TECHNICAL SPECIFICATION

FOR

FOAM PROTECTION SYSTEM

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

CUSTOMER : BIHAR STATE ELECTRICITY BOARD (BSEB)

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

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1. INTENT OF SPECIFICATION:

1.1. The intent of this document is to establish the minimum requirement of design, engineering, selection, manufacture, assembly, inspection, shop testing, shop painting, delivery FOR site properly packed for transportation suitably protected from weather including transit insurance of all equipment, supervision of Erection & Commissioning, final handling over as mentioned hereinafter for the Foam Protection System (FPS), which form part of project.

1.2. It is not the intent to completely specify all details of design, manufacture and construction. Nevertheless the equipment and installation shall conform to high standard of engineering and shall be capable of performing in continuous commercial operation in a manner acceptable to the Purchaser and end customer.

2. SPECIAL NOTES TO BIDDERS

2.1. This specification shall be read in conjunction with all its enclosures. In case of any discrepancy arising between this job specification & its enclosures, the most stringent of all (as determined by purchaser) shall be followed. Further, if a requirement in this specification or any of the enclosures, calls for a decision from the Purchaser, it shall be bidder's sole responsibility to clearly bring out/highlight the same distinctively in his pre-bid queries, so as to enable purchaser to furnish their decision/clarification. If such issues/requirements are not duly addressed by bidder during the pre-bid stage and if such issues/requirements are observed later during order execution stage, it shall be binding on the bidder to comply with the final decision made by the purchaser subsequently, without any cost, delivery, or any other commercial implications.

2.2. Any additional equipment, material, services etc., which are not specifically mentioned in this specification, but required to make the FPS complete in all respects, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be covered under the scope of this specification.

2.3. Any specific hardware/software/item/ etc. required as indicated in 2.2. above but not listed elsewhere in this specification or its enclosures, shall be deemed to be included in the basic price quoted by the bidder.
Also, all mounting hardware/ accessories/fittings/conduits/etc. required for the completion of the Foam Protection System package shall be deemed to be

included in the basic price quoted by the bidder. Bidder, at no point of time, shall be eligible to raise any extra claim in this regard.

2.4. The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipments and the FPS as a whole. These shall be executed on the basis of proven design principle and in accordance with the latest state of the art in such a manner that the purpose to be served by the plant is fulfilled in every respect and a maximum of operational dependability and efficiency are assured. Standardization of equipment, materials etc. shall be employed in the design. Care shall be taken to ensure safe operation as well as simplicity of assembling and dismantling of all parts of the plant.

2.5. By accepting the contract, the bidder shall be deemed to have accepted the obligation of supplying everything that is necessary for the completion of the FPS as per the intent of this specification, regardless of any omission in the specification or on the drawings.

2.6. Even though, the requirements are specified in detail to the extent possible, bidder to apply good engineering practices in the design, selection of equipment, manufacturing, procurement, transportation, fabrication, painting, inspection & testing, supervision of erection & commissioning of system etc., wherever same is not clearly spelt out.

2.7. Bidder to note that the Purchase Order for the entire FPS system for the 2 x 250 MW BSEB Barauni thermal power project shall be placed on lump sum fixed prices based as per tender specification requirements.

Bidder to further note that they shall not be permitted for any claim for additional commercial implication on any account during the detail engineering stage including the following:

- Change (increase/decrease) in dimensions of equipments/areas
- Change in location of equipments/areas within the battery limits.
- Change (increase/decrease) in quantities in the equipments/areas covered by different FPS facilities
- Furnishing of any Input drawing to bidder at any stage of contract execution
- Changes in any of the Input drawings.
- Other conditions mentioned elsewhere in this specification.

2.8. Bidder shall quote strictly as per the scope of supply and requirements of this specification.

2.9. Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.

2.10. In case bidder feels that it is necessary to exclude some components of scope of supply or some of the features of specification requirements due to any technical constraints, bidder shall bring the same to the notice of purchaser during pre-bid stage and take their prior approval before submission of their bid.

2.11. All such clarifications required by the bidder shall be intimated to BHEL together as a single notice **within a week of receipt of enquiry by bidder**. In case no such clarifications are sought during pre-bid stage, it will be assumed that bidder has no comments or observations on BHEL's specification and no deviations to the specifications will be taken by the bidder.

2.12. Bidder to quote strictly as per BHEL's price format. Failure to do shall make their offer liable for rejection. Any tampering/modification/change of the BHEL's price format is not allowed and is liable for rejection of bidders offer.

2.13. Incase Bidder is unable to offer due to any specific requirement of specification, Bidder shall bring out the same in their regret letter. Otherwise it will be considered that non participation by the bidder is attributable to reasons other than any specification requirements.

2.14. Compliance with this specification shall not relieve the bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.

2.15. Accordingly, bidder to furnish their comments if any on this specification as a part of pre-bid query.

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

2.17. The intending tenderers shall be deemed to have visited the site and have studied the conditions before submitting the Bids. Non-familiarity with the site conditions will not be considered a reason either for extra claims or for not carrying out the work in strict conformity with the drawings and specifications.

2.18. Equipment layout of Foam Pump House (Drg No. 13810105642-R0) as attached in the Annexure, which is to be followed for Foam Protection system.

3. PROJECT DESCRIPTION

1	Owner	Bihar State Electricity Board (BSEB).
2	Project	2 X 250 MW Unit # 8 & 9, Barauni-TPS, Begusarai
3	Consultant	M/S Steag Energy Services (India) Pvt. Ltd.
4	Location	Town: Barauni, District: Begusarai, State: Bihar
5	Site	Existing ash dyke are of about 340 acres
6	FFL/FGL	FFL EL+/- 0.0 corresponds to **RL 45.50 M** above MSL FGL corresponds to **RL 45.00 M** above MSL
7	Nearest Airport	Patna-115 Kms.
8	Nearest Rail Head	Simaria Railway Station on North Eastern railways
9	Access to site	The site is at Barauni-Mokama section of National Highway (NH-31)

4. GEOGRAPHICAL & METEOROLOGICAL DETAILS

Sl. No.	Description	Data
1	Latitude	N $25^0$23’13.5” to N $25^0$23’54”
2	Longitude	E $86^0$01’05.1” to E $86^0$01’46.3”
3	Maximum Ambient Air Temperature	35.2° C
4	Minimum Ambient Air Temperature	11.4°C
5	Dry Bulb Temperatures	
5.1	Highest recorded :	35.3°.C
5.2	Lowest recorded :	12.1° C
6	Wet Bulb Temperatures	
6.1	Design AMB WBT	Minimum – 12.0°.C Maximum- 29.0°.C
7	Relative Humidity	
7.1	Design AMB Humidity	Minimum- 26% Maximum- 98%
7.2	Annual Mean	52 %
8	Rainfall	
8.1	Annual Total	1003.4 mm
9	Wind data	
9.1	Wind Speed	47 m/sec
9.2	Prevailing Wind Direction	East (blowing from)
9.3	Wind Pressure	Minimum 990 hPa. Maximum 1011.5 hPa.
10	Seismic coefficient	Zone IV as per IS-1893 Part-I (2002)

5. GENERAL PLANT REQUIREMENT

5.1. FPS shall be designed to operate 24 hours per day and 365 days in a year.

5.2. The life span to be considered in the design, equipment and component selection shall be a minimum of 20 years.

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

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

5.5. The design of the plant shall ensure that the plant can, in the state of normal operation, adapt itself to load, pressure with primary parameter variation within the allowable range of design.

5.6. Equipments installed outdoors shall be able to operate in all-weather conditions and to withstand the work site environment. For equipment in operation or in standby that may be influenced by direct sunshine, shelter or cover shall be provided.

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

5.8. If during the execution of works it is found that there is interference with other facilities / structures, the Bidder shall revise his design/detailed drawings to clear the interference and shall provide all necessary measures for the safety of structures under construction. No claim in terms of cost or relaxation in time shall be entertained for any redesign, rework and for the safety measures provided. If at any stage of work, any dismantling or modification or relocation of any facilities is required to be done to complete the work in bidder's scope and which has been agreed by the Purchaser, the same shall be done by the bidder at no extra cost or time implication to the Purchaser. All such changes will be executed only after the proposed drawings and work plan are approved by the purchaser.

5.9. The Bidder shall take all necessary precautions to protect all the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to the activities of the Bidder on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be immediately made good by the Bidder at his own cost to the satisfaction of the purchaser.
The Bidder shall also take all necessary safety measures at his own cost, to avoid any harm or injury to his workers and staff from the equipment and facilities of the power station.

5.10. Supplies shall be rendered in conformity with proven design principles. The purpose of this contract must be fulfilled in its entirety and the maximum of reliability and economy guaranteed. All the components shall be so designed that repairs and overhauling is minimum and can be carried out easily in the shortest possible time.

6. BIDDER'S SCOPE OF SUPPLY

6.1. The FPS of this project shall consists of the following major systems which are included in bidder's scope of supply and supervision of erection-commissioning:

Foam Protection System

Areas to be covered under Foam Spray System:
i) HFO storage tanks (2 Nos. Tanks of 16M DIA & 10.8M Height)
ii) LDO storage tanks (2 Nos. Tanks of 7M DIA. & 10.4m Height)

NOTES:

1. All equipments connected with the above systems shall be ISI marked or from companies which carry ISO certification or FM/UL/Vds approved.
2. All deluge valves and spray nozzles used in the spray system shall be UL/FM/Vds approved.

6.2. Other Items Included in Bidder's Scope of Supply for Completion of E&C of complete Foam Protection System as per the intent of this document.

6.2.1. FIRST FILL OF CONSUMABLES

6.2.1.1. All the first fill consumables like lubricants etc. and replacements, if any, are in bidder scope till successful handing over of plant to BHEL and subsequently by BHEL to end customer after successful completion of erection and commissioning and /or site performance test.

6.2.1.2. Price of these items shall be construed to be included in the main package price. No separate price for the same shall be offered.

6.2.2. ERECTION AND COMMISSIONING SPARES:

6.2.2.1. All commissioning spares as required during erection and commissioning of the Foam Protection system is included in bidder's scope.

6.2.2.2. Bidder to ensure that all the spares are procured from the original equipment manufacturers (as per their recommendation) and shall make them available at site well before the start of commissioning activities.

6.2.2.3. All spares having a shelf life shall be dispatched to site only after completion of major erection activities. The dispatch schedule of these spares shall however be planned in a way that in doesn't delays any commission activity.

6.2.2.4. Bidder shall also ensure supply of all erection & commissioning spares along with main equipment as per his experience, for replacement of damaged or unserviceable ones during the execution of the project by bidder at site, to avoid delay in the project schedule.

6.2.2.5. Price of all the above items shall be construed to be included in the main package price. No separate price for the same shall be offered.

6.2.2.6. Any equipment not specifically mentioned above but required for satisfactory operation of complete Foam Protection system and to meet desired intent of specification shall be included in scope of supply of bidder.

6.2.2.7. Such requirements, if any, whenever noticed during any stage of order execution shall be deemed to be included in bidder's scope without any commercial implication to purchaser.

6.2.3. SPECIAL TOOLS AND TACKLES:

6.2.3.1. The bidder shall furnish a complete set of all special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance of the system supplied, as a part of scope of supply.

6.2.3.2. All special tools and tackles which are necessary or convenient for erection and commissioning of the Foam Protection System shall be supplied at site by bidder. Price of these items shall be construed to be included in the main package price. No separate price for the same shall be offered

6.2.3.3. All the special tools and tackles shall be shipped in separate heavily constructed wooden boxes.

NOTES:

3. All Tools and tackles required for dismantling, maintenance, adjustment, and calibration of the all the equipments that form part of Foam Protection system shall be supplied.

4. Bidder to note that if at a later stage the requirement of any other special tool & tackles is required for the Package, same has to be supplied by bidder without any delivery or commercial implication. Decision of the Purchaser regarding the requirement of any additional tools and tackles will be final and binding on the Purchaser.

5. All special tools and tackles shall be handed over to end customer warehouse / place informed by the Purchaser, prior to the issuance of the PROVISIONAL ACCEPTANCE CERTIFICATE for the FPS.

6.3. RECOMMENDED 3 YEARS SPARES:

6.3.1. The bidder shall quote separately with unit prices as optional price for the recommended list of spare parts for 3 years operation, with recommended quantities for the equipment covered under this specification.

6.3.2. Bidder shall furnish such a list with unit rate for each item along with offer.

6.3.3. Bidder to note that item shall not be considered for price bid evaluation to finalize the L1 bidder.

7. BIDDER'S SCOPE OF SERVICES

7.1. TAC APPROVAL

Obtaining TAC (or the authority presently having jurisdiction or as may be applicable) shall be in the scope of the bidder.

The system shall be designed for maximum insurance rebate.

All activities related to this including preparation of documents, furnishing clarifications, information etc. as and when required, till final approval is obtained, will have in bidder's scope.

All comments, modifications etc. suggested by the TAC / TAC accredited agency shall have to be incorporated by the bidder without any extra cost to the purchaser.

7.2. SUPERVISION OF ERECTION & COMMISSIONING:

7.2.1. Supervision of erection, commissioning performance testing & final handing over to end customer for the supplied system shall be included in bidder's scope of service.

7.2.2. Bidder to note that the supervision charges for erection & commissioning shall consists of the following:

- Per day supervision charges of an Engineer including all other expenses like boarding, lodging, local travel, insurance etc.
- Travel expenses (inclusive of any clearance charges like Visa fee etc, insurance) from / to vendor works to site.

7.2.3. Per diem charges shall be applicable from the day bidder's person reaches site, up to the day he leaves the site.

7.2.4. For the purpose of tender total no of 50man days to be covered in 7 visits have been considered. However, either or both of the number of man days or no of visits may change on either side based on the actual site requirement.

7.2.5. All payments towards supervision of E&C shall be made only after BHEL-site supervision.

7.2.6. Bidder to mobilize concerned competent person for supervision of Erection & commissioning activities within a period of 7 days of receipt of intimation in this regard by BHEL.

7.2.7. Bidder to quote supervision of erection and commissioning activities strictly as per BHEL's price format.

7.3. LIST OF MAJOR SERVICES INCLUDED IN BIDDER'S SCOPE:

a. Detailed Engineering
b. Engineering for interfacing all inputs and outputs
c. Submission and obtaining approval of all engineering documents
d. Engineering for procurement
e. Preparation of all MTOs and MRs, as required
f. Ordering of all equipments and materials
g. Preparation of Documentation and obtaining owner/consultant approvals for the same
h. Overall Project Management and progress reporting to owner/consultant
i. Expediting suppliers and sub vendors
j. Procurement
k. Manufacture, fabrication and assembly at works
l. Inspection and testing including third party Inspection
m. Painting at works , painting at site including touch up paint
n. Dispatch and transportation of equipments, consumables, construction aids and other material to site.
o. Preparation of all fabrication drawings.
p. Furnishing activity wise work program and taking necessary approvals from the related department in the refinery before carrying out any activity. Any statutory approval, if required, shall also be taken.
q. Supervision of erection and commissioning of the complete Foam Protection System.
r. Insulation with cladding and painting

s. Material Reconciliation
Material re-conciliation will be done jointly by Purchaser's erection office (BHEL-PSER) & Sub-vendor. Bidder to note that the payment towards the supply for any item will be made only after the completion of the material reconciliation activity at site.
Bidder to further note that no separate payment shall be made by Purchaser for material reconciliation activity (material reconciliation at site will not be considered as a part of supervision of E&C activity) & any price of this service will be deemed to be included in the basic price of supply of the package quoted by the bidder.

t. Mechanical Completion
u. Preparation of startup and operating manuals
v. Supervision of Pre-commissioning activities and rectification
w. Supervision of Commissioning and reliability run
x. Running of the Foam Protection System as per Purchaser / End customer's requirements till final handing over.
y. Successful Performance guarantee testing
z. Handing over the plant to the owner
aa. Coordination and statutory approval from government/non-government bodies/agencies
bb. Supply of all test reports /certificates
cc. Providing as built drawings
dd. Training of the Clients Engineering and Operating Personnel

NOTES:

6. Bidder to note that the above list is not exhaustive and any other service required as per the intent of this specification / project requirements /good engineering practice shall be deemed to be included in bidder's scope without any commercial implication to the purchaser.

