimum requirement, the offered serial link shall have a data integrity checking and retransmission facility in case of error detection, independent of the DCS or external system software. Hardware and software failures during data transmission shall be monitored and alarmed onto the DCS.

The communication link shall be redundant. In case of failure in the communication, quick manual automatic switch-over to the standby communication link shall be possible with automatic switchover and fault reporting and diagnostic facilities.

The functions realized in the PLC and the method by which they are invoked shall be represented graphically similar to IEC 61131-3.

Additionally, a verbal program description supported where required for easy understanding of complex functions with functional diagrams according to IEC 60848 shall be provided.

Programming devices with keyboard, VDU and printer for ease of programming, effective on-line monitoring and diagnostic functions, together with the necessary equipment to write in and to erase EPROMs shall be provided.

The Contractor shall guarantee that spare parts for the offered PLC system will be available for at least 15 years after commissioning of the Power



Plant as well as upward/forward compatibility for future upgrades of the system. If necessary, the Contractor shall provide successive system upgrades to ensure spare part compatibility for that time span.

For local operation and monitoring a panel or desk mounted Human Machine Interface (HMI) unit, operable by keypad or touch screen with LED-displays shall be provided. Protection class of panel mounted HMI (front side) shall be IP 22 according to IEC 60529.

B0.6.19.4 Control cubicles

DCS, PLC hardware and other associated control equipment shall be installed in suitable control cubicles. The cubicles shall be set up in local switchgear/ electronic rooms (CER or LER) or in local control centers (LCC). The protection class required is specified under **Section B0.6.18**.

Outdoor installed cubicles shall be provided with thermostatically controlled heating elements in order to prevent the formation of condensate which may occur due to large variations of ambient conditions, if necessary. Adequate lighting and sockets for hand tools protected by 30 mA Residual Current Differential Switch (RCDS) shall also be provided for cubicles and panels, if necessary.

The cubicles shall be secured in such a way that failure of one node cannot cause the failure of the whole system.

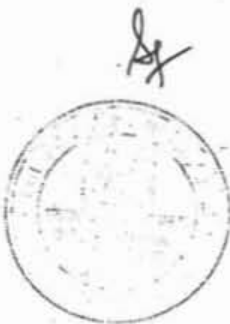
The required control elements and displays (annunciation and status lights, analogue displays, switches etc.) shall be so configured that as far as possible they can be viewed from the associated secondary system. Should it be necessary to place the control and monitoring elements in the field, these shall be installed in separate, robust housings (protection class IP 55W). All alarms/ annunciations shall as well be available in DCS.

In preference LED displays shall be used. Ease of access and operation of the equipment shall be ensured.

Visual display unit (VDUs) will be employed for field operation and monitoring.

All cubicles shall be adequately ventilated in order that the heat generated by the equipment mounted there shall remain within the specified limits, even in the case of high ambient temperatures that may occur in the event of failure of the air-conditioning system.

Locally installed cubicles shall be suitable for the location in which they are situated and shall provide adequate protection against dust, moisture or mechanical damage for the equipment mounted therein. Cubicles shall be designed in such a way that vibrations of the building shall be absorbed to a large extent. Sunshades shall be provided for all cubicle located outdoors.



Cable connections to cubicles, panels and desks shall be made via suitable seals so as to prevent the ingress of dust, vermin or the propagation of a possible fire. During installation period, a provisional sealing of cable penetrations shall be ensured.

B0.6.19.5 Racks, junction boxes

Marshalling racks

Separate cubicle type marshalling/ termination panels shall be provided, i.e. field signals shall not be terminated in the rear side of the system cabinets.

Open type racks constructed of angle steel may be used for the marshalling and termination of low voltage control cables within the Central Electronics Rooms (CER & LER). Cubicle type marshalling racks may also be considered.

For voltages exceeding 60 V, a suitably separated Section with isolation cover shall be provided.

Instrument racks

Wherever possible, instruments and devices, e.g. transmitters, thermo element cold junctions, terminal boxes, located in the field, shall be mounted on local instrument racks. The instrument racks shall be installed with due regard to control engineering needs, material-saving assembly and easy accessibility for maintenance and checking work, and shall be constructed of standard angle Section steel.

Junction boxes

In order to simplify local collection of cables and distribution of signals and to centralize connections in the Plant the junction boxes shall be fitted on all the necessary:

- cable crossover terminal points,
- electrical actuators,
- central collecting points for individual analog and binary signals and local transmitters,
- central distribution points for local signals.

The necessary intermediate terminal boxes must at least have degree of protection IP 55 in accordance with EN 60529 and must be equipped with the necessary terminal strips and attachment components for the connection of the cables. The necessary earthing terminals shall be provided for the earthing of the boxes. In hazardous areas, terminal boxes shall be in accordance with EN 50019 or 50020, depending on zone classification.

After commissioning, the junction boxes, marshalling racks, instrument racks, etc. must contain at least 10% of spare space. The Contractor shall furthermore provide at least 10% of fully fitted spare terminal capacity.