7.4. Training To End Customer:

7.4.1. Prior to handing over of the system to Owner, the supplier shall provide operational training to Owner's operating personnel, which shall consist of control system operation, troubleshooting procedures, emergency procedures, safety requirements etc.

7.4.2. The duration of the training shall be for a minimum of seven working days.

7.4.3. The cost of all such training shall be included in the price quoted by the bidder.

7.5. After award of work, before finalizing his layout especially the layout/levels of equipments cable/pipe routes and other services, the bidder shall carry out a site survey to identify the location & details of existing facilities that may interfere with his proposed facilities. He shall suitably modify his layout/levels

to prevent dislocation of existing facilities without any commercial implication to the purchaser.

7.6. Arrange for services of manufacturer's installation / commissioning engineer at site during mechanical completion / pre-commissioning & commissioning of all the major equipment and systems is included in bidder's scope. All the cost including that towards boarding, lodging, servicing, Insurance, Local Travel, Service charges etc. for arranging all the above visits shall be deemed to be included in the bidder's quoted price. Bidder shall not be eligible to raise any extra claim in this regard.

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

7.8. MONTHLY RATES FOR MAINTAINING AND RUNNING PLANT:

7.8.1. Bidder shall quote Monthly rates for maintaining and running the plant at bidder's risk and cost till the plant is taken over by customer from BHEL (after handing over to BHEL subsequent to successful commissioning and conductance and acceptance of site performance test.)

7.8.2. All the required manpower ,consumable, maintenance spares etc. during such period shall be in included in bidder's scope of supply only.

7.8.3. Following shall be the minimum scope of work for the above.

Sl. No.	Item	By Bidder	By BHEL/ Customer
1.	Round the clock supervision, operation and maintenance of plant in three shifts as per the requirement of engineering in charge by deputing/deploying the required no. of operator at site to ensure continuous supply of water as per specified quantity & quality.	√	X
2.	Maintaining the log sheets of operation and present the same whenever asked for.	√	X
3.	All lubricants, lubrication and control oils, greases, filters, etc., required for the operation of the project.	√	X
4.	Spares required for the operation of the system during O&M period	√	X
5.	Solving technical problems related to system operation	√	X
6.	Keeping the plant neat & clean	√	X
7.	Compliance to various industry safety measures	√	X
8.	Providing inputs like Instrument Air etc. for system as per specification	X	√
9.	Store room for keeping spares and consumables	√	X

Sl. No.	Item	By Bidder	By BHEL/ Customer
10.	Independent sitting /monitoring arrangement for bidder's operators	X	√
11	Any other activity deemed necessary by Purchaser / End Customer for the safe and intended operation of the complete FPS	√	X

NOTES:

7. Bidder to note that this is an Optional Item and shall not be considered for price bid evaluation to finalize the L1 bidder.
8. Bidder to note that this rate will be operated only after successful completion and acceptance of performance guarantee test and handing over the FPS to Purchaser / End customer's.
9. Till the successful completion and acceptance of performance guarantee test and eventual handing over the FPS to purchaser all activities & consumables towards the running and maintenance of the complete /Partly completed FPS as per Purchaser / End customer's requirement shall be included in bidder's scope and no extra payment shall be made on account of this.

8. CLARITY OF SCOPE IN OTHER AREAS (SCOPE MATRIX)

8.1. MECHANICAL

Sl. No.	Item	By BHEL	By Bidder
1.	Support structure for piping, cabling etc	No	Yes
2.	Insert plates for support of pipes cables etc	No	Yes
3.	Support structure like structural steel, anchor bolts, brackets etc [Supply / exhaust], piping, cabling, etc	No	Yes
4.	Pump house crane/lifting equipments (Foam Pump House)	Yes	No

8.2. ELECTRICAL, CONTROL & INSTRUMENTATION SYSTEMS

SL. NO.	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1.	6.6kV / 415V Switchgear	BHEL	BHEL	1. 6.6kV / 415 V AC/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. DC supply (battery bank, charger etc) and any other supply as required for PLC/control panel (as applicable) shall be provided by vendor. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2.	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3.	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL Vendor BHEL	 BHEL BHEL BHEL	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalization of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL except for cabling in vendor scope. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
4.	Any special type of cable	Vendor	BHEL	

	like compensating, co-axial, prefab, MICC, fibre optical etc.			
5.	Lighting	BHEL	BHEL	
6.	Cable trays, accessories & cable tray supporting system.	BHEL	BHEL	BOQ to be furnished by the vendor after award of contract.
7.	Below grade grounding system.	BHEL	BHEL	
8.	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	BHEL	Cabling shall be through conduits. However vendor can use the trunk route where available for laying of cables. Conduits shall be supplied by vendor and shall be medium duty, hot dip galvanized cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage
9.	Equipment grounding & lightning protection	BHEL	BHEL	
10.	Motors with base plate and foundation hardware	Vendor	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
11.	Cable glands and lugs for equipment supplied by vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
12.	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13.	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
14.	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
15.	a) Input cable schedules b) Cable interconnection details (diagram) c) Cable block diagram	Vendor Vendor Vendor	-	Cable listing for control cables for vendor-supplied equipment (soft copies in the BHEL cable schedule format) shall be furnished during detail engineering by vendor.
16.	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in

				AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17.	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

10. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
11. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

8.3. CIVIL

Sl. No.	Item	By BHEL	By Bidder
1.	Construction of Foam pump house including equipment foundation	Yes	No
2.	Pedestals, deluge valve housing, central hose station, isolation valve chamber, all insert plates, anchor fasteners, clamps, tie rod, other metallic supports etc. for pipes running on pedestals for the complete plant	Yes	No
3.	Construction of pedestals for the FPS Piping	Yes	No
4.	All civil buildings, Box Culverts/Pipe bridges for road/railway/cable trench/duct bank/drain/sewer lines crossing	Yes	No
5.	Excavation of soft soil and back filling after laying of pipes, ramming, leveling, etc, as may be necessary	Yes	No
6.	Construction of Deluge Valve foundation & sheds, as may be necessary.	Yes	No
7.	Construction of underground Valve Chambers, and foundation/support for aboveground valves, as may be necessary.	Yes	No
8.	Construction of sleepers wherever required, as may be necessary.	Yes	No
9.	Making openings in walls for and making them good after installation for the purpose of installing bidder's supplied items	Yes	No
10.	Grouting/fixing of all equipment including supply of grouting material, insert angle/plain frames in the walls, support structures, foundations bolts, anchor bolts etc	Yes	No
11.	Supply and fixing of framework	No	Yes
12.	Supply of vibration isolators / fixing hardware to be embedded / mounted on foundations	No	Yes

NOTES:

12. Counter flanges at all the terminal points is included in bidder's scope.
13. Isolation Valve at all terminal points is in bidder's scope.

14. All necessary supports cross over, approach ladder required for the proper erection and operation of all equipment supplied by bidder shall be included in bidder's scope.
15. All lugs, glands and termination kits for the equipments supplied by the bidder shall also be included in bidder's scope.
16. Bidder to furnish utility list with the offer indicating the requirements of the above services.

8.4 **TERMINAL POINTS**

8.4.1 **Mechanical:**

8.4.1.1 The terminal points for Foam Protection system shall be provided by the others with valve connections and with blind flanges nearest to Foam Pump house.

8.4.2 **Electrical:**

8.4.2.1 LT Power Supply for Motors : At Motor terminals
8.4.2.2 LT Power Supply at Local LCP : At LCP terminals

8.4.3 **Control & Instrumentation:**

8.4.3.1 Interconnection between controls of Foam House equipments and Remote I/O panel (supplied by others) placed in Foam pump house. However necessary I/O list shall be given by bidder.

8.5 **EXCLUSIONS**

8.5.1 Storage, preservation of Materials/Equipments at site (however detailed storage and preservation procedure shall be furnished by bidder)
8.5.2 Erection and Commissioning (supervision of Erection and Commissioning is in the bidder's scope)

ADDITIONAL POINTS

GENERAL

1. Bidder shall note that FOAM PROTECTION SYSTEM shall be offered on turnkey basis for areas specified, meeting specification requirements.
2. Bidder to note that bypass valves shall be provided across deluge valve.
3. Bidder to confirm that there is no technical deviation from the tender specification no. PEMC-03843.

4. Bidder shall also note that the deviation in any form is not acceptable and same shall not be considered for review/ evaluation purpose / comments and it is assumed that the system/ materials/ equipments have been offered strictly in line with specification requirements.
5. Bidder shall confirm the requirement of vibration level, noise level as per specification.
6. Bidder shall confirm complete basis of design, all calculations, equipment selection criterion, layout drawings/schemes/G.A. drawings and documents like data sheet, technical particulars etc. shall be subject to CUSTOMER & or BHEL approval during detailed engineering stage.
7. Bidder shall confirm that all drawings and documents shall be AutoCAD based. For inputs from customer, BHEL will extend all efforts to get the same in soft copy, but there is no commitment about soft copy.
8. Bidder to confirm adherence to codes and standards indicated in the specification.
9. Bidder shall note that quality plan shall be subject to CUSTOMER & BHEL approval after award of contract i.e. during detailed engineering. All comments as given by BHEL/ customer shall be taken care by bidder without any commercial & delivery implication.
10. Bidder to comply with sub-vendor list enclosed with the specification. If any item is left over other than indicated in the sub-vendor list, sub-vendor name shall be furnished during detail engg. subject to BHEL/ customer approval. Non-acceptance of any sub-vendor by BHEL / customer shall not have any commercial & delivery implication.
11. Bidder shall include adequate necessary supports / frames as required for supporting the piping / equipments etc. on lump sum basis and no unit rates shall be applicable for these items. Bidder to note this and confirm.
12. Bidder shall note that makes of equipments / items not specified in the enclosed sub vendor list shall be subject to CUSTOMER & BHEL approval during detailed engineering stage.
13. Materials required for earthings at the vendor-supplied equipments shall be included in the bidder's scope of supply.
14. Bidder to confirm that the performance guarantee of the equipments shall be as per data meeting specification requirements and system requirement.
15. Bidder to confirm acceptance to furnish drawings/documents as per the drawings/documents distribution as per project requirements.
16. Bidder to confirm that instruments required for performance testing of various Equipments / systems of the package shall be arranged by bidder at site without any cost Implication to BHEL.
17. Bidder to confirm that all instruments for testing shall be calibrated before taking up testing.
18. Bidder shall furnish one set of catalogue for equipment items offered for this package.

19. Bidder to furnish characteristic curves for all major equipments offered indicating duty point.
20. Bidder to confirm that entire Foam Protection System shall be subject to approval by TAC accredited agency to qualify maximum premium discount and responsibility to get approval from TAC Accredited agencies shall rest on the Bidder only.
21. Bidder to furnish the Hydraulic calculation from standard approved software subjected to approval from BHEL/customer.
22. Noise level near equipments at 1 m horizontal and 1.5 above floor level shall be max. of 85 dB.

Additional following points/clauses to be noted by the bidder:

1. Painting to suit environment for all equipments/items for this package shall be in the scope of Foam Protection system bidder.
2. Adequate/necessary supports/frames as required for supporting the piping/equipment etc. as lump sum basis is in the scope of Foam Protection plant bidder and no unit rate shall be applicable for these items.
3. Makes of equipment/items shall be subject to approval by Customer and or BHEL.
4. The minimum grade of concrete for the pedestals and pipe encasings shall be M25. The reinforcement shall be TMT bars of minimum grade Fe500D. The minimum founding level of pedestal footings shall be 1 m below the finished ground level. The pedestals shall be designed for the piping loads as per relevant IS codes. The maximum permissible net bearing pressure of 5 T/sqm shall be considered for the design of pedestals. All the road crossings shall be with cement concrete pipes of class NP3 with encasing. All the rail crossings shall be with cement concrete pipes of class NP4 with encasing.
5. Pl. note that all components of foam protection system including foam storage tanks, valves, pipes, fittings etc. shall be of stainless steel construction.
6. Pl. note that in addition to automatic operation of foam system, manual operation override shall be provided locally with push button station.
7. Pl. note that Hydraulic calculation shall be submitted strictly in Pipenet/ Flownet validated software's.
8. Pl. note that any crossovers, walkway, if required with in Foam Pump House building shall be in bidder scope.
9. Pl. note that 240V, 1Ph power supply for IRD blower shall be provided by BHEL at one point. Bidder to lay a power supply cable for further working in its scope.

9. TECHNICAL DETAILS:

9.1. Applicable Codes & Standards

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

9.1.1.1. Tariff Advisory Committee (TAC) of India guidelines as below :

- Foam Protection Manual (Internal Appliances, Fire Engines, Trailer Pumps, & Hydrant System),
- Rules of Water Spray Systems,
- Rules for Automatic Sprinkler Installation,
- Fire Alarm Rules.