B0.6.19.6 Mimic diagrams

Mimic diagrams shall be offered where specified or alternatively where their presence would assist Plant operators in assimilating the operational state of the Plant.

Where used, the mimic diagram shall harmonize with the other equipment in the control room. Mimic diagrams shall be of the mosaic type.

On mimic diagrams for electrical systems, the different voltage levels shall be distinguished by the use of mosaic elements having an inlaid coloured strip. These elements shall be fitted together to show the location of the different busbars. The operational position of circuit breakers and isolators shall be indicated by semaphore indicators, and the operation of switchgear from the mimic diagram shall be by means of discrepancy switches or pushbuttons designed to operate in a similar manner.

On process mimic diagrams, methods shall be used to clearly indicate the path of the various media, the preferred technique being by means of raised plastic strips which shall have a distinctive colour. Also a uniform scheme of colours for different media shall be adopted.

Where pushbuttons are proposed for operation, enabling pushbuttons shall also be provided and it shall require the operation of both the pushbutton actuating the device and the enabling pushbutton to operate the device.

The Contractor shall propose the mimic colour code for process and electric system identification of the P&ID and electric single line mimics in the VDU or mimic panel.

B0.6.19.7 Power supply and fusing

The power supply for the equipment requiring uninterrupted supply (UPS) (e.g. emergency valves, flame monitors, measuring and control system, recorders, printers, VDUs, OWS and servers) shall be taken from the safe AC as described in other parts of the specification, especially **Section B0** and **Section B7**.

The 24 V DC independent supply systems shall be provided for the control cubicles of independent control systems. Ni-Cd or lead-acid planté batteries shall be used in the main plant area whereas in offsite plant areas only Ni-Cd batteries shall be used.

The 24 V DC systems shall consist of 2 sets of power supply with each set consisting of 1 x 100% battery charger, 1 x 100% batteries for 1 hour duty and 1 x 100% DC distribution board.



Each individual consumer shall be provided with an infeed from each set with diode decoupling at the consumer.

The supply voltages for the control cubicles within the central electronic rooms (CER & LER) shall preferably be 24 V DC and must be arranged as separately fused double infeeds. The individual feeders can serve either a single cubicle or several cubicles combined as a logical group.

Intelligent Battery health management system shall be provided for each set of 24VDC power supply system and UPS batteries (except mini-UPS). It shall be connected to DCS.

All battery systems shall be provided with a manual discharge resistance bank.

All equipment shall be adequately protected against overcurrent by means of fuses or other current protection devices. The main power supply fuses shall be located in functional groups within separate power distribution cubicles. Fuse ratings and time characteristics shall be such that in all cases, a fault within an individual item will cause the fuse associated with that item to rupture and thus disconnect that item from the power supply, before the main fuse is affected.

Failure of a main fuse shall affect the overall operation of the Plant as little as possible and shall be indicated in the central control room (CCR) by means of an alarm. This alarm shall state the identity of the failed main fuse.

Failure of an individual cubicle, module or component fuse shall be indicated by a general alarm and a detailed diagnostic message. The Section of the control cubicle in which the fuse is located shall be indicated. It shall also be possible to locate visually the fuse that has failed.

The design of the electrical power supplies and fusing system must ensure that any faults in modules or other devices, which may block sequence logic interlocks, automatic control systems or other control systems, are restricted to the system in which the fault has occurred.

All electronic devices shall be protected against transient voltage levels which would otherwise damage the device.

B0.6.19.8 Transmitters

All transmitters shall have an impressed output signal of 4 - 20 mA corresponding to zero to full range input. However, digital communication shall also be acceptable.

Generally, 2-wire transmitters shall be used. If for some special purposes (e.g. analyzers) 230 V AC power supply is required, the output circuit shall be isolated.



As far as possible, all transmitters shall be of the SMART-type. This applies also to field mounted temperature transmitters.

All transmitters shall be fitted with a local analog or digital indicator displaying appropriate physical units which may be read clearly from an easily accessible position.

Transmitters with accuracy class "0.5" or better must be used. The repeatability shall be within a range of $\pm 0.1\%$ of full span.

The output signal of all transmitters must be independent of the burden of the transmitter output circuit including cable resistance over a wide range.

The removal of connected devices must not open the transmitter output circuit or cause malfunction of this circuit. In the case of failure and return of the supply voltage within a measuring circuit, no false signals endangering the system shall be issued. All transmitters shall be individually fused. If not specified otherwise, local parameterization at the transmitter or via modem and PC/laptop or hand held communicator using HART-protocol shall be possible.

For the continuous remote position indication of valves, dampers etc. also transmitters with impressed output signal of 4- 20 mA shall be employed.

All transmitters shall be suitable for field installation and shall have strong, moisture and dustproof cases of IP 65 or better according to EN 60529. This applies also for temperature transmitters when installed in the field.