9.1.1.2. NFPA (National Foam Protection Association) codes.

- NFPA-11

9.1.1.3. BIS Codes for Fire Fighting Equipments

- IS 636 : Non percolating flexible firefighting hose.
- IS 884 : First aid hose reel for firefighting
- IS 902 : Suction Hose coupling for firefighting purpose
- IS 903 : Fire hose delivery coupling , branch pipe
- IS 2871: Branch pipe, universal ,for fire fighting purposes
- IS 2932 : Enamel , synthetic , Exterior
- IS 4927 : Unlined Flax canvas hose for fire fighting
- IS 8442 :Functional requirement for Stand Post type water monitor for fire fighting
- IS:3070(Part II)-1966 -Expulsion type lightening arrestors(with Amendment No.1 (Reaffirmed 1977)
- IS:11548 -Capacitor for surge protection, above 650V
- IS:694-1977 -PVC insulated cables for working voltages upto and including 1100 volts(second revision) with Amendments No.1 to 3)(Amendment No.1, Rs.1.50)
- IS:3961 -Recommended current ratings for cables.
- IS:3961(Part II)-1967 -PVC insulated and PVC-Sheathed heavy duty cables(with Amendment No.1)
- IS:3961(Part IV)-1968 -Polyethylene insulated cables.
- IS:3961(Part V)-1968 -PVC-insulated light duty cables.
- IS:4800 -Enamelled round winding wires.
- IS:4800(Part I)-1968 -Conductor data (with Amendments No.1 and 2) (Reaffirmed 1978)

- IS:4800(Part-II)-1968-Maximum overall diameters (Reaffirmed 1978) (with amendment No.1)
- IS:4800(Part V)-1968 -Wires for elevated temperatures (with Amendments No.1 and 6) (Reaffirmed 1978)
- IS:4800(Part VII)-1970 -Wires with good dielectric properties under humid conditions(with Amendments No.1 to 3)(Reaffirmed 1978)
- IS:4800(Part 12)-1986 -Self bonding wires, heat or solvent bonding enamelled round copper wire with temperature index 155.
- IS:1122-1985 -Dial, scales and indexes for indicating analogue measuring instruments.
- IS:1248(Part I)-1983 -Direct acting indicating analogue electrical measuring and their accessories: Part I General requirements(Second revision)
- IS:1248(Part II)-1983 -Direct acting indicating analogue electrical measuring instruments and their accessories: Part II Ammeters and Voltmeters (Second revision)
- IS:6236-1971-Direct recording electrical measuring instrument (Reaffirmed 1987)
- IS:3107-1974 -Portable multipurpose direct (Reaffirmed 1987) -acting electrical indicating instruments (first revision) (with Amendments No.1 & 2)
- IS: 2419-1979 -Dimensions for Panel mounted indicating & recording electrical instruments (first revision) (with Amendment No.1.)
- IS:8573-1977 -Digital electronic DC voltmeters and DC electronic analogue-to-digital convertors(with Amendment No.1) (Reaffirmed1991)

9.1.1.4. ANSI B 16.5 - Pipe flanges and flanged fittings.

9.1.1.5. SMPV rules , PESO Nagpur (For Storage Cylinders)

9.1.1.6. NACE : RP-0169-97, RP-0285-95

9.1.1.7. BS : 7361 Part I-1991 (Formerly CP 1021-1973)

9.1.1.8. VDE: 0150, protection against corrosion due to stray currents from DC installations.

9.1.1.9. DIN :30676

9.1.1.10. Petroleum Act, 1976(Govt. of India., Corrosion control in Petroleum production TPC Publication No.5)

9.1.1.11. Statutory Requirements

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

a. Factories Act
b. Indian Petroleum Rules
c. Tariff Advisory Committee (TAC) Guidelines (for Insurance purposes)
d. Indian Boiler Regulation Act (IBR)
e. Civil Aviation Rules
f. Indian Railway Authority
g. Indian Electricity Act
h. Indian Electricity Rules
i. Central Electrical Authority (CEA)
j. NACE : RP-0169-97, RP-0285-95
k. BS : 7361 Part I-1991 (Formerly CP 1021-1973)
l. VDE : 0150, protection against corrosion due to stray currents from DC installations.
m. DIN : 30676
n. IEC/NEC : Relevant codes for Cathodic protection
o. Fire insurance regulations.
p. Regulations laid by Chief Electrical Inspector of State.
q. Regulations laid by Chief Inspector of Explosives.
r. Regulation laid by Factory Inspector of State.
s. Petroleum Act, 1976(Govt. of India., Corrosion control in Petroleum production TPC Publication No.5)
t. Director General, Factory Advice Service and Labor Institute, Bombay
u. Central Mines Research Institute (CMRI), Dhanbad
v. Department of Atomic energy
w. Requirement of Petroleum & Explosives Safety Organization (PESO), Nagpur, India.
x. Department of Water Resources, Gujarat.
y. Stipulations stated in Environmental clearance granted by Ministry of Environment and Forest, Govt. of India.
z. Liquid Effluent Discharge as per Minimal National Standards for Liquid effluents and air emissions confirming to Pollution Control Board Standards
aa. Stipulations of Environmental authorities of the State of Gujarat.
bb. Other legislations relating to Environmental protection such as (but not limited to) :
    - Hazardous wastes (Management and Handling) Rules 1989.
    - Water (prevention and control of pollution) Act, 1974
    - Water (Prevention and Control of Pollution) Act, 1977.
    - Environment (Protection) Act, 1986

- Forest (Conservation) Act, 1980
- Municipal Byelaws of Urban Development Authority of State Government for Buildings in Township.

cc. Pollution Control Board.
dd. Weights and Measures Dept.
ee. National Institute of Oceanology.
ff. Central/State Govt. regulations for ROU & land acquisition.
gg. National Highway Authority of India.
hh. Public Works Department (PWD).
ii. Forest Authority
jj. Immigration/Canal Authority

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

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

9.1.5. In case of any conflict between this specification and above codes, standards and guidelines requirements, the most stringent requirement of these shall govern and the decision of purchaser in the resolution of the any such conflict shall be final.
It shall be bidder's sole responsibility to clearly bring out/highlight the same distinctively in his pre-bid queries, so as to enable purchaser to furnish their decision/clarification. If such issues/requirements are not duly addressed by bidder during the pre-bid stage and if such issues/requirements are observed later during order execution stage, it shall be binding on the bidder to comply with the final decision made by the purchaser subsequently, without any cost, delivery, or any other commercial implications.

9.1.6. All materials supplied under this contract shall be new and unused. All equipments connected with the above systems shall be ISI marked or from companies which carry ISO certification or FM/UL/Vds approved. All deluge valves and spray nozzles used in the spray system shall be UL/FM/Vds approved. All monitors shall be UL/FM/Vds approved.

9.1.7. All equipment/items supplied shall conform to the provisions of statutory & other regulations in force in India and the State/Province where the project is executed, such as the Indian Factories Act, Indian Electricity (Supply) Act, Indian Electricity Act, Indian Electricity Rules, International Electric Technical Commission (IEC) Publication, Environmental Rules, etc. Obtaining of all permission and approvals from statutory authorities for the installation of the plant and machinery, and to ensure that the purchaser /end customer does not face any problems in future on account of non-conformance with these

regulations as indicated above, shall be the responsibility of the bidder. All the legal formalities including preparation of documents, furnishing clarifications, information etc. as and when required, for obtaining any of the permissions and approvals related to the Foam Protection System will have to be done by the bidder.

9.1.8. Any special approvals that may be applicable for certain items, like for explosion-proof items from CMERI-Dhanbad, etc., shall be have to be duly considered and ensured.

9.1.9. The bidder shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at his office.

10. DESIGN CRITERIA AND PHILOSOPHY

10.1.1. Foam System

Foam Injection system shall be provided for all the fuel oil storage tanks located in dyke. The fixed foam system shall consist of foam concentrate tanks, pumps balancing line with automatic controlling valves, foam makers, discharge outlets, interconnecting piping, valves, fittings, instrumentations etc. The operation of fixed foam system shall be automatic with the aid of dedicated fire detection system provided around the tank. The semi-fixed system shall be operated through the foam hydrants/monitors; portable type foam water monitors, hoses and nozzles for extinguishing spill fire in and around the tank area.

Design Basis/Criteria

a) Complete system shall be designed as per NFPA-11.

b) Water for the foam system shall be tapped off from the hydrant system.

c) Foam concentrate shall be AFFF type. The minimum foam application rate of 3 % foam solution shall be 12 lpm/sq.m of seal areas of floating roof type and 6.1 lpm/sq.m for fixed roof type tanks.

d) The minimum effective capacity of each foam concentrate tank and foam pumps shall be designed for simultaneous protection of one fuel oil tank of each type or size and operation of two foam monitors/hydrants at its designed capacity for a minimum duration of 60 minutes.

e) A design margin of at least 10 % shall be considered over the calculated foam concentrate capacity, tank capacity and discharge capacity of the foam discharge pumps.

f) The maximum spacing of the foam hydrants around the dyke area shall be similar to that of water hydrant system.

g) The operation of foam system shall be automatic with the aid of fire detection system provided (by others) for the HFO / LDO tanks with a provision for manual operation. Auto/Manual selection switch shall be provided at the local panel.

h) One number foam proportioner (of 100% capacity) shall be provided for each type or capacity of 2 no. HFO & 2 no. LDO tanks with a common standby foam proportioner. Separate isolation valves (manually operated) shall be provided for each proportioner for maintenance.

i) The system shall incorporate features such as non-return valves to avoid mixing water with foam concentrate pipelines, strainers in water inlet and in foam concentrate lines, isolation valves of pumps/ flow control valves/ ratio proportioning devices etc.

j) Three nos. portable (wheeled type) foam generators/ monitors each of minimum 190 lpm capacity along with required hoses.

k) Automatic solenoid valve shall be provided in foam supply line to each of the HFO tanks at the upstream of foam proportioner. In the event of detection of fire, the signal shall start the foam pump, operate the deluge valve of water inlet valve to the designated foam proportioners of the tank, and as well as open the foam solution inlet valve to foam proportioner and thereby foam is injected to the tank under fire foam makers discharge outlets.

l) All piping shall be laid over ground on RCC pedestal.

The minimum effective capacity of each foam concentrate tank and foam pumps shall be designed considering the following:

Simultaneous protection of any of the HFO tank and LDO tank and operation of two hydrants for 60 minutes.

OR

A design margin of at least 10% shall be considered over the calculated foam concentrate capacity, tank capacity and discharge capacity of the foam discharge pumps.

Foam concentrate shall be of 100% AFFF type and shall be provided in 2x100% capacity foam concentrate tanks with two coats of Zinc Chromate primer as per IS 2074, followed by 2 mm thick FRP lining. Foam shall be discharged to the foam pumps inductors through 2x100% capacity foam pumps (one of motor driven and another of diesel engine driven) pumps through balancing line, with control valves, flow controllers etc. located in the Foam Pump House near the Fuel oil dyke area.

Manual operation of the foam system shall be facilitated locally through local push button.

10.1.2. **LOCAL CONTROL PANELS**

CONTROL CUM ANNUNCIATION PANEL (CAP) - FOAM PUMP HOUSE.

The panel shall be PLC based (Supplied by others) and all controls of the foam pump house equipment shall be controlled by PLC system.
The PLC panel shall have:
a) Required I/O cards
b) Redundant power Supply units
c) Redundant processor

Control panel shall be having following features. The one no. PLC shall be located at control room within the Fire water P/H, which will take care the control aspects of system at Fire water P/H & Foam P/H. Remote I/O panel (Supplied by others), shall be provided at Foam Pump House.

Interconnection cabling between remote I/O panel to bidder supplied equipments are in bidder's scope of supply.

However bidder has to provide details of I/O required for control & instrumentation of all equipments during detail engineering stage.

10.1.3. **INSTRUMENTATION & CONTROL**

All instruments i.e. pressure switches, pressure gauges, level switches, level indicators etc. as per approved drawings shall be provided.

10.2 Electrical design Parameters

1. Equipment design temperature (IS-9676) : 50°C
2. Minimum temp for battery sizing : 10 ^{o} C
3. Lt Motor Voltage: AC 415 V, 3 phase, 50 Hz (for motors up to 160 kW)
4. Frequency : 50 Hz
5. Design voltage variation: +/- 10 %
6. Design Frequency variation: +/- 5 %
7. Combined variation (Voltage & Frequency) : 10 %(sum of absolute values)
8. Fault Level at rated voltage: 50 KA (1 sec)

11. FOAM SUB SYSTEM & EQUIPMENT DETAILS

11.1. RESTRICTION ORIFICE

-

RO at Hydrant outlets shall be provided to reduce the pressure to: 7kg/cm^2
RO at tapings of water spray system to keep the system pressure in the range specified in the TAC.

11.2. ISOLATION VALVES

11..2.1. Isolation valves shall be provided at the following places:

a. In such a way that not more than 4 (four) hydrants are isolated at a time and at crossings (Junctions) to ensure easy maintenance and uninterrupted water supply in case of break down.
b. Shall be provided below monitor and at all hydrants and landing valves.
c. Shall be provided at all tapping points of all spray headers.

11..2.2. Isolation Valves shall be gate valve type.
All isolation valve/cut-off valves shall be CI as per IS: 210, FG 260 body, with 13% Cr. SS stem & seating surfaces of gate valves as per guidelines/requirements specified in TAC.

All butterfly valves shall be CI as per IS: 210, FG 260 body, SS to AISI: 410 stem & seating surfaces of gate valves as per guidelines/requirements specified in TAC manual. All globe/check valves of sizes 50 NB and below shall be as per ASTM B62 / IS:318 Gr LTB2. These valves shall have screwed ends. All globe valves of sizes 65NB & above shall be CI valve confirms to BS:5152.

All check valves of sizes 65 NB and above shall be as per BS: 5312 (Part-I) CI as per IS 210, Gr. FG 260.

Valve shall have provision of locking arrangements in open and closed position.
All the flanges & counter flanges will conform to IS-2062 Gr. A Slip on (Dimension/Drilling as per ANSI B 16.5 Cl. 150./IS: 1538).

All valves shall be of minimum class of 150.

Strainer Body shall be as per IS:2062 (tested).

3.

11.4. ELECTRICAL SYSTEM

11..4.1. ELECTRICAL EQUIPMENT FOR HAZARDOUS AREAS

The electrical equipment for hazardous areas shall be selected as per IS-5571 and petroleum rules and Gas group shall be selected based on the hazardous area classification. The minimum requirement is summarized below:

Equipment	**Zone -1**	**Zone -2**
Push Button Station	Ex-d	Ex-d
Plug & Socket	Ex-d	Ex-d
Junction Boxes	Ex-d	Ex-d/Ex-n
Break Glass unit (fire Alarm System)	Ex-d	Ex-d/Ex-n

11..4.2. The electrical equipment for hazardous areas shall generally be suitable for gas group IIB and temp classification T3 as applicable to the selected type of explosion protection. In case of hydrogen or hydrocarbon mixtures having more than 30% hydrogen, the gas group to be considered shall be IIC.

11..4.3. No un-armoured cable shall be used.

11..4.4. All power cables in racks/trays shall be laid in single layer only. Further 20% spare space shall be provided in cable trays/trenches for future use.

11..4.5. Heat shrinkable type EHV/HV cable end termination kits and straight through jointing kits shall be used.

11..4.6. WIRING TYPE

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

11..4.7. CABLE LAYING PHILOSOPHY

Sl No	Area	Details
a.	Offsite paved area	Above Ground cable tray on sleeper/ Overhead rack/RCC trench
b.	Offsite unpaved area	Above Ground cable tray (on sleeper/Overhead rack) /directly buried.
c.	Type of cable trays	Galvanized prefabricated
d.	Road Crossings for Underground cables	PVC Pipes /Cable culvert
e.	Road Crossings for Above Ground	Overhead cable bridge/culvert

	cables	
f.	Walkways for overhead cable trays on pipe rack	I. Process area required II. Offsite areas required

NOTES:

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

11..4.8. CABLE SIZE

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

Sl No	Area	Details
a.	Medium voltage power cable	From 2.5 mm^2 up to 16 mm^2 -Copper, Above 16 mm^2 -Aluminium
b.	Control cables	2.5 mm^2 (Copper)
c.	Fire alarm system	1.5 mm^2 (Copper)

NOTES:

12 Fire alarm System cable sizes are indicative only and these shall be finalized as per the recommendations of equipment manufacturers. However minimum conductor size shall be as mentioned above.

11..4.9. LOCAL CONTROL STATION

11..4.10. Flameproof and/ or weatherproof control stations (IP-55) for Deluge Valve Operation shall be provided.

11..4.11. Provision for start addition to local/remote, Auto/manual selector switch as per operation requirements shall be provided.

11..4.12. Outdoor area Local control stations shall have canopies for additional weather protection.

11.5. INSTRUMENTATION

11..5.1. The design and installation of instruments shall be generally in accordance with ISA/API recommended practices and other applicable standards like BIS, IBR etc. Material specifications and practices shall, in general, conform to appropriate ASTM or equivalent standards.

11..5.2. All instruments and equipments shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and/or chemicals may be present As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-55 as per IEC-60529/ IS-13947 and secure

against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive plant atmosphere.

11..5.3. Instruments used in hazardous areas shall generally be intrinsically safe and shall be selected based on entity parameters, except for solenoid valves which shall be flameproof. If intrinsically safe item is not available for any instrument, then it must be flameproof.

11..5.4. Instruments shall be suitable for Zone 1 & 2 classified areas as applicable certified by a statutory body with gas grouping as per requirement. Additionally, Instruments shall be certified by PESO (Petroleum Explosive Safety Organization)/CCE (Chief Controller of Explosives), India. Also indigenous flameproof equipment shall comply with BIS requirement.

11..5.5. Following points must be considered while designing an intrinsically safe system: -

a. All intrinsic safety barriers shall be active isolating type and shall have isolation between input, output and power supply.
b. Barriers must be selected based on entity concept. Cable parameters shall also be considered while matching entity parameters.
c. The signal transfer accuracy of barrier shall be at least equal to or better than the transmitter selected.
d. Each instrument in the hazardous area and the intrinsic safety barrier shall be certified for intrinsic safety by a statutory authority.
e. Each input and output in a loop shall have separate barrier. No barrier shall be shared between two loops or input/outputs.
f. Any intrinsically safe loop requiring any device to be connected in the hazardous side permanently or temporarily shall also be intrinsically safe.
g. Configuration tools whenever required for any intrinsically safe item which forms part of the intrinsically safe item shall also be certified intrinsically safe.
h. Universal barrier with programmable capability shall be used for temperature inputs i.e. for thermocouple/RTD inputs.
i. It is desirable to use one make of barrier for entire plant. The series shall be of MTL / P&F or equivalent reputed makes.

11..5.6. Material of construction and end connection rating shall be as per piping material specification as a minimum.

11..5.7. Process switches, wherever specified, shall be provided with sealed micro switch contacts rated for the specified application. Contacts shall be 1 no. DPDT preferably. Otherwise 2 nos. SPDT can be considered. Contacts used in intrinsically safe applications shall be gold plated.

11..5.8. Smart transmitters where used shall be with an accuracy of ± 0.075% of span with a range ability of 10:1 unless specified otherwise. Hand held communicator shall be supplied for smart transmitters and fieldbus

transmitters. All transmitters shall have minimum static pressure rating of100 kg/sq.cm.g.

11..5.9. Threaded end connections shall be to NPT as per ANSI B 1.20.1. Flanged end connections shall be as per ANSI B 16.5.

11..5.10. All cable entries to junction boxes shall be from side or bottom.

11..5.11. Solenoid valves used in hazardous area shall be flameproof (Ex'd'). Solenoid coil shall be rated for continuous operation of the upper limit of supply voltage (i.e. rating shall be 110 V DC continuous). Class F rating for solenoid valves preferable.

11..5.12.

a. Following power supply voltage levels shall be used, unless otherwise specified:
   - For Instruments, Control Systems, 110 V AC± .10% (UPS) 50 Hz ±.3 Hz
   - Solenoid Valves, Relays, lamps 110 V DC± .10%
   - Input interrogation voltage .24 V DC± 10%
   - Panel/cabinets lighting 230 V AC ±. 10%

b. All instruments, control systems (PLC) shall be able to operate at the following power supply specification:
   - Voltage level: 110 V AC±10%
   - Frequency: 50 Hz ±3 Hz.
   - Switch over time: 5 milli seconds.

c. Any voltage level other than 110VAC UPS (including 24 V DC) if required for powering any subsystem, input interrogation, relays and lamps etc, same shall be generated by the bidder using dual redundant bulk power packs. The bulk power supplies shall be redundant and shall be sized for 35% loading of its capacity in normal time. In the event of failure of one of these supplies the load in backup power shall not exceed 70% of capacity of Bulk power supply (BPS).

11..5.13. **Signal Interface Philosophy**

11..5.13.1. Direct signals from field to control room and DGFPA

a. All signals from field to central control room/Satellite Rack Room (SRR) shall be terminated in the junctions boxes located at appropriate locations in the field.

b. Separate junction boxes shall be used for the following type of signals:

i. -Intrinsically Safe Analog Inputs/Outputs (4-20 mA)

ii. -Non Intrinsically Safe Analog Inputs/Outputs (4-20 mA)
iii. -Intrinsically Safe Thermocouple Inputs
iv. -Intrinsically Safe RTD Inputs
v. -Intrinsically Safe contact Inputs
vi. -Non Intrinsically Safe contact Inputs.
vii. -Non Intrinsically Safe contact Outputs.
viii. -Intrinsically Safe contact Outputs.

c. All pulsed signals or serial signals shall be routed directly to control room(s) without the use of intermediate junction boxes, in general. In case, where single cable length is a problem, intermediate junction boxes can be used, however in all such case, same junction box shall not share signals from two or more device.

d. Whenever multidrop serial communication is adopted, intermediate junction boxes may be used for multi-dropping purpose only.

11..5.13.2. Signals from bidder's scope to purchaser

a. Whenever signals are required to be routed for purchaser's use, bidder shall use separate dedicated junction box or terminal strip for each type of signal i.e for 4-20 mA/alarm/contacts/temperature element etc.

b. In case of serial signals, contractor shall provide a separate dedicated port for purchaser's use.

11..5.13.3. Repeat Signals from Sub-Package Local Panel

a. Generally separate junction boxes shall be used for interfacing signals from sub-package to control room.

b. Where signals as indicated in clause above is less in number and do not justify separate junction boxes, all such signals may be routed via local control panel if provided by bidder.

c. All such signals shall be terminated on separate terminal strips in the local control panel. The terminal strips shall be segregated as explained elsewhere. The non-intrinsically safe signals shall be provided in certified flame proof junction boxes in local panels.

d. Intrinsically safe barriers for all intrinsically safe signals, wherever required, shall be provided.

e. Repeat signal, which is a part of fieldbus segment, shall be repeated to LCP through remote indicator. Remote indicator shall be part of same segment, which the respective transmitter is connected in the same segment.

NOTES:

13 Generally locating barriers in the local panels shall be avoided.

11..5.14. BIDDER'S SCOPE OF SUPPLY AND INSTALLATION

Sl. No.	Description	Supply	Installation
1.	PANELS		
i.	PLC Panel	BY OTHERS	BY BHEL
ii.	Deluge Valve Local control panel	BY BIDDER	BY BHEL
iii.	Any other Panel as per this specification.	BY BIDDER	BY BHEL
2.	INSTRUMENTS		BY BHEL
i.	All field mounted instruments as per P&IDs and sub-package items	BY BIDDER	BY BHEL
ii.	Any other items required as per Bidder detailed engineering	BY BIDDER	BY BHEL
iii.	Remote panel/ cabinet mounted instruments (if applicable)	BY BIDDER	BY BHEL
3.	Junction boxes for the following:		
i.	For interconnection between field and local panels and remote panels	BY BIDDER	BY BHEL
ii.	For interconnection between field instruments and control room and any other areas instruments and equipments of Steam and Power Generation Package	BY BIDDER	BY BHEL
iii.	For 4-20 mA DC signals (intrinsic safe and non-intrinsic safe), two-wire, non-two-wire	BY BIDDER	BY BHEL
iv.	For Thermocouple/RTD signals	BY BIDDER	BY BHEL
v.	For contact signal	BY BIDDER	BY BHEL
vi.	For Interlock and Shutdown signals	BY BIDDER	BY BHEL
vii.	For FF field instruments (also including FF components like field barriers etc.)	BY BIDDER	BY BHEL
viii.	For any other signal not covered but required for completion of job	BY BIDDER	BY BHEL
ix.	Serial Links between field and control room (if applicable)	BY BIDDER	BY BHEL
4.	Cables		
i.	Between field instruments and junction boxes & field instruments and local panel	BY BIDDER	BY BHEL
ii.	Between junction boxes and local panel.	BY BIDDER	BY BHEL
iii.	Between local panel and control room	BY BIDDER	BY BHEL
iv.	Cabling from substation /switchgear to control room and any other areas of Steam and Power Generation Package / field.	BY BIDDER	BY BHEL

v.	All types of system cables indoor/ outdoor for Bidder supplied systems	BY BIDDER	BY BHEL
vi.	All earthing cables and strips (GI / Cu)	BY BIDDER	BY BHEL
5.	Installation materials		BY BHEL
6.	Impulse tubing/ piping, tube/ pipe fittings, valves and valve manifolds	BY BIDDER	BY BHEL
7.	Cables, cable trays, cable glands and accessories	BY BIDDER	BY BHEL
8.	Instrument air valves and pipes, tubing, fittings etc.	BY BIDDER	BY BHEL
9.	Instrument Cable Ducts, RCC trenches, perforated trays, angle trays, structural supports, consumables for cable laying within the battery limits of Steam and Power Generation Package.	BY BIDDER	BY BHEL

11..5.15. **INTERLOCK AND SHUT-DOWN SYSTEM:**

Control panel / hard wired console instrumentation: Closed back, Non graphic, Console Type

Redundancy philosophy		
Controller Data Acquistion System	1:1 Redundant	
Communication sub system	1:1Redundant	
History	1:1 Redundant	
Powe supplies sub-system	1:1 Redundant	
Loading Philosphy		
Control Processor	60 %	
Communication Processor	50%	
Communication Bus	50 %	The maximum number of nodes in the network shall not exceed 70 % of the maximum capacity. There shall not be more than 80 closed loops per controller

11..5.16. **Power Supply Requirement**

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

NOTES:

14 24 V DC wherever required shall be generated by 110 V AC

Ref. Doc

11..5.17. **Signal type**

a) For Smart transmitters: 4- 20 mA DC with superimposed Digital Engineering Data (HART)
LCD display in Engineering Unit and % for level in field
b) Fieldbus : Foundation Fieldbus
c) Pneumatic : Signal 0.2- 1 kg/cm²g

11..5.18. Hazardous Area Protection: (Note-31)

a. Fieldbus system : field barriers
b. Field transmitters : Intrinsically safe.
c. Field switches : Intrinsically safe
d. I/P converters (wherever applicable: Intrinsically safe
e. Solenoid valves : Flame proof
f. Positioners : Intrinsically safe
g. Special instruments : Intrinsically safe
h. Analyzers etc. : Purged

NOTES:

15 If intrinsically safe item is not available for any instrument, then it must be flameproof. Hazardous Area protection is not applicable only for MCC I/Os. Intrinsic safe barriers: Required

11..5.19. **INSTRUMENT CABLES**

11..5.19.1. Single pair/triad cables shall be used between field instruments and corresponding type of junction box/ Local Control Panels/PLCs.

11..5.19.2. All the cables shall be Flame Retardant (FR) type. Fire resistant cables shall be used wherever specifically required.

11..5.19.3. Multi cables between junction boxes in the field and the Panels in the control rooms shall be as per following philosophy:

a. Signals: (4-20mA or switch contact) :6 / 12 pair individually and overall shielded (screened) and armoured, twisted, 0.5 mm^2 conductor.
b. RTD: 6 / 8 Triad individually and overall shielded (screened) and armoured, twisted, 1.5 mm^2 conductor.
c. Solenoid valves: 6 /12 pair overall shielded, armoured, 1.5 mm2 conductor

NOTES:

16 Higher conductor size shall be selected to limit the voltage drop within the specified limit.

11..5.19.4. Fieldbus network cables between wiring/ terminal blocks and panels in control room / shall be individually shielded twisted pair overall screened cable, called Type A cable.

11..5.19.5. The color of outer sheath, inner sheath and individual core for each type of cable shall be as mentioned below:

Sl.No	Type of cable	Signal type	Outer sheath	Conductor +ve	Insulation -ve
a.	Signal	IS	blue	blue	Black
b.	Signal	Non IS	black	blue	Black
c.	Alarm /control/power	IS	blue	blue	Black
d.	alarm/control/power	Non IS	black	blue	Black
e.	extension cable	IS	As per IEC 60584-3		

NOTES:

17 Triad cable shall have blue, black and brown color.

11..5.20. **JUNCTION BOX**

11..5.20.1. The junction box shall be suitable for the type of signal and type of multicore cables used

11..5.20.2. The following types of junction boxes shall be used:

a. For all intrinsically safe and safe signals: Weatherproof junction boxes
b. For all input/output connected to explosion proof/flameproof instruments junction boxes : Explosion proof/flameproof
c. In addition separate junction boxes shall be used for DCS, PLC and/ or other system.

11..5.20.3. In general separate junction boxes shall be used for the following:

a. 4-20 mA DC signals (IS)
b. 4-20 mA DC signals (non-IS)
c. Thermocouples
d. RTDs
e. Contact signals [(Field switches push buttons etc (I.S)]
f. Contact signals [(Field switches push buttons etc (non I.S)]
g. Interlock and shutdown signals (Solenoid valves)
h. Power supply to various instruments

NOTES:

18 Separate junction boxes shall be provided for fieldbus instrumentation and non-field bus instrumentation.

11..5.20.4. 3-way junction boxes shall be used for connecting field transmitter and field mounted (remote type) analog indicator in series with control room receiving equipment.

11..5.20.5. Each JB shall be provided with 2 multi-cable entries with one plugged with weather proof plugs. Plugs shall be flame proof also in case of flameproof JBs.

11..5.20.6. Junction boxes, cable glands and accessories shall be weather proof if area classification is safe. Junction boxes, cable glands and accessories shall be weather proof and flameproof for flameproof instruments. Slipper type PVC sleeves shall be used over cable glands for all cable entries in junction boxes to avoid water entry in junction boxes.

11..5.20.7. One junction box shall be connected to one multicable only. The other cable entry shall be plugged.

11..5.20.8. The junction boxes in the field as well as local panels shall be provided with sufficient number of terminals to terminate all the pairs of multi-cable (including spare pairs) and shields of individual pairs as applicable.

11..5.20.9. The junction boxes shall have cable entries suitable for the multi and single cables used. 20% additional cable entries must be provided. Unused entries shall be plugged.

11..5.20.10. Junction boxes (JB) shall have the following features:

a. JB shall be either Weather proof type or Weather proof and flameproof type. No other type of junction boxes shall be offered / provided.

b. The enclosure shall conform to the following standards:
Weatherproof housing: IP 55 to IEC-60529/IS-13947
Flameproof housing: Flameproof/Ex (d) as per IEC-60079/IS-2148.

c. Junction boxes with top entries shall not be offered. The size of cable entries shall be as per the cable sizes.

d. Each junction box shall have spare entries as follows:
i) Minimum of 2 Nos. for 6P/12C JB
ii) 4 numbers for 12P/24C JB.

e. All spare entries shall be provided with plugs certified Exd for flameproof junction boxes.