Diaphragm seals shall be provided to serve as a barrier for corrosive process fluids, slurries or highly viscous oils. The seal shall be of the flanged type, suitable for the same conditions as those for the transmitter. The material selection shall be according to the requirements of the fluids to be measured. The seal shall be provided with a flushing connection.

Transmitters to be used in hazardous areas shall be explosion proof. Suitable intrinsically safe circuits are to be provided in accordance with EN 60079-11.

All transmitters potentially subjected to vacuum shall be capable of withstanding 100% vacuum without damage.

No stress shall be imposed through the connections between Plant and the transmitter. As far as possible, the transmitters shall be grouped together into enclosed racks or panels for easy access. Sunshades shall be provided for all outdoor panels.

Individually installed transmitters shall have their own weather proof enclosure of robust construction and be suitable for the proposed

environment. All field equipment terminals shall be wired to a terminal box using screwed connections.

Transmitters shall be provided with all necessary isolating, vent and blow-down valves and facilities shall be provided for the connection of test instruments at the input and output of each transmitter, to enable calibration to be carried out.

In general limits (for alarms or switching actions) shall be derived from the analogue measurement value in the DCS (use of switches shall be avoided). Where binary signals cannot be derived from an analog value, **binary transmitters** e.g. temperature switches, pressure switches etc. may be used. Indicators with integrated limit switches are allowed within package units. Preferably limit switches shall be of the proximity type.

All switches shall be of robust design and reliable performance. Temperature switches, pressure switches, level switches, and etc. shall be of the snap-action and change over type. The switches shall have an adjustable switching hysteresis. Parity checks shall be supplied for switches. (Note: Parity checks refer to the supervision of switches, i.e. it shall be supervised that switches have one defined state and are not undefined e.g. neither open nor closed. Finally this means that there have to be 2 DI to be used for each switch, one for "open" detection and one for "closed" detection.)

The set point and the deadband (reset point) of each switch shall be adjustable from inside the case, over the full range specified. The set point and reset point shall be indicated on the adjusting mechanism.

For the sensing of level in tanks, vessels or bunkers float switches, vibration level switches or other suitable switching devices with conductive or capacitive electrodes shall be provided.

For monitoring of machine coolant or lubricant flow (dry running protection) suitable flow or level sensors shall be employed.

The switches shall be housed in robust, dust and moisture proof cases having glanded cable entries and shall be suitable for the ambient conditions local to the equipment on which they are mounted.

B0.6.19.9 Temperature measurements

Glass thermometers, bi-metallic and capillary remote thermometers are to be used for local temperature measurement. For both, class 1.0 shall be provided.

Glass thermometers are to be inserted into pockets provided for the purpose. The use of mercury is forbidden.

Capillary remote thermometers shall be with a case diameter of preferably 160 mm and must be mounted on fixtures or instrument panels in such a



way that they are protected from vibration, jarring and sprayed water. The capillary tube must be laid in a protected position.

If possible, resistance thermometers (Pt-100) in accordance with IEC 60751 shall be used for remote measurements. All resistance thermometers shall be wired according to the four-conductor principle.

Otherwise, thermocouples with appropriate heat resistance in accordance with DIN IEC 60584-1 or equivalent may be used for remote measurements.

All thermocouples shall be of the quick response type, ungrounded and preferably of double element type.

Thermocouples shall be arranged in such a way that the ambient temperature of the head is lower than 100 °C, and that the measuring inserts can easily be exchanged.

All thermocouples and extension leads shall be terminated with a suitable gland and the conductor to sheath resistance shall be greater than 100 M-Ohms when tested after termination.

Thermometers and thermocouples shall generally be fitted in protective wells. They shall be provided with weatherproof terminal heads and shall be installed so as to totally prevent the ingress of foreign matter.

High speed response pockets shall be provided for all applications involving control of critical process temperatures. Thermowells with high speed of response shall be used.

Where more than one temperature measurement e.g. for redundant loops, recording, indication, automatic control is to be made at one location, individual protective wells with sensors shall be provided at the common place of measurement. Protective wells for unoccupied test measuring points shall be arranged with the opening inclined downwards wherever possible and shall be provided with a screw-on protection cover.

Insofar as local conditions or extreme temperature do not require otherwise, screw-in immersion wells for exhaust gas and air shall meet the following requirements:

- nominal length not less than 0.5 m
- attachment of the well in the wall of the exhaust gas channel or air duct must be gas-proof.

For the measurement of temperature of other media the following requirements shall be observed:

For all pipework a minimum immersion depth of 55 mm in the internal pipeline cross-section and a minimum distance of 15 mm from the opposite



pipe wall must be provided. If the diameter of the pipeline does not allow the thermometer to be inserted perpendicular to the pipe axis while still maintaining the above mentioned measurements, another solution must be found in cooperation with the Employer/ Engineer. When determining the lengths of the insertion and connecting tubes the insulation thickness is to be taken into consideration.

For all remote temperature measurements (i.e. for RTDs and TCs) transmitters shall be installed locally in a transmitter protecting box on a DIN rail.

B0.6.19.10 Pressure measurements

Pressure gauges of class 1.6 or better must be used. The standard measuring ranges must be selected with regard to the maximum operating pressure.

A pressure instrument installed for measurement of steady pressure at varying pressure shall operate in a band centered on 60% of its maximum range.

When the pressure impulse line is liquid filled the measuring unit shall be compensated for static head. The head correction shall be stated on the unit.

Pressure gauges shall have a dial size of 160 mm and shall be located in such a way that they can be easily observed or shall be combined in groups on local gauge boards or cubicles.

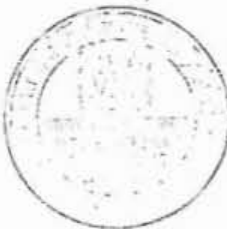
Pressure gauges shall be resistant against vibrations. Furthermore, pressure gauges shall be designed in such a way that the measured value may reach the end of the indicating range without affecting the calibration of the gauge.

Pressures to be remotely indicated, recorded or used for automatic control loop inputs shall be measured by means of pressure transmitters (refer to relevant part of Section B0).

Pressure measurement tapping points shall generally be in accordance with the specification for the pipeline in which they are installed and shall be equipped with one, and for high pressure installations (45 bar) two, isolating valves arranged directly at the tapping point. Excluded from this stipulation are measuring points for vacuum and measuring points for combustion air and exhaust gas.

Piping shall be of approved quality and sized for the particular service. In all cases the pipe size shall be chosen to ensure strength and freedom from blockage. Instrument impulse pipework shall be manufactured from a suitable grade of stainless steel to the approval of the Employer/Engineer.

Pressure transmitters for remote measurement shall not be mounted directly at the tapping point, but shall be arranged at a distance from the tapping



point by means of enclosures. The impulse line between tapping point and transmitter shall be arranged in such a way as to form a siphon loop, when steam pressure measurements are involved.

A valve combination or multiway cock shall be provided directly on each pressure gauge or transducer connection. They shall be equipped with a connection for test gauges, and it shall be possible to shut off the test connection without isolating the service pressure gauge at the same time.

Open blowdown / drain connections shall not be arranged within panels and local equipment. Instead it shall be led to a drain external to the panel. All valves shall be installed so that they are accessible for in-situ maintenance from a floor or permanent structure landing.

Transmitters are to be protected from the measuring media, if required.

In addition to the above requirements, special valve block equipment shall be provided, where differential pressure is to be measured. Alternatively, differential pressure type transmitter can be considered.

B0.6.19.11 Flow measurements

Remote flow measurements of water, steam, combustion air, flue gas etc. shall, unless otherwise specified, be carried out by means of differential pressure, ultrasonic, electromagnetic, annubar, coriolis, turbine meters, oval-wheel flow meters.

The transmitters shall be as specified under **Section B0**. Changes in density, pressure or temperature of the measured medium shall be compensated wherever necessary.

Tags on orifice plates shall be stamped with the basic design information (i.e. flow rate, pressure and temperature of the passing fluid, the orifice diameter and the pressure differential generated).

Primary elements such as orifices or nozzles located in steam or high pressure feed water pipes shall be of the weld-in type. Material, dimensions and installation of orifices, nozzles and tapping points etc. shall be in accordance with the specification for the pipes in which they are installed

Orifice Plate installation using Weldneck Flange assemblies shall be offered. Tappings shall be on the flange and not on pipe.

Isolating valves shall be provided at the tapping points of the orifices, nozzles. In the case of steam flow measurements condensing vessels (steam traps) shall be provided between the tapping point and the isolating valve.



The material and dimensions of the piping shall conform to those laid down for the piping concerned. The welds shall be executed in such a manner as to avoid turbulence that can affect the measurement.

In order to achieve exact installation, the vendor supplying the orifice plate or nozzle for high pressure pipes shall install the orifice plate or nozzle in its own works in a Section of pipe of about 3.5 times the pipe diameter (1.0 x NB in the outlet, 2.5 x NB in the inlet). For orifice plates or nozzles installed in pipes with a nominal bore smaller than 80 mm, complete meter runs shall be supplied.

Orifice plates and nozzles shall be manufactured of ANSI 316 Stainless Steel unless specified otherwise. Orifice plates shall be sized according ISO 5167-2.

Orifice plates shall be sized for a d/D ratio not less than 0.20 and not greater than 0.70. Higher rather than lower d/D ratio are preferred to minimize line restrictions. All sizing calculations shall be submitted to the Employer/ Engineer for approval.

Tags on orifice plates shall be stamped with the basic design information (i.e. flow rate, pressure and temperature of the passing fluid, the orifice diameter and the pressure differential generated).

Venturi tubes according to ASME MFC-3M shall only be considered when operating economy requires low permanent pressure losses.

The erection welding seams shall be executed in such a manner that no turbulence, which will affect the measurement, can occur.