11..5.21. **ELECTRICAL JUNCTION BOX**

a. The material of construction of electrical junction boxes shall be die-cast aluminium of minimum 5 mm thick (LM-6 alloy).

b. Weather proof junction box shall have hinged type door with neoprene gasket, which shall be fixed to the box by plated countersunk screws.

c. Flameproof junction box shall have detachable cover, which shall be fixed to the box by means of cadmium plated triangular head/hexagonal head screws.

d. Flameproof junction boxes for signal, alarm and control shall have the following warning engraved/integrally cast on the cover:
"Isolate power supply elsewhere before opening"

e. Power junction boxes (junction boxes for power supply cable / distribution) shall have either the warning cast or shall have warning plate with following marking and shall be suitable for incoming armoured power cable up to 150 sq.mm conductor size:
"Isolate power supply elsewhere before opening".

f. Terminals shall be spring loaded, vibration proof, clip-on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.

11..5.21.1. All terminals used in signal, alarm and control junction boxes shall be suitable for accepting minimum 2.5sq.mm copper conductor, in general.

11..5.21.2. Each junction shall have minimum of 30% spare terminal of those actually required to be utilized. Number of terminals for various types of junction boxes shall be as follows:
24 Nos. for 6 pair junction box.
48 Nos. for 12 pair junction box
36 Nos. for 6 triad junction box.
48 Nos. for 8 triad junction box.

11..5.21.3. Terminals shall be identified as per the type of input signal e.g all terminals for intrinsically safe inputs shall be blue while others shall be grey in color.
Junction boxes shall be provided with external earthing lugs.

11..5.21.4. The junction boxes shall have terminals suitable for the cable wire size and shall preferably be of Phoenix or equivalent make. All wiring/ terminal blocks used in FISCO service shall be orange in colour while other service shall be painted gray.

11..5.21.5. The multi cable entry for 6 pair Junction Box (JB) shall be 1" NPTF and for 12 pair/ 8 triad junction box, it shall be 1 1/2" NPTF.

11..5.21.6. Each junction box shall be provided with 2 multicable entries with one plugged with weatherproof, flameproof plug as required. Multicable entries shall be from the bottom whereas 1 pair/triad from the side.

11..5.21.7. One junction box shall be connected to one multicable only. The other cable entry shall be plugged.

11..5.21.8. The junction boxes in the field as well as local panels shall be provided with sufficient number of terminals to terminate all the pairs of multi-cable (including spare pairs) and shields of individual pairs as applicable.

11..5.22. **GENERAL REQUIREMENT OF INSTRUMENTS**

11..5.22.1. Ranges for instruments shall be selected in general, such that in normal process operation the indication is between 40% to 60% of span for linear and 60% to 80% of span for square root inputs. The set range for field instruments shall be 1.1 times the maximum process value or 1.4 times the operating process value whichever is higher rounded to the nearest ten

11..5.22.2. All transmitters shall have an integral output meter. Remote mounted meters may be provided for specific applications.

11..5.22.3. Major instrumentation shall be electronic type with final control elements as pneumatic.

11..5.22.4. Electronic Instruments

a. All electronic instruments requiring separate power supply, shall generally operate on 24 V DC.

b. Electronic transmitters shall generally be two wire type. These shall have transmission/output signal of 4-20 mA DC and shall be capable of delivering rated current into external load of at least 600, When powered with 24 V DC nominal voltage.

c. Fieldbus based instrument shall be used in general. If FF transmitter is not available as standard, contractor may provide SMART transmitter. If Smart transmitter is not available electronic (microprocessor based) transmitter with 420mA output shall be used.

d. Fieldbus transmitter when selected, shall be digital, two-way, bus powered, multidrop communication link among intelligent measurement and control devices

e. All receiver instruments shall be microprocessor based and shall operate on voltage input of 0.25 to 1.25 V, 1 to 5 V, or 0 to 10 V DC, in general.

f. The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4. All electronic instruments shall be immune to Radio frequency interference caused by Hand held Radios/ Radio stations/ Hands free systems/ Cell phone mobiles used in proposed wireless communication system.

g. Unless specified otherwise, the instruments shall have an over-range protection of at least 130% of range or maximum/ design pressure, whichever is higher, as a minimum.

h. The meter electronics shall be protected against transients induced by lightning and power supply surges. Transient protection of electronics shall preferably be provided in the terminal block. The transient protection shall meet the requirements specified in IEC-60587.

i. For flow meters which include transducer, preamplifier, transmitter, display unit, etc, contractor shall ensure that the input /output signals and performance characteristics of individual instruments are compatible with each other.

j. Terminals for electrical connections shall be clearly identified, and polarity shall be permanently marked. Electrical conduit entries shall have internal ½" NPT threads.

k. Peak to peak ripple and total noise level in the analog output signal shall not exceed 0.25% of the maximum signal.

l. The design of electronic instruments shall be in compliance with the

electromagnetic compatibility requirements as per IEC 61000-4 and shall be immune to RFI and EMI radiation.

11..5.22.5. Pneumatic instruments

a. Pneumatic Instruments whenever used shall operate on air supply of 1.4 kg/cm^{2}g and shall
b. They shall have transmission and output signal of 0.2 to 1.0 kg/cm^{2}g.
c. Instruments in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. All connections shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.
d. Any gasket used in the assembly of the instruments shall be spiral wound type only with suitable filler material.
e. Compressed asbestos fibre (CAF) gaskets shall not be used.

11..5.23. **CONTROL PANELS**

11..5.23.1. All control panels shall be provided in pre-tubed/pre-wired conditioned and shall be completely tested at manufacturer's works prior to dispatch.

11..5.23.2. Control panels shall be free standing type and fabricated preferably from 2 mm thick cold rolled steel sheet shall be used for front side and all other side shall be 1.6 mm of CRCA.

11..5.23.3. Angle iron frame work shall use a minimum section of 50 x 50 x 4 mm angle.

11..5.23.4. The finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filler and two coats of high grade lacquer with wet sanding between coats. Two coats of paint in panel color shall be given for non-glossy high stain finish.

11..5.23.5. Panel face final color can be any of the following shades as per to IS-5 :

a. Opaline green : ISC No.- 275
b. Light Admiralty Grey : ISC No.- 697
c. Sky blue : ISC No.- 101

11..5.23.6. Panel rear interior surface, frame work and mounting plates shall have a finish color of pale cream to IS-5 ISC No.- 352 or Beige to IS-5 ISC No.-388.

11..5.23.7. A final coat of paint shall be given at site. Equivalent color shade according to BS/RAL are also acceptable.

11..5.23.8. Control panel shall be open back with each section of typically 2100 mm high, 1200 mm wide and 800 mm deep, when mounted inside the control room on 100 mm channel base covering wall to wall, else these shall be totally enclosed cubicle type. The panel width may be increased if necessary.

11..5.23.9. Enclosed cubicle panels shall have removable hinged doors, generally at the back for easy maintenance and accessibility of the instruments. Doors shall be double leaved type with handle and shall be provided with lock and key. Adequate illumination shall be provided inside the panel. All light fittings shall be suitable for 230 V, 50 Hz AC.

11..5.23.10. No process fluid of any kind, except instrument air shall enter the control panel. Also power supply greater than 230 V shall not enter the local panel.

11..5.23.11. All cable entries to the local panel shall be from panel bottom only using cable glands of adequate size. Cable gland plate thickness shall be a minimum of 3 mm cold rolled cold annealed (CRCA) as a minimum. All unused cable entries must be plugged.

11..5.23.12. Space heater shall be provided where condensation is expected.

11..5.23.13. The design of control panel shall incorporate provision for expansion by installing adequate spare capacity. Each panel shall be designed to accommodate the following additional equipment, as a minimum;

- 20% of panel front/inside mounted instruments including lamps, push buttons, switches, relays etc.
- 20% additional power feeders each provided with switch fuse assembly.
- 20% additional spare windows in alarm annunciators.
- 20% spare cable entry points.

11..5.23.14. Panel layout shall be designed considering ease of operation. No push button or hand switch shall be located below 600 mm. Instrument Mounting heights, in general, shall be as follows:-

- Miniature and subminiature instruments (3 rows) Bottom row 1100 mm
  Middle row 1350 mm
  Top row 1600 mm
- Annunciators -1950 mm
- Electric push buttons/ Switches, lamps etc. -700 mm

11..5.23.15. The internal panel layout shall be designed considering proper approach for instruments, terminals and other accessories for maintenance, easy removal and online calibration. No instrument, terminals, power distribution box etc shall be mounted on the panel side plates inside the panel.

11..5.23.16. All lamps, status as well as alarm, shall be provided with lamp test facility. One single lamp test push button shall be used for each panel.

11..5.23.17. Color Scheme

1	Status Lamps		
		On/Open/Permissive	Green
		Off/Close/Emergency	Red
2	Alarms		
		Normal/Pre-trip alarms	White
		Shutdown alarms	Red

3	Push/Pull buttons		
		On/Open	Green
		Off/Close	Red
		Emergency shut-down (ESD) (Push-button with cover/ Mushroom push button)	Red

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11..5.24. **Panel piping & tubing**

11..5.24.1. Instrument air header shall be adequately sized with brass packless isolation valves and shall be complete with suitable dual filter-cum-air reducing station.

11..5.24.2. Panel tubing from the bulk head to the panel instruments and instrument air supply to the panel instruments shall be of 6 mm x 1 mm polyethylene tubing. The tubing shall be laid in plastic slotted ducts. Panel air header and tube fittings shall be of brass, suitably protected against corrosion.
Shut off valves shall be installed in all branch lines taking off the transmission and output signal. Each tube shall be identified at both the terminating ends.

11..5.25. **Panel Wiring**

11..5.25.1. Open terminals shall generally be avoided. Terminal strips shall be of 'Phoenix/ Wago/ Elmex' or equivalent type and shall preferably be mounted in an enclosure. Fused terminal may be used wherever necessary.

11..5.25.2. A minimum of 1 mm^2 multi stranded PVC insulated copper conductor shall be used in general. All wiring shall be laid in the PVC troughs. No trough shall be more than 70% full.

11..5.25.3. Wires carrying measurement signals associated with thermocouples, resistance thermometers, pH instruments and other low level signals shall be routed in separate troughs/wire ways and not alongwith power cables.

11..5.25.4. Power wiring and control wiring shall be separated by not less than 150 mm. The crossing, if unavoidable, shall be as close to right angles as possible.

11..5.25.5. Extension cables/wires shall be used for all thermocouple inputs.

11..5.25.6. Intrinsically safe wires, non-intrinsically safe and power cables shall be routed in separate wire ways, independently. Intrinsically safe wiring and terminals shall be light blue in color and shall be separated from non-intrinsically safe terminals at least by 50 mm.

11..5.25.7. Separate cabinets shall be considered for wiring/ termination of Fieldbus signals.

11..5.25.8. All incoming power feeders shall be terminated on separate terminals suitable for the incoming feeder size. These shall be located at the bottom of the panel and shall be suitably covered for protection against accidental shorting and for human safety.

11..5.25.9. Following design philosophy shall be followed while deciding the internal layout of panels:

1.	Distance between terminal strip and side of the panel upto 50 terminals width	100 mm (min.)± trough
2.	Distance between two adjacent terminal strips	100 mm (min.)±trough
3.	Distance between gland plate and bottom of the strip	300 mm (min.)
4.	Distance of terminal strip from instrument/trough/panel top	100 mm (min.)

11..5.26. LOCAL CONTROL PANELS

11..5.26.1. Local control panel for the package units shall be installed within the battery limit of the package considering operational and maintenance requirements and accessibility.

11..5.26.2. In case of skid mounted packages, panel shall be located away from the skid. In case local control panel is housed outdoor i.e. not in a local control room, it shall be designed to meet IP-55 requirements.

11..5.26.3. In addition, panel must be provided with a rain cum sun shade canopy/shed.
Local control panel/panels shall be totally enclosed cubicles. Panel sizing shall be carried out based on equipment being installed keeping in view the maintenance clearances and easiness. Although the panel dimensions shall be guided by the actual requirements, typical dimensions of 2100 mm operational (height) x 1200 mm (width) x 1000 mm (depth) shall be kept in mind while finalising the panel size.

11..5.26.4. Local control panels located in the hazardous area shall be either purged type or flameproof Exd as finalized by the purchaser. In case pressurised panels are finalized the same shall be purged and pressurised as per NFPA-496 requirements to render space within the panel non hazardous. For panels located in IEC Zone 2 hazardous area type Z purging shall be used with a purge fail alarm in central control room. In case, panels are located in Zone1,
the power shall be cut-off on pressurisation X-purge requirement of NFPA-496.

An alarm shall be provided on local panel and a contact shall be provided for remote annunciation, whenever the panel pressurisation falls below 2.5 mm of H2O. A protective device to protect the panel from over pressure must be provided.

Panel pressurisation with start-up panel purging scheme shall be fully automatic however it shall be started manually from a push button. Solenoid valves and differential pressure switch required for panel purging shall be

flameproof, however other items like relays, switches/pushbuttons, timers etc. shall be located in a flameproof housing. Other items like valves, restriction orifice plates, dual filter regulators, pressure gauges, variable area flowmeters etc required for pressurisation, shall also be located in the non-pressurised section of the panel

11..5.27. **SOLENOID VALVES**

11..5.27.1. Solenoid valves in classified areas shall be flameproof type and shall be rated for 110 V DC. All solenoid valves shall be certified weatherproof to IP-65 as a minimum, in addition.

11..5.27.2. The solenoid coil design shall be suitable for working continuously with the specified voltage levels.

11..5.27.3. Solenoid valves body material shall be SS 316.
Bidder shall categorically analyze selection with respect to cabling distance, type of cable, before finalizing make/model.

11..5.28. **PRESSURE GAUGES AND DIFFERENTIAL PRESSURE GAUGE**

- Pressure gauges shall be weatherproof to IP 55 as per IEC 60529 / IS 13947, as a minimum, with dial size of 150 mm and shall have screwed bezels.
- Pressure gauge sensing element shall be an elastic element like bourdon tube, bellow, diaphragm etc. of SS316 and movement of Stainless steel, as a minimum.
- The design of pressure gauges shall confirm to IS-3624.
- Case material shall be SS304 and vapor-tight.
- Dial markings and dial colour shall be as per IS 3624. The pointer stops shall be provided at both ends of the scale to restrict the pointer motion beyond 5% above the maximum of scale and less than 5% below the minimum of the scale.
- Pointers shall have external micrometer adjustment for gauge zero adjustment.
- Unless otherwise specified, the accuracy including repeatability and hysteresis shall be ±1% of full scale for Direct pressure gauges, ±2% of full scale for Chemical seal type pressure gauges and for Differential pressure gauges.
- Over range protector shall be provided.
- In case of pressure gauges with diaphragm seal, same shall be installed between the seal and the gauge.
- Snubbers/pulsation dampners/gauge sever of SS304 shall be used for all pulsating services. These shall be floating pin type, externally mounted and externally Over range protector and Snubbers, whenever used, shall be same as socket material, as a minimum.

- Where vibrations and pressure fluctuations are expected, Glycerin filled type shall be used. In case of vibrating services like pump outlets, flexible armored hoses shall be used in place of impulse piping and gauges shall be mounted on separate stanchions.
- Bourdon element shall be welded to socket and tip end shall be stress relieved.
- Pressure gauges with range as 0 to 100kg/cm2g and above shall have safety type solid front case.
- The pressure gauges shall have an over-range protection of at least 130% of maximum working pressure, as a minimum.
- Process connection shall normally be 1/2" NPTM bottom.
- Sensing element for Draft gauges shall be suitable to measure the draft ranges such as capsule, bellows.
- All pressure instruments shall be provided with 2- valve manifolds along with
  Prefabricated hook ups made of SS316.
- All Differential pressure gauges shall be provided with 3-way manifold of SS316. It shall be suitable for mounting on 2” pipe. Mounting accessories shall be provided with gauge.
- All differential pressure gauges shall be of magnetic piston type. Alternatively DP transmitter with local indication shall be provided.
- All gauges shall be provided with a blowout device i.e. blow out disc of aperture not less than 25mm for gauges with dial size 100mm and above, while 20mm for gauges with dial size less than 100mm.
- The process connection shall be 1½” flanged for all application except where line size is below 1”, chemical seal type pressure gauges with ½”NPT connection are acceptable for 1” below line size.
- Receiver pressure gauges for local transmitter output indication shall have 100 mm dial with stainless steel element and 1/4" NPTM instrument connection.
- The dial cover shall be made out of shatter proof glass sheet of thickness 1.5 to 3mm for gauges with dial size less than 100mm while minimum 3.0mm for gauges with dial size 100mm or greater.
- The gauge socket shall be in one piece without any capillary or tube in between for bourdon tube type element and for others tubing with minimum bore of 3 millimetres is acceptable. Socket shall be welded type only.

11..5.29. **PRESSURE SWITCHES**

- Pressure switches shall have elastic element like diaphragm, bellow etc. as pressure sensing element of SS316 material as a minimum.
- Switch type shall be mechanical snap action sealed microtype with silver plated for non IS circuits and gold plated for IS circuitsc.

- Pressure switch with Reed type switches shall not be selected.
- Pressure switches shall be blind type with ½" NPTF process connection and shall be operative in full specified range. Set point shall be field adjustable. An indicating scale shall be provided for set point adjustment (with locking mechanism).
- Ranges for process switches shall be selected, in general, such that the set point falls preferably in the middle 30% of full adjustable range i.e. the set point shall fall between 35% and 65% of adjustable range.
- The switch differential shall be selected as per operating conditions, it shall be less than 60% of difference between set value and operating value and shall reset at 10% below the Set pressure.
- Repeatability shall be ± 1% of set range and Scale Accuracy: ± 1% of set value.
- Receiver pressure switches shall have SS316 bellows as measuring element with 1/4" NPTF connection.
- Requirements, design and selection of Over range protection, Over range protector, Snubber/ pulsation damper and, diaphragm seal (chemical seal) for pressure switches shall be same as indicated in pressure gauges.

11..5.30. **Instrument Valves and Manifolds**

a. Bidder shall provide instrument valves (miniature type) and valve manifolds wherever required.
b. Body rating shall be as per piping class or better. All valves and manifolds shall be forged type only.
c. For all valves and manifolds with body material of carbon steel/stainless steel, the valve trim material shall be SS316, as a minimum. For any other body material, trim material should be same as body material as a minimum. Superior trim material shall be selected as required by process conditions. Packing material in general shall be of PTFE. The o-ring materials wherever used shall also be of PTFE.
d. Instrument Valves (Miniature) shall be of globe pattern needle valves forged/ bar stock with inside screwed bonnet, with back-seated blow out proof system.
e. Instrument Air Isolation Valves (Miniature) shall be full-bore ball type with forged body.
f. Instrument Air Needle Valves (Miniature) shall be globe pattern-needle valves.
g. For all these valves types, Body material shall be SS316.
h. End connection shall be ½"NPTF to ANSI B 1.20.1 for Instrument Valves (Miniature) and Instrument Air Isolation Valves (Miniature) and ¼" NPTF to ANSI

11..5.31. CABLES

11..5.31.1. All cables shall have PVC insulated primary insulation of 85°C PVC as per IS-5831 Type C. Thickness of primary insulation shall be 0.5 mm as a minimum. For PE insulated cables, primary insulation shall be of 70° C Polyethylene. Inner and outer jacket (sheath) shall be made of extruded flame retardant 90°C PVC to IS-5831 Type ST-2 and meeting flame retardant requirements for bunched cables as per IS 10810 (Part 62) category AF or IEC 60332 category A. Minimum Oxygen index of PVC shall be 30% at 27 °C ±2°C, temperature index shall be over 250°C, a rip cord shall be provided for inner sheath, Outer sheath shall be suitable for protecting the cable against rodent and termite attack.

11..5.31.2. All cables shall be fire retardant as per standard IEC 60332-3 Part 3 Cat.A. Fire resistance cables whenever specified shall be as per IEC 60331 Cat. A.

11..5.31.3. Following are the Specific Requirements for fire resistant cable:

a. The cables shall have circuit integrity as per IEC 60331.
b. Primary insulation shall be heat resisting elastomeric which can withstand temperature up to 90°C such as silicon rubber/mica glass tape/EPR (medium grade) as per IS 6380. Insulation thickness shall be 1.0mm minimum and shall confirm to IEC 60092.
c. A wrapping of tape made of PETP (polyethylene terepthalate)/woven glass shall be provided over core insulation.
d. Individual pair triad shall be shielded. The shield shall be aluminum backed by glass
e. Mica/PETP tape with the metallic side down helically applied with 25% overlap on either side and 100% coverage. Minimum shield thickness shall be as per IEC 60092. Drain wire shall be 0.5mm² (7/0.3mm dia), multi-stranded bare tinned annealed copper conductor. Drain wire shall be in continuous contact with aluminum side of the shield.
f. Inner and outer sheath shall be made of low smoke, heat resistant, oil resistant and flame retardant material with oxygen index over 30, temperature index shall be over 250°C. Acid generation shall be maximum 20% by weight as per IEC 60754. Smoke density rating not to exceed 60% as per ASTM D 2843.
g. The thickness of the sheath shall be as per IEC 60092. Inner and outer sheath color shall be orange. A rip cord shall be provided for inner sheath.
h. Armour bedding over inner sheath shall be of special high oxygen index, low smoke halogen free fire resisting compound.

11..5.31.4. The insulation grade shall be 600 V/1100 V as a minimum and shall meet insulation resistance, voltage and spark test requirements as per BS-5308 Part-2.

11..5.31.5.

a. All cables shall be armoured. Armour over inner jacket shall be of galvanized steel wire/flat as per IS-1554 part I. Requirement and methods of tests for armour material and uniformity of galvanisation shall be as per IS 3975 and IS 10810 (Part 40) respectively.

b. All the cores of single pair or multipair shall be twisted and numbers of twist shall not be less than 10 per meter.

c. The thickness of the sheath shall be as per IS 1554 part 1.

d. Tolerance in overall diameter of cable shall be within ± 2 mm over offered value.

e. Overall twist of all pair/triads shall be as per vendor's standard.

f. The cables used in installations under the jurisdiction of Director General of Mines and Safety (DGMS) shall meet all requirements of DGMS. The word “Mining Cable” shall be embossed on the cable outer sheath as per IS 1554 (Part 1).

11..5.31.6. For signal and control cables, inner sheath colour shall be black. Outer sheath colour shall be light blue for intrinsically safe application and black for others.

11..5.31.7. Maximum DC resistance of the conductor of the completed cable shall not exceed the
Following:

a. 12.3 O/km at 200C for cables with 1.5 mm2 conductor.

b. 39.7 O/km at 200C for cables with 0.5 mm2 conductor.

11..5.31.8. The mutual capacitance of the pair/ triad or adjacent cores shall not exceed 250 pF/m at a frequency of 1 kHz and between the pairs/ triads for PE Insulated cables shall not exceed 100 pF / metre at a frequency of 1 KHz. The capacitance between any core and screen shall not exceed 400 pF/ m at a frequency of 1 kHz.

11..5.31.9. L/R ratio of adjacent cores shall not exceed 40 µH / O for cables with 1.5 mm2 conductor and 25 µH / O for cables with 0.5 mm2 conductors.

11..5.31.10. The drain wire resistance including shield shall not exceed 30 O/km. Electrostatic noise rejection ratio shall be over 76 dB.

11..5.31.11. A pair of communication wire shall be provided for multipair/multitriad cables. Each wire shall be 0.5 mm2 of plain annealed single or multi-strand copper conductor with 0.4 mm thick 850C PVC insulation. Insulation shall be green and red colour coded.

11..5.31.12. Bidder shall ensure a minimum of 20% of quantity of each type of cables provided as spare including any special cable. And in each multipair cables 20% pairs shall be kept as spare.

11..5.31.13. Running length of the cable shall be printed at least at every 1-meter interval.

11..5.31.14. For multipair/ multitriad cables, pair identification shall be provided with numbers at interval of not more than 250mm as per bidder's standard. The embossing /engraving shall be legible and indelible.

11..5.31.15. Signal Cables

a. Single pair shielded signal/alarm cables shall be used between field instruments/ switches and junction boxes/local control panels.

b. Multipair individually and overall shielded signal/alarm cables shall be used between junction boxes/local control panels and control room / satellite rack room as the case, in general.

c. The Type-I single pair/triad cables shall be 1.5mm^2 conductor size made of annealed electrolytic copper conductor of 7 strands with each strand of 0.53 mm diameter. Type-II Multipair/ Multi-triad cables with individual pair/ triad shield and overall shield with 1.5mm^2 conductor size shall have 7 strands of annealed electrolytic grade copper conductor with each strand of 0.53 mm diameter. Type-III (Multi-pair / Multi-triad cable with only overall shield) cable shall be same as type-II cable, except that the individual pair/ triad shall not have shielding. Type-IV Multi-pair /Multi-triad cable (with individual pair shield and overall shield) with 1.5 mm^2 conductor shall have 7 strand with each strand of 0.53 mm diameter. Type-V Multi-pair / Multi-triad cable (with overall shield only) shall be same as type IV except that the individual pair/triad shall not have the shielding.

d. Each pair/triad shall be shielded. Shield shall be aluminium backed mylar/polyester tape bonded together with metallic side down helically applied with either side having 25% overlap on either side and 100% coverage. Minimum shield thickness shall be 0.05 mm in case of single pair/ triad and 0.075 mm in case of multipair/ triad cable.

e. Drain wire shall be provided for individual pair and overall shield which shall be 0.5 mm^2 multi stranded bare tinned annealed copper conductor. The drain wire shall be in continuous contact with aluminium side of the shield.

f. All multi pair cables shall have 6 pair/12 pairs only while multitriad cable shall have 6 triads/8 triads only.

11..5.31.16. CONTROL CABLES

a. Single pair control cables shall be used between field mounted solenoid valves and junction boxes/local control panels and shall meet the requirements specified above.

b. Multipair control cables shall be used between junction boxes/local control panel and control room mounted devices in general. These cables shall have only overall shielding.

c. These control cables shall have 1.5 mm2 conductor size with 7 stranded conductors of annealed electrolytic grade copper, with each strand of 0.53 mm diameter as minimum.

11..5.31.17. POWER SUPPLY AND OTHER CABLES

a. All power supply cables shall be as per IS-1554 Part I and shall have copper/aluminum conductors depending on conductor size.
b. Minimum conductor size shall be 2.5 mm2 of copper conductor.
c. For higher sizes, aluminum conductor can be considered.
d. All these cables shall be PVC insulated and armoured.

11..5.31.18. Cable Glands, Plugs and Reducers/Adaptors

a. All cables glands shall be of nickel-plated brass and they shall be double compression type suitable for armoured cables.
b. Flame proof glands wherever required shall be provided with Exd certification.
c. Bidder shall provide a minimum of 20% of cable glands as spare.
d. All cable glands shall be weather proof to IP-55.
e. Cable glands shall be NPT for all field items and junction boxes where as ET thread with check nuts for control room end.
f. Cable glands shall be provided to suit the cable dimensions along with tolerances. Various components like rubber ring, metallic ring, metallic cone and the outer / inner nuts etc. shall be capable of adjusting to the tolerances of cable dimensions.
g. Reducers / adapters shall be nickel-plated brass, as a minimum. These shall also be weatherproof and / or flame proof wherever specified and certified for the electrical area classification specified.
h. Plugs shall be of nickel-plated brass and shall be certified flameproof when used with flameproof junction boxes.

11.6. **PIPING:**

All piping for the FPS shall be welded type.

11..6.1. PIPE SUPPORTING CRITERIA & GENERAL GUIDELINES

11..6.1.1. All piping shall be adequately supported, guided or anchored so as to prevent undue vibration, deflection/expansion or loads on connected equipment and piping and leakage at joints.

11..6.1.2. Piping at valves requiring periodic maintenance, shall be supported in such a way so that the valves can be removed with a minimum necessity of installing temporary pipe supports.

11..6.1.3. Pipe support pedestal drawing shall be submitted for information and the type of pedestal including load capacity shall be marked on Isometrics. Piping support standard, with load bearing capacity, shall be submitted for purchaser's review.

11..6.1.4. Piping system shall be properly supported taking into account the following:

a. Sustained Loads
-Weight of Piping (Bare pipe, service fluid, valves, flanges etc)
-Weight of Insulation (if any)
-Weight of online equipments (if any)
-Weight of instruments (if any)
-Pressure relief loads due to safety valve operation
-Dynamic loads due to pulsating flow/two phase with slug flow

b. Occasional Loads
-Seismic loads (as and when required)

c. Thermal Loads
-Thermal loads due to operating/design/steam out/decoking or any other possible abnormal condition.

11..6.1.5. Additional supports, guides, anchors, special supports like spring supports and sway braces shall be provided based upon detailed analysis of piping system to restrict the forces on nozzles of critical equipments like pumps, compressors, turbines, exchangers, Air coolers etc.

11..6.1.6. A permanent support, either resting or spring support shall be provided for lines which do not need any supporting otherwise but require supporting during maintenance.

11..6.1.7. Adequate care shall be taken for small bore (1 1/2 and below) branch from piping. a rule, for all lines in 600# & above classes, lines having two phase flow and lines having Pulsating flow such as discharge of reciprocating compressors & reciprocating pumps, all small bore branches, e.g. vents, drain, orifice taps, pressure tapings, temperature tapings, sample connections, PSV inlet, TSV inlet etc. shall be provided with 2 number stiffeners at 90º to each other from the main pipe to impart adequate stiffness to the branch connection.

11..6.1.8. The stiffeners shall be made of 6mm thick flats of material equivalent to the pipe material. Further, irrespective of line rating, the stiffeners shall be provided for all orifice taps, all small bore tapings from PSV inlet / outlet lines and all small bore tapings from Control Valve manifolds.

11..6.1.9. Pipe support design shall be such that deflection in piping systems due to sustained loads shall not exceed 15mm, between two adjacent supports.

11..6.1.10. All piping shall be laid such that weld seam always lie in the upper quadrant.

11..6.2. **PIPE SIZE**

11..6.2.1. Pipe sizes shall normally be 0.5", 0.75", 1.0", 1.5", 2.0", 3", 4", 6", 8", 10",12",14",16"

11..6.2.2. Welded pipes shall be acceptable only with longitudinal weld made employing automatic welding.

11..6.2.3. Galvanized Pipes shall be only Hot Dip galv. to ASTM A53.

11..6.3. **FITTINGS**

11..6.3.1. All fittings shall be seamless in construction unless otherwise specified.

11..6.3.2. Thickness of fittings at ends to match pipe thickness for BW fittings.

11..6.3.3. SW fittings shall be 3000#, 6000#or 9000# depending on the pipe thicknesses S80, S160 and above S160 respectively.