Rectangular venturi tubes may be considered where other measuring devices are impossible or impractical (e.g. in large rectangular air duct of boilers).

For flow measurements in LP-systems e.g. water or condensate, orifice plate installation using slip-on orifice flanges shall be provided. All orifice plates for installation between flanges shall have their own tapings for differential pressure measurements incorporated in the plate. Simple orifice plates with the tapings situated in the pipe are not allowed. The flow direction shall be consistently marked on the orifice or nozzle by means of an arrow.

Special conditions may dictate the use of devices such as:

- venturi tubes for low pressure gases
- pitot tubes such as Annubar.

Ultrasonic flow sensors shall provide a double transmitter/ receiver system and be for installation with a calibrated pipe. The tube lining material shall be as required for the fluid and its temperature and be as specified in other chapters of this **Section B0**. The use of ultrasonic clamp on flow meters shall be avoided and requires dedicated approval of the Employer/ Engineer.



The accuracy shall be 1% of the calibrated span. An overpressure security shall be provided of 50% above the maximum pressure range.

Electromagnetic measurements may be used for flow measurements of inhomogenous liquids with or without solids content in completely filled pipes. The limits of application of the measuring system due to the medium parameters planned on a case-by-case basis shall be observed. Inductive flow sensors shall be of alternating field or pulsating DC field type and be for inline installation with a pipe.

The tube lining material shall be as required for the fluid and its temperature and be as specified in other chapters of this **Section B0**. The accuracy shall be 1% of the calibrated span. An overpressure security shall be provided of 50% above the maximum pressure range.

Coriolis measurements shall be used for mass flow measurements of homogenous liquids and gases without solids content in completely filled pipes, in particular for natural gases, fuel oils and solvents as well as other media with fluctuating densities. The accuracy shall be typically at 0.5% of the measured value.

B0.6.19.12 **Level measurements**

Where detection of discrete levels is required, the simple float operated switch should be used, however each switch shall have snap action with limited hysteresis to prevent contact bounce caused by small fluctuations in level. For sumps the level should be measured using non-contactive measuring principles such as ultra sonic with local control box.

Switches used for level detection shall provide facilities for testing the mechanical and electrical operation of the switch without its removal from the process. Isolation by means of shut-off valve will be allowable during testing.

Generally, the use of switches shall be avoided. Instead limit values shall be derived from analog transmitters.

For measurement of large storage tanks, the load indication and transmitting mechanism shall be located at the base of the tank.

For the measurements of boiler separator water level, feed water tank levels etc., differential pressure transmitters shall preferably be used.

The transmitters shall be as specified under **Section B0**.

For special applications such as chemical tanks, techniques such as ultrasonic, radar, capacitance probes, etc. should be considered. For level measurement in tanks with underpressure (vacuum) guided wave radar shall be used.

For level measurement of the fabric filter (FF) hopper dust radio frequency (RF) / Capacitance type level switch can be considered.



For measurements where a reference leg of process fluid is used, the design of the system shall ensure that the reference leg is fully maintained at its prescribed height during all conditions of process level change and changes in process conditions and the density of the reference leg does not vary from that of the process fluid due to temperature changes or other reasons.

All measurement transmitters for differential pressure shall be provided with:

- a. shut-off valves to be arranged directly at the condensing vessels and active pressure tapping points
- b. valve blocks enabling the transmitter to be isolated from the active pressure and enabling the transmitter zero point to be checked
- c. separate blow-off valves for cleaning the active pressure tubes.
- d. 2 ways for relative pressure, 5 ways for DP.

The aforementioned valves shall be of the weld-in type.

Where a standpipe exists, the level transmitters or level switches must be connected to the standpipe by means of shut-off valves, so that the units can be replaced easily in service.

Local level indicators for water shall be provided with an illumination device and indicators shall be designed so that the water column can be seen as whole, i.e. level indicators only showing the level as a point will not be accepted. Level indicators shall be equipped with shut-off valves which permit exchange or replacement of glasses or mica during operation.

The indicating range of local level indicators shall cover all switching points of level switches mounted on the tank or similar as a minimum requirement.

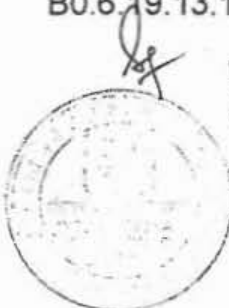
On all forms of measurement all parts of the switch, transmitter, etc. in contact with the process fluid shall be made of material compatible with the process fluid. Stainless steel shall normally be used for all corrosive duties.

B0.6.19.13 Analysers and monitoring systems

B0.6.19.13.1 Analyses of steam and water (SWAS)

The steam and water analyzer core instruments shall comply with EPRI (Electric Power Research Centre Inc.) guidelines.

The main analyzers for steam and water shall be arranged in groups in such a way that excessively long process pipes will not be necessary.



If required by the medium to be analyzed, all samples shall be adequately cooled and pressure reducing devices shall be provided where necessary. Manual sampling shall be possible.

A protective device shall be incorporated in the sample cooler to isolate the analyzer in the event of excessive temperature.

In order to eliminate the influence of conditioning agents on the conductivity measurement, cation filters shall be provided. The cation filters shall have visible colour indicators to show when they have to be regenerated.

For all analyzers temperature compensation shall be provided, with the temperature sensor being an integral part of the probe.

Chlorine residual monitors and hypochlorite concentration meters shall preferably be able to measure high and low concentrations. Measurement of hypochlorite concentration shall not be affected by the presence of other oxidizing components in the sample.

Individual or multiple prefabricated analyzer installations shall be used to reduce site installation work. This prefabrication shall include sample conditioners, analyzers, air and electrical distribution, cooling water distribution or coolant circulating system all piped and wired on a common frame. Interconnecting pipework and accessories shall be of stainless steel. The arrangement shall permit testing of the entire assembly before dispatch to site and shall be arranged for convenient removal from on-line operation to facilitate routine maintenance and calibration.

The sampling system shall include but not be limited to all probes, valves, filters, coolers, drainage facilities, flow regulators, flow meters, piping and pumps as necessary, to give the analyzer a representative and suitably conditioned sample.

Analyzers shall be provided as follows:

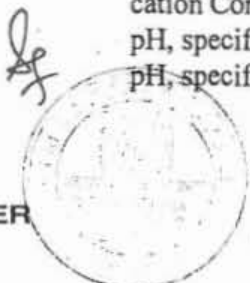
Sample Point

Condenser make up water
Condensate pump discharge water
Condensate at deaerator inlet water
Deaerator effluent water
Economizer inlet water
Boiler blow down steam
Saturated steam
Main steam
HP5 heater drain water
Closed cooling water

Analyzing Required

specific Conductivity
pH, cation Conductivity, DO
pH, specific Conductivity
pH, DO
pH, cation Conductivity, DO
pH, specific Conductivity
cation Conductivity, SiO₂, Na
cation Conductivity
pH, specific Conductivity
pH, specific Conductivity

Note:



DO: Dissolved Oxygen

Chemical reagent for the sampling system commissioning period but not exceeding 180 days shall be provided.

Each automatic analysis sampling point shall be provided with a manual sampling point to permit a sample to be easily taken. Manual sampling shall not interrupt automatic sampling. All sampling lines shall be run to common sampling racks on which shall be fitted all the analysis associated equipment.

The sampled points of analyzers shall be indicated and monitored at the local panel.

The corresponding analogue measuring signals (4-20 mA) and the status signals (24V DC) shall be transmitted over serial link to the DCS.

The SWAS system, for both Units should be located at ± 0.0 meters in an air conditioned room.

B0.6.19.13.2 Effluent Monitoring

The operational philosophy of water supply/ distribution system shall be based on a continuous Possur river water quality analysis, potable water quality monitoring, sampling and analyzing concept and shall consider preventive and active measures against water pollution and adaption of operating mode(s) to changes in water conditions.

Sample Extraction for Laboratory Analyses:

A tapping shaft for extraction of samples for laboratory test shall be provided and installed at the various measuring locations, before the waste waters are mixed with the circulating cooling water and discharged to the sea.

Continuous Effluent Monitoring:

A continuous monitoring shall also be implemented for water quality measurements of all kinds of discharges to the river.

The sensors for continuous monitoring of effluent parameters shall be located within the sample-tapping shaft. Additionally flow and temperature sensors shall be mounted within the discharge lines.

Following kind of analyzers shall be considered at least:

- pH analyzer
- conductivity analyzer
- chemical oxygen demand (COD) analyzer
- biological oxygen demand (BOD) analyzer



- total suspended solid (TSS) analyzer
- oil in water (OIW) analyzer

Continuous quality monitoring system shall be installed at the CES. The corresponding electronic equipment shall be mounted in a weatherproof container to be located nearby the point of measurement at the discharge pipes of waste water.

The corresponding analogue measuring signals (4-20 mA) and the status signals (24V DC) shall be transmitted by multicore cables to the DCS.

B0.6.19.13.3 Potable water quality monitoring system

Water quality control and monitoring of the Plant's drinking water shall be performed at the Plant interface (downstream the potable water tanks).

The water quality monitoring system shall at least consist of, but not be limited to the following online metering, measurement, sampling and analyzing equipment, including data acquisition and data storage facilities:

- alkalinity
- conductivity metering
- pH monitoring
- temperature measurement
- turbidity monitoring
- residual chlorine monitoring
- TDS (computed value)
- LSI (computed value)
- sampling points and equipment for potable water sampling at the online measuring units.

B0.6.19.13.4 Quality monitoring for fuel

For fuel oil a sampling point for discontinuous manual analysis shall be provided for the facility at the fuel oil storage tanks.