11..6.3.4. Upto 600# all branch connections shall be as follows, unless specifically mentioned otherwise in PMS:

a. Up to 1-1/2" NB Half couplings/ Tee

b. 2" and above Tees/ Pipe to pipe with or without reinforcement pad

11..6.3.5. For reducing BW fittings having different wall thickness at each end, the greater one shall be employed and the ends shall be matched to suit respective thickness.

11..6.3.6. All welded fittings shall have maximum negative tolerance equivalent to pipe selected.

11..6.3.7. All welded fittings shall be double welded. Inside weld projection shall not exceed 1.6mm, and the welds shall be ground smooth at least 25mm from the ends.

11..6.3.8. For fittings made out of welded pipe, the pipe itself shall be of double welded type, manufactured with the addition of filler material and made employing automatic welding only.

11..6.3.9. All welded fittings shall be normalized for CS, normalized & tempered for AS; and 100% radiographed by X-ray for all welds made by fitting manufacturer as well as for welds on the parent material.

11..6.3.10. Bevel ends of all BW fittings shall undergo 100% MP/DP test.

11..6.4. **FLANGES**

11..6.4.1. Flanges shall be as follows:

Rating	Size	Type	Remarks
150	Up to 1.50”	SW RF	If used with non-metallic gasket
	Up to 1.50”	WN RF	If metallic/spiral wound

			gasket is used
	2" & above	WN RF	For CS
300,600	Up to 1.50"	SW RF	
	2" & above	WN RF	

11..6.4.2. All flange joints on piping system including flanges on the equipments , manholes etc shall be tightened using Hydraulic bolt tensioners per the following table:

Nominal bolt diameter	Condition	Remarks
All	When specified by process licensor/ vendor /project Specifications	
50 mm & over	All joints	
38 mm &above & below 50mm	a)class 600 & above b) joints with leakage potential c)critical joints	
25 mm & above & below 38mm	a) joints with leakage potential b)critical joints with equipments	

11..6.4.3. All the stud bolt length shall be longer by one diameter to facilitate bolt tensioning.

11..6.4.4. Following Joints shall be considered as Joints with leakage potential :

I. Joints involving tapped holes
II. Items not subjected to hydrotest eg. Joints for equipment manholes
III. equipment mounted temp, pressure & level instruments, line mounted temp connections, online instrument joints like control valves and safety valves, compressor volume bottles.
IV. Items involving two sets of gaskets with one set of bolt eg orifice flange joint, joints with spectacle blind, spacer, flangeless wafer check valve, wafer type butterfly valves.

11..6.4.5. Critical joints with equipments shall include inlet & outlet flanges of pumps.

11..6.4.6. For Ring Joint Flanges, Blinds and Spacers, the hardness shall be as follows :

Sl No	Flange Material	Min. Hardness of Groove (BHN)
1	Carbon Steel	140
2	1% Cr to 5% Cr, 1/2 Mo	150
3	Type 304,316,347,321	160
4	Type 304L. 316L	140

11..6.4.7. For RTJ flanges, blinds & spacers, the hardness of the groove shall be specified on the test report. Bore of weld neck flange shall correspond to the inside diameter of pipe for specified schedule/thickness. Ends shall be bevelled to suit the specified schedule / thickness. For RTJ flanges, only octagonal section ring joint flanges shall be used.

11..6.5. **GASKETS**

11..6.5.1. Asbestos filler for spiral wound gasket shall not be permitted. Al gaskets shall be non-asbestos type.

11..6.5.2. Full face gaskets shall have bolt holes punched out

11..6.5.3. Non-metallic ring gaskets as per ASME/ANSI B16.21 shall match flanges to ASME/ANSI B16.5 upto 24", and ASME/ANSI B16.47 or AWWA for sizes > 24" unless otherwise specified.

11..6.5.4. Spiral wound gaskets as per ASME B16.20 shall match flanges to ASME/ANSI B16.5 upto 24", and ASME B16.47 series 'B' for sizes > 24" unless otherwise specified.

Rating	Material	Temperature	Type	Gasket or strip material + filler material/RTJ gasket material
150	CS& SS (utilities except steam)	Up to 371 ^{o}c	Plain	BS 7 531 Gr.X
150	Cs & LTCS (process and steam)	Up to 371 ^{o}c	Spiral wound	Ss316 +Grafoil
150	AS(all services)	Up to 371^{o}c	Spiral wound	Ss316 +Grafoil
300 & 600	CS	Up to 472 ^{o}c	Spiral wound	Ss316 +Grafoil

11..6.6. **VALVES**

All isolation valves in the fire water network shall be Gate Valve type

11..6.6.1. SW valves –Up to 1½ inch, for 150#, 300#, 600# (except ball & plug valves).

11..6.6.2. Ball & Plug valves shall be flanged for all sizes.

11..6.6.3. Flanged valve- 2” inch above for 150#, 300#, 600#.

11..6.6.4. BW valves -900# and above

11..6.6.5. All flanged valves (except forged) shall have flanges integral with the valve body.

11..6.6.6. Weld-on flanges shall be made by full penetration joints and 100% radiographed.

11..6.6.7. Yoke material shall be at least equal to body material.

11..6.6.8. Forgings are acceptable in place of Castings but not vice-versa.

11..6.6.9. DIMENSIONS: Face-to-Face/End-to-End dimension shall be as per ANSI B16.10. In case the same is not covered under B16.10, the dimension shall be as per BS 2080 / Manufacturer's Std.

Valve type	Class	For sizes ≥
Gate/globe	150	12"
	300	12"
	600	12"
Gate /globe/y-globe/stop-check	900	6"
	1500	3"
	2500	3"
Ball/plug(other than pressure balance plug)	150	6"
	300	6"
	600	4"
	900	3"
	1500	3"
Butterfly	150	6"
	300	6"

11..6.7. **OPERATION**

Generally the valves are hand wheel or lever operated.

11..6.7.1. Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500 mm on each side. Effort to operate shall not exceed 35 kgf at hand wheel periphery.

11..6.7.2. However, failing to meet the above requirement, vendor shall offer gear operation.

11..6.7.3. Quarter-turn valves shall have "open" position indicators with limit stops.

Class	Size	qty
150	Upto 24"	5%
300	Upto 16"	10%

11..6.8. RADIOGRAPHY OF CAST VALVES

11..6.8.1. All casting shall be of radiographic quality. This requirement to be ensured by sample radiography before proceeding with the actual production.

11..6.8.2. Radiography procedure, areas of casting to be radiographed, and the acceptance criteria shall be as per ASME/ANSI B16.34.

11..6.8.3. Radiography requirement for casting shall be as follows:

11..6.9. **Ball/Plug/Butterfly Valves**

11..6.9.1. Each valve shall be supplied with a lever/wrench except for gear operated /motor operated valves.

11..6.9.2. Soft-seated Ball, Plug & Butterfly valves shall be supplied with antistatic devices.

11..6.9.3. The ball of Ball valves shall not protrude outside the end flanges.

11..6.9.4. Ball valves shall be floating ball type/ trunion mounted type as per following:

Sl No	Class	Floating Ball	Trunion Mounted
1	150	8 " & below	10" & above
2	300	4" below	6" & above
3	600 & above	1.5 & below	2 " & below

11..6.9.5. Use of soft seated ball/plug/butterfly valves shall be suitably selected based on temperatures handled.

11..6.9.6. Butterfly valves shall be suitable for throttling application.

11..6.10. **STRAINER**

11..6.10.1. Pressure drop calculations shall be furnished during detail engg stage.

11..6.10.2. Type of Strainers:

Y Type	Upto 1½" irrespective of service 2" & above in steam service
T type	2" & above in services other than steam

11..6.10.3. All 2" & higher sized Y type strainers shall be provided with 3/4" threaded tap and solid threaded plug as drain connection on the blind flange. For less than 2", this shall be 1/2" size.

11..6.10.4. Bottom flange of Y-type strainer shall not have tapped hole. Full length standard size studs shall be used for joining blind flange.

11..6.10.5. For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP/MP checked.

11..6.10.6. All the strainers shall be hydrostatically tested at twice the design pressure.

11..6.11. **STUD, BOLTS, NUTS AND JACK SCREWS**

11..6.11.1. All bolting shall be as per ASME/ANSI B18.2.1 for Studs, M/C Bolts and Jack screws, and ASME/ANSI B18.2.2 for nuts.

11..6.11.2. Threads shall be unified (UNC for .= 1" dia and 8UN for > 1" dia) as per ANSI B1.1 with class 2A fit for Studs, M/C Bolts and jack screws, and class 2B fit for nuts.

11..6.11.3. Stud bolts shall be threaded full length with two heavy hex nuts. Length tolerance shall be in accordance with the requirement of table F2 of Annexure F of ASME B16.5

11..6.11.4. The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process.

11..6.11.5. The length of the studs/ bolts should be such that minimum two threads should be out of the nut on either side.

11..6.11.6. All the stud/ bolt should have metallurgical certificates in case of alloy/ SS metallurgy with identified colour marking at the stud ends/ bolt side face.

11..6.11.7. Heads of jack screws and M/C bolts shall be heavy hexagonal type. Jack screw end shall be rounded.

11..6.11.8. Wherever bolt tensioning is specified stud bolt length shall be longer by minimum one diameter to suit bolt tensioner. Excess threads shall be protected by a threaded nut.

11..6.12. **WELDING PROCESSES**

11..6.12.1. Welding of various materials shall be carried out using one or more of the following processes with the approval of the Engineer-in-charge :

- -Shielded Metal Arc Welding process (SMAW)
- -Gas Tungsten Arc Welding process (GTAW).

11..6.12.2. Automatic and semi-automatic welding processes shall be employed only with the express approval of the Engineer-in-charge.

11..6.12.3. The welding procedure adopted and consumables used shall be specifically approved.

11..6.12.4. A combination of different welding processes could be employed for a particular joint only after duly qualifying the welding procedure to be adopted and obtaining the approval of engineer-in-Charge.

11..6.12.5. For additional details “Welding Specification for Fabrication of Piping as mentioned elsewhere shall be referred.

11..6.12.6. Potable water shall be used for testing of Carbon steel & Alloy steel piping. For testing of Stainless Steel piping maximum chlorine content in water shall be 15-20 ppm.

11..6.12.7. All small bore piping and steam tracer lines, size ¾” and below shall be welded by TIG process for all type of joints, e.g. Butt Weld, Socket Weld, tee etc.

11..6.13. **BOLT TENSIONING AND BOLT TORQUES**

11..6.13.1. Bidder shall include Quality checks during plant construction and proper Records /documents should be maintained. Special attention is needed for high-pressure system, handling hazardous material.

11..6.13.2. Mechanical integrity of flange joints in high-pressure systems has to be ensured by the bidder. A standard check list for this activity along with post box-up checks should be developed and practiced.

11..6.13.3. The following guidelines shall be used besides other relevant codes like ASME etc. This checklist should include following points :

a. Ensuring right type of Gasket, fasteners etc., conforming to the specifications as per design and drawing.

b.

i. Alignment of flanges and inspection of threads in case of tapped holes in flanges.
ii. Inspection of gasket surface
iii. Ensuring that gasket is properly seated.
iv. Checking that fasteners are tightened upto required depth in tapped holes.
v. Ensuring that fasteners are tightened as per tightening procedure and using specific torque value with well-maintained tools and torque wrenches.

c.

i. All critical joints should be boxed up under the supervision of the Purchaser's representative
ii. Each joint shall be boxed up and tightened by only skilled Technician duly approved by competent authority.

d.

i. Checking the individual joint for any leak during system pressure testing by using special tapes, soap solution or as per relevant code.
ii. Inter-face joints should be system pressure tested as per relevant code to ensure their integrity.

e.

i. Differential hardness between RTJ gasket and flange shall be considered.

11..6.13.4. All the points in the checklist, including the names of the persons involved in the execution/inspection of the boxing up of critical and high-pressure joints, should be recorded. Purchaser / End customer reserve the right to review these records at site.

11..6.13.5. Box-up of interface flange joints which are not subjected to hydrotest, need extra attention. Separate records shall be maintained for such joints.

11..6.14. **HYDRAULIC BOLT TENSIONER**

11..6.14.1. Flange connections with bolting of nominal diameter 25mm (1 in) and over shall have sufficient clearance and access to allow the use of hydraulic tensioning equipment.

11..6.14.2. Hydraulic bolt tensioning shall be used for the following:

NOMINAL BOLT DIAMETER	CONDITION
50mm and over	All joints
38mm and over	Class 600 and over
25mm and over	a. Joints subject to high temperature or cyclic duties. b. Joints with leakage history.

11..6.14.3. Stud bolts shall be longer by one diameter to facilitate the bolt tensioning for all sizes specified in table above. Excess thread shall be protected by a threaded cap. On bolts at ambient temperature duty the cap should have a grease nipple.

11..6.14.4. An applied bolt stress of 30,000 to 40,000 lb/in^2, and typically 35000 lb/in^2 is adequate for most duties. It should not generally exceed 50% of the bolt material yield stress. The applied bolt stresses should be individually calculated for particularly critical or problematic joints.

12. PAINTING

12.1. **See Annexure-II**

13. INSPECTION AND TESTING

13.1. Bidder shall maintain an effective Quality Assurance System, to ensure that all equipment and material supplied as a part of the Foam Protection System package meet required Quality standards and specifications.

13.2. After award of contract bidder shall submit Quality Plan for approval. The quality plan shall be submitted in BHEL quality plan format, [For guidance and blank format, refer to Annexure V].

13.3. Bidder to note that all the cost involved in any of the inspection & testing requirements as per the approved quality plan shall be deemed to be included in the price quoted by the bidder. Bidder shall not be eligible to raise any extra claim on account of any inspection & testing of the complete FPS as per the approved quality plan.