B0.6.19.13.5 Analysis of exhaust gas (CEMS)

The analysis of O₂, CO, CO₂, NO_x, SO₂, particulate matter (opacity) in the exhaust gas shall be performed by appropriate analyzers of proven type.

The equipment shall be constructed for operation in dusty and humid environments at high ambient and exhaust gas temperatures. The use of equipment capable of multi-parameter measurement shall be considered.

The reliability and response time of the O₂-analyzer shall be of the quality required for closed-loop control. The accuracy of the system shall be better



than 2.0% of the span and the drift shall be not more than 0.1% O₂ per week. A zirconium oxide measuring cell shall be used. Maintenance shall not be more than once a week.

Analyzers provided shall have auto-calibration for zero and span as well as self-diagnostic functions. Analyzers and sensors can be of extraction or insitu type.

All equipment of the continuous emission monitoring system (CEMS) shall be suitable for operation in dusty and humid environments at high ambient and flue gas temperatures. Continuous Emission Monitoring System (CEMS) shall be provided for each unit.

If sampling of exhaust gas is used, sampling probes shall preferably be vertically installed on the top of horizontal exhaust gas ducts, in order to avoid blockages.

In order to keep the sampling lays to acceptable limits the analyzers shall be located close to their sample take-off point, so that easy access to the sample take-off point and to the analyzers shall be provided for maintenance.

The exhaust gas sampling lines shall be heated to prevent condensation and shall not form a siphon in the case where condensate may be collected during heater failure. Condensate drainage facilities shall be provided at the analyzers.

Generally, the analyzers and the sampling probe equipment shall be suitable for mounting in ambient plant conditions, e.g. within a standard cubicle. However, if this is not feasible, the equipment shall be mounted in an air-conditioned room or container.

Power failure and system failures of analyzers shall be monitored in the DCS by a group alarm.

Measured values and certain status signals shall be processed by an emission evaluation computer via serial interface, to be installed within the central control room. The emission data shall be calculated, converted, printed out and stored according to the governmental requirements. Possibilities for line data readout for authorities shall be provided.

B0.6.19.13.6 Ambient air quality monitoring system (AAQMS)

An ambient air quality monitoring system shall be provided consisting AAQMS stations and metrological stations. A centralized data acquisition PC shall be installed to collect all information from the AAQMS. The AAQMS stations shall be suitably distributed on the Plant area.

The AAQMS stations shall contain at least the following:



- Analyzers for SO_x, NO_x, CO, O₃, mercury
- Multi gas calibration system
- PC based data logger
- UPS
- Suspended particulate monitors (TSP)
- Sampling inlet heads

Metrological station shall include at least:

- Metrological sensors such as wind speed, wind direction, air temperature, relative humidity (rH), solar radiation, rain gauge
- Metrological mast

All ambient gas analyzers and dust monitors shall conform to the US EPA reference of equivalent method. A proof of approvals and certificates of the compliance of internationally reputed agencies such as US EPA, German TUV, etc shall be provided.

A sampling system compatible with the analyzers shall be provided. The system shall be compatible with analyzers for Pb (which the Employer may procure in the future). The system shall have the facility for moisture removal.

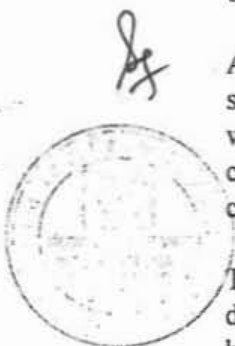
Built-in calibration facilities shall be provided for all analyzers. To cross check the built-in calibration facilities of the analyzers/ monitors, a standard multi-gas calibration system for each AAQMS station with fast response time shall be provided.

The metrological sensors for wind speed and wind direction shall have an accuracy of 2% of full scale. The accuracy of the relative humidity sensor shall be 3% for the range between 10 and 90% rH.

The rain gauge shall be of self recording type and of reputed make. Electronic recording facilities shall be provided. The instrument shall have automatic functions for computing rainfall for pre-set time periods. The gauge shall be rugged and be of material resistant to atmospheric corrosion. The accuracy shall be 1% for rainfall ranges above 125 mm/hr and 5% below this value.

A metrological mast shall be provided for mounting of the metrological sensors. It shall be complete with all necessary hangers and holders along with electrical earthing for the installation of the sensors. Material and construction of the mast shall be robust and shall be resistant to atmospheric corrosion.

There shall be PC based data loggers for each AAQMS station. The entire data capture and mean value calculation as well as control of analyzers shall be through user friendly software and operate on the latest Windows operating system. Diagnostic features shall be included in the software and



any unauthorized access shall be prevented by appropriate measures such as password protection.

Data loggers for the metrological station shall be provided with the necessary analogue and digital inputs and internal memory for all collected parameters. The data loggers shall have the capacity for future extension with additional sensors.

Location for centralized data collection PC stations shall be decided during basic/detailed design stage

B0.6.19.14 .Electrical value measurements

For the processing of electrical values such as voltage, current, power, frequency etc. electronic type transmitters shall be provided to convert the output of current and voltage transformers into an impressed direct current in the range 4 - 20 mA. The transmitters shall be housed in the switchgear.

For power measurements precision electricity meters for asymmetrical three-phase networks are to be supplied. Connection of the meters shall generally be to 3 x 1 A current transformers and 3 x $110/\sqrt{3}$ V voltage transformers. The meter accuracy class is to be approximate to the respective transformer classes. Instrument transformers with an accuracy class of 0.5 or better shall be used for metering purposes.

For the purpose of billing for electrical energy and for acceptance tests, an instrument transformer of at least class 0.2 (precision) accuracy and high precision electricity meters of class 0.2 have to be provided. Meters for billing purposes shall be of the approved calibrated type (certified by independent testing stations). All meters for billing purposes are to be provided as double 2 x 100% meters.

At all points where power direction reversal is possible, the necessary meters for both directions are to be provided.

The meters in the local switchgear are to be arranged behind the clear plastic fronts of the cubicle doors so that the counter readings can be taken without opening the doors.

B0.6.19.15 Control valves

Control valve spindles and internals shall be made of chromium steel and shall have a high resistance to wear and corrosion. Cones and seats shall be hard faced with materials with a high resistance to wear and corrosion. Housings shall be made of forged or cast steel. A hand wheel, with provision for switching to manual operation and a local position indicator shall also be provided.



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All control valves, orifices and nozzles shall comply with the relevant international standards such as DIN, BS or any other which may be agreed to by the Employer/Engineer.

Control valve characteristic shall allow smooth and continuous control of the control parameter.

Valves shall not generate noise in excess of 85 dB(A), measured at a point 1 meter downstream of the valve outlet and 1 meter from the pipe centerline. Where this requirement must be exceeded because of physical limitation, suitable sound attenuators shall be provided in terms of special valve trim, in-line attenuators, isolators and enclosures to satisfy the noise requirement.

Valves shall have trim designed to avoid cavitation damage. If an application cannot avoid cavitation entirely, material selection shall be such as to withstand the effects without damage.

Line strainers shall be provided upstream of control valves where required.

The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. The design pressure drop across the valve should be 15 to 20% of the total available pressure drop at no flow.

Although control valves shall not be used for shut-off service, to provide reasonable shut-off performance, leakage through a closed control valve shall not exceed 1% for single ported valves or 2% for balanced ported valves.

All control valve materials shall be compatible with the fluid handled. Materials shall be in accordance with the piping materials standard and/or as approved by the Employer/ Engineer.

Valve characteristics shall be selected to suit the process and control system dynamics.

All the control valves for boiler feedwater services should be of anti-cavitation type with flash-flow trims and cage type to avoid cavitation problems.

The installation shall include upstream and downstream isolating valves and, for critical control valves, a bypass valve for each control valve on all services. Unless otherwise agreed by the Employer/Engineer the bypass valve shall have a similar characteristic as the control valve but shall provide tight shut-off. Any exceptions or variations to the requirement shall be subject to the approval of the Employer/ Engineer. Where a service is subject to a pressure above 3 bar a 25 mm vent valve shall be provided, between the upstream and downstream isolating valves, in order to relieve the pressure to enable maintenance to be carried out on the control valve.



Control valves shall be adequately supported in all cases and shall be accessible for maintenance. Local pressure gauges shall be provided upstream and downstream of each control valve.

If as per steam turbine OEM's proven design, isolating valves or bypass valves are not envisaged for control valves of internal piping, same is also acceptable.

For normal duty globe type valves shall be used.

The use of butterfly valves shall be avoided in the main plant. Where very large sizes are involved (on high flows), or low pressure drops and low static pressure are a determining factor, making globe valves unattractive or impossible, butterfly valves may be used. They shall be of the "balanced torque" type disc usable to the fully open position (90° opening). The overall shaft rating shall be at least 25 % above the static pressure as differential across the closed valve.

Multi-stage valves (e.g. multi seat or multi cage valves) shall be used on services, e.g. steam and gas, having very high pressure drops which would result in supersonic velocity inside a conventional body and shock waves in the piping, creating unacceptable noise levels.

Angle valves shall be provided:

- for steam pressure reducing de-superheating stations of the "combination" type,
- for erosive services, e.g. slurries,
- on applications where solid contaminants might settle in the valve body,
- on hydrocarbon services with a tendency for "coking".

Ball valves shall be used for on-off and throttling services under moderate operating conditions.

The control valves must be provided with all data important for their identification, such as flow direction, type, nominal diameter, nominal pressure, seating, CV value.



B0.6.19.16 Actuators

Intelligent drives with integrated power switch unit and further electronics shall be installed. Actuators equipped with integral controls shall be supplied which can be operated via the operation elements on the local controls as soon as power is connected. Only operation commands and feedback signals shall be exchanged between the control system and the actuator. Motor switching shall be performed within the device and virtually without delay.