13.4. **GUIDELINES FOR ITPS / QAPS FOR FPS**

13.4.1. INSPECTION AND TEST REQUIREMENTS FOR WELDED PIPES.

Sl no	Stage/ Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1a.	Raw Material Inspection	Marking and correlation with TC	100%	Inspection Report	-	W	R
1b.	Raw Material Inspection	Chemical composition	One sample per heat	Inspection Report	-	R	R
2	Pipe Rolling	Process Control	As per Internal QA Plan	Inspection Report	-	W	-
3	Manufacturing , Welding	Approved WPS,PQR,WPQ	100%	WPS,PQR,WPQ	-	W	R
4	Manufacturing , Welding	New WPS,PQR,WPQ	100%	WPS,PQR,WPQ	-	H	W
5	Manufacturing , Welding	Welding	100%	Internal Report	-	W	-
6	Heat Treatment (if applicable)	Stress reliving, normalizing, Tempering etc. as applicable	100%	HT chart	-	W	R
7	UT (if applicable)	Surface and Internal Imperfection	Material Specification	Inspection Report/Graphical record	-	W	W (at Random) 100%

							R
8	RT (if applicable)	Surface and Internal Imperfection	Po, Material Specification	RT Films	-	R	R (100% of films)
9a	Destructive Testing (Note: Special Impact, Hardness, Requirements for H2, sour service	Material Properties	Each heat no/size	Lab Report	-	H	H
9b	Product analysis	Chemical composition	One sample per heat or As per specification	Inspection Report	-	W	R
10	Destructive Testing (for SS Material)	Corrosion properties	Highest thickness and highest carbon/HT Lot	Lab Report	-	H	H
10 A	Ferrite check of SS pipes (if applicable)	% ferrite check	Random on pipe body/weld	Inspection report	-	W	RW
11	Galvanizing (if applicable)	Integrity of galvanized coating	100%	Inspection/lab report	-	W	RW
12	Hydro testing	Leak check	100% by supplier, At random by PURCHASER / END CUSTOMER	Inspection Report/Hydro Graph	-	H	H
13	Final inspection	Surface condition, straightness, end finish, Bevel Angle, Root Face, Outer dia. , Thickness, Length, Coating, Marking, color coding, End	100% by supplier, At random by PURCHASER / END CUSTOMER	Inspection report	-	H	H

		Caps					
14	weight checking	Weight	100%	Inspection report	-	W	-
15	Final inspection (for AS & SS pipes)	PMI check	As per 6-81-0001	Inspection report	-	R	RW
16	Marking	Pipe no , acceptance no. , H No. Size, Grade, Thickness & color code	100%	-Do-	-	W	RW

13.4.2. INSPECTION AND TEST REQUIREMENTS OF VALVES.

Sl no	Stage/ Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming Material						
1a	Casting and forging (Body, Bonnet , Disc, Stem ,Body Rings,)	Surface Quality MPT for Hydrogen Service.	As per supplier's Sampling Plan	Inspection Report	P	P	R
1b	-Do-	Diamension	As per supplier's Sampling Plan	Inspection Report	P	P	R
1c	-Do--	Chemical and Mechanical Properties(Not Special Requirements of heat treatment, Hardness, Impact, Bend, Tensile Test etc. for H2 service and NACE)	All Heats	Inspection Report , Supplier's TC	P	R	R
1d	All Castings Materials	Heat Treatment as per Specs	All Lots	HT chart on TC	p	R	R
1e	Casting,forgings for Austenitic StainSteel body and bonnet only.	Inter Granular Corrosion (IGC) Test and Stabilisation Heat Treatment	Per Heat /Per solution Annealed Lot	HT chart on TC	p	R	R
1f	All Castings	Radiography Examination	As per datasheet (if	Films and report	p	R	R

			applicable)				
1g	Bars for Trim Materials	Chemical Analysis	All Heats	Lab Reports	p	R	R
II	**Bought Finished and Sub Contract Items**						
2a	Stems, Gaskets, Gear Unit, Fastener, Gland , Packing etc.	Surface Defects	As per supplier sampling Plan	Inspection report	p	R	R
2b	-do-	Diamension	As per supplier sampling Plan	Inspection report	p	R	R
2c	Stems, Gaskets, Gear Unit, Fastener, Gland , Packing etc.	Physical and chemical properties	All heat Lot	Supplier's TC	p	R	R
III	**WPS/PQR/ WPQ**						
3a	Previous qualification for Overlay/Stelliting (body seat ring/wedge)	Thickness of overlay/ stelliting hardness	100% by supplier and PURCHASER / END CUSTOMER	WPS/PQR/WPQ	-	P	R
3b	New qualification for Overlay/Stelliting (body seat ring/wedge)	Thickness of overlay/ stelliting hardness	100% by supplier and PURCHASER / END CUSTOMER	WPS/PQR/WPQ	-	P	New H Old R
IV	Product Evaluation and Testing						
4a	Finished Valve	Shell Test Gate/Globe/Check Back Seat-Gate/Globe Seat Test-Gate/Globe/Check	100% by supplier and PURCHASER / END CUSTOMER as per specs	Test Report	-	P	H
4b	Finished	All Mandatory	100% by	Test Report	-	P	H

	Valve	Test or Supplementary Test, Helium Leak Test (Hydrogen Service)	supplier and PURCHASER / END CUSTOMER (Helium Leak Test) as per specs				
4c	-Do-	Functional/Operational Test (For motor Operated /Actuator Operated)	100% by supplier and PURCHASER / END CUSTOMER as per specs	Test Report	-	P	H
V	Final Inspection						
5a	Finished Valve (Body, Bonnet,Stem)	PMI Check	100% by supplier and 10% by PURCHASER / END CUSTOMER		_	P	H
5b	Finished Valve (Body, Bonnet,Stem)	Visual (TC Verification,Sl no Marking, Flange Finish, Tag no) Bevel, Diamension and Special Requirements in PR, Painting of Carbon and Low alloy Steel and provision of bypass arrangement (if applicable)	- Visual 100% by Supplier and PURCHASER / END CUSTOMER. Diamension-100% by supplier and at random by PURCHASER / END CUSTOMER subject to a minimum of 10 %	Inspection Report	-	P	W
VI	Strip Check , Differential Hardness as applicable	Verify component	1 valve per Type/size and order.	Inspection report	-	P	H
VII	Pre qualification Test	Fire safe test (soft seated ball,plug, butterfly and lubricated plug valves) cryogenic test	1 valve per Type/size and order	Acceptance report	-	P	New H Old R
VIII	Packing	-	-	Inspection report	-	P	R
IX	Documentation	Verification of TCs & Compilation of Inspection report	100% by supplier and 100% PURCHASER /	MTC, Inspection release notes	-	P	H

			END CUSTOMER				

13.4.3. Inspection and Test Requirements for Forged, Seamless and Welded Fittings.

Sl no	Stage/Activity	Characteristics	Quantum of check	Format of Record	Scope of Inspection		
					1	2	3
1.	Review of Procedures (Manufacturing/HT/NDT/DT/WPS/PQR/WPQ)	Adequacy of available procedures to comply with available PR/specs	100% by supplier & PURCHASER / END CUSTOMER	Supplier's in-house Documents	-	H	R/W
2	Raw material Identification (billets, rounds, Pipes, Coil, Plates, etc.)	Marking Co-relation with TC, Dimensional/Thickness adequacy(as applicable)	100% by supplier & PURCHASER / END CUSTOMER	Mill Test Certificate, Supplier Inspection report		H	H
2.1	Check Testing of Raw material, If original Mill TC is not available.	Verification of Mill TC	100% by supplier & PURCHASER / END CUSTOMER	Mill Test Certificate, Supplier Inspection report		H	H
3	Forming and HT	Forming Temperatures and procedures	100% by supplier	Supplier's Procedures records	-	H	-
4	Sampling of Test Coupons	Heat/HT Lot size, Location, Orientation, No of Test Coupons	100% by supplier & PURCHASER / END CUSTOMER	Sampling Inspection Report	-	H	H
5	NDT Examination	Approved procedure	100% by supplier & PURCHASER / END CUSTOMER , RT,Others 10%	NDT Inspection Report	R	W	R&W
6	Selected Coupons Testing	Physical/chemical/corrosion/service/properties	100% by supplier & PURCHASER / END CUSTOMER	Test Records	R	H	H
7	Cleaning and Finishing	Blast Cleaning,Galvanising,Pickling?p	100% by supplier & Random	Inspection Report	R	H	R or W

		assivation, Supplier's standard etc.	by PURCHASER / END CUSTOMER				
8	Final Inspection	Size ,Thickness/schedule, dimension, surface quality, marking, color coding etc.	100% by supplier & Random by PURCHASER / END CUSTOMER -10 % min	Inspection Report	-	H	H
9	Positive Material Identification (Final Inspected Fittings)	Compliance with Stipulated Material	100% by supplier & Random by PURCHASER / END CUSTOMER -10 % min	PMI Report	-	H	H
10	Final Release and Certification	Final Stamping, Issue of Inspection certificate	100% by supplier & PURCHASER / END CUSTOMER	Final offer list	-	H	H
11	Packing and dispatch	Protective coating/type of packing/end protection etc.	100% by supplier & Random by PURCHASER / END CUSTOMER	Supplier records	-	H	-
12	Documentation	Verification of TCs and compilation of Inspection reports	100% by supplier & 100% by PURCHASER / END CUSTOMER	MTC, Inspection Release Notes	-	H	H

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

Sl no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming Material	Heat no, mill Test Certificate, Chemical	100%	Mill TC/Lab report	-	W	R

		Composition & Other Applicable Test					
2	Heat Treatment as applicable	Cycle(Time Temp)	100%	HT Chart	-	W	R
3	Identification of Heat Treated forging & selection of Test Coupons	Selected of Test Coupons	Each HT Lot/Each heat no/size	Forging Identification Report	-	H	H
4	Testing (Including special Test for H2 service, NACE)	Tensile , hardness, impact, inter granular corrosion, Test, Product chemical analysis (as applicable) , groove hardness	Each HTLot/Each heat no/size	Lab report	-	H	H
5a	Manufacture, welding	Approved WPS/PQR/WPQ	100%	WPS/PQR/ WPQ	-	P	R
5b	Manufacture, welding	New WPS/PQR/WPQ	100%	WPS/PQR/ WPQ	-	P	W
6	NDT (if applicable)	Ultrasonic, magnetic, Dye penetration Test (if applicable)	100% by supplier, random by PURCHASER / END CUSTOMER	Test report		W	RW
7	Galvanizing (if applicable)	Coating thickness, Embrottlement Adherence	100%	Inspection report, Lab report		W	R
8	Final inspection	PMI check	100% by supplier, random by PURCHASER / END CUSTOMER	Inspection report	-	W	W
9	Final	PMI check	100% by	PMI report	-	W	RW

	Inspection		supplier random by PURCHASER / END CUSTOMER				
10	Packing and Despatch	Verification of surface coatings/ type of packing	100% by supplier	Shipping documents	-	W	R

13.4.5. INSPECTION AND TEST REQUIREMENTS OF BOLTING MATERIAL

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

			R				
6	Destructive Testing	Mechanical properties	Each HT Lot/Each Heat no size	Lab Report	-	H	H
7	Galvanising (if applicable)	Thickness, Embrittlement , Adherence , Finish and Appearance	As listed in A 153	Inspection/Lab Report	-	W	R
8	Final Inspection	Visual Marking,color coding , dimension	100 % by supplier, at random by PURCHASER / END CUSTOMER	Inspection Report	-	H	H
9	Final Inspection	PMI check		PMI Report	-	W	RW

13.4.6. INSPECTION AND TEST REQUIREMENTS OF GASKETS

Sl no	Stage/ Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	CAF Gaskets						
1.1	Raw Material Inspection	Physical	100% by supplier	Manufacturer's TC	W	R	-
1.2	In process inspection (Punching & Finishings)	Identification, Verification	100% by supplier	Inspection Report	-	W	-
1.3	Final Inspection	Identification, Verification	100% by supplier , at random by PURCHASER / END CUSTOMER	Inspection Report	-	W	W
2	Spiral Wound						
2.1	Raw Material Inspection	Physical, chemical , visual, dimensional	100% by supplier	Manufacturer's TC , check Test Report	-	W& R	R
2.2	Testing	Compressibility, recovery, sealability	Lot of every sizing/rating	Inspection Report	-	P	W
2.3	Final	Identification,	100% by	Inspection	-	W	W

	Inspection	Verification	supplier , at random by PURCHASER / END CUSTOMER	Report			
3	RTJ Gasket						
3.1	Raw Material Inspection	Physical, chemical , visual, dimensional	100% by supplier	Manufacturer's TC , check Test Report	W	R	R
3.2	Final Inspection	Identification, Verification, visual dimension, hardness	100% by supplier , at random by PURCHASER / END CUSTOMER	TC , Inspection Report	-	W	W
3.3	PMI non CS	Compliance with stipulated material	100% by supplier , at random by PURCHASER / END CUSTOMER	PMI Report	-	P	W
4	Jacketed Gasket						
4.1	Raw Material Inspection	Physical, chemical , visual, dimensional	100% by supplier	Manufacturer's TC , check Test Report	-	W	R
4.2	Final Inspection	Identification, Verification,	100% by supplier , at random by PURCHASER / END CUSTOMER	Inspection Report	-	W	W
5	Packing and Despatch	Separate container marked with size, rating, material, spec , item code	100% by supplier	Supplier records	-	P	-

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13.4.7. INSPECTION AND TEST REQUIREMENTS OF **STRAINER**

Sl no	Stage/Activity	Characteristics	Quantum of check	Format of Record	Scope of Inspection		
					1	2	3
A1	Incoming Material (Tees, Castings, Forgings etc..)	Chemical and mechanical properties	All Heats	Test certificates	W	R/W	R
A2	Incoming Material (Tees, Castings, Forgings etc..)	Dimension	As per supplier sampling plan	Report	W	W	R
A3	Incoming Material (wire mesh)	Chemical	Each lot	Lab record	W	R	R
B1	WPS/PQR/ WPQ new qualifications	Visual, radiography, tensile, bend etc..	100% by supplier and PURCHASER / END CUSTOMER	WPS/PQR/ WPQ	-	R	W
B2	Existing WPS/PQR/ WPQ	Visual, radiography, tensile, bend etc..	100% by supplier and PURCHASER / END CUSTOMER	WPS/PQR/ WPQ	-	R	R
B3	Welding	Visual and dimensional	100%	Report	-	W	R
B4	Welding	Weld soundness (RT)	100%	Radiograph	-	R	R
B5	Heat Treatment	PWHT	100%	HT Chart	-	W	R
C1	Product evaluation and Testing	Leak tightness of body	100%	Test report	-	H	H
C2	Final inspection	PMI check	100% by supplier, 10% by PURCHASER / END CUSTOMER	Test report	-	W	W
C3	Final inspection	Visual, dimensional , Marking	100% by supplier, 10% by PURCHASER / END CUSTOME	Dimensional report	-	W	W

			R				
C4	Final inspection	Painting/Picklin g, Marking , color coding, & passivation for stainless steel components	100%	Painting Report	-	W	R
C5	Packing	-	At random	-	-	W	R
C6	Documentat ion	MTC/Check Testing Reports/Hydro Test/HT Charts/dimensi on report/painting report/inspecti on release note	100%	TC or TPIA Inspection release note	-	H	H

13.4.8. Inspection and Test Requirements of FLAMEPROOF CONTROL STATION

Sl no	Stage/Activit y	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming Material (casting, Terminal , glass , ammeter ,voltmeter switch etc.)	Physical chemical properties. material certificate, accuracy , make etc..	Same as per supplier' s standard	Supplier' s test record	W	W/R	-
2	Flameproof enclosure without components	Routine pressure test	100% by supplier	Supplier' s test record	-	P	R*
3	Flameproof control station	Acceptance Test:- • Visual • Dimensional , thread • Workmanship • Gaps, Flame path, clearances, • Paint shade • Marking on each piece for suitability to area classification, Tag no etc.. • Terminal size • Compatibility of cable Glands with cable size/entry • Electrical operation	100% by supplier and random samples by PURCHA SER / END CUSTOM ER	Inspectio n witness test records	-	P	H/ W

		Test & BOM • Isolation arrangement of 2 boxes connected together • High voltage test • IR test before and after high voltage					
4	Submission of certificates:-	• Certificate of statutory testing agency for suitability of area classification • Certificate of statutory approval authority like CCOE/PESO as applicable • Valid BIS license as applicable • Degree of protection certificate as applicable	Each module	Certificates from statutory bodies	-	R	R
5	Flameproof control station	Internal test reports for all items	100%	Supplier's test records	-	-	R

* Pressure Test may be witnessed by PURCHASER / END CUSTOMER on one or two samples of enclosures during final acceptance stage after removing internal components

13.4.9. Inspection and Test Requirements of Flame Retardant Type PVC sheathed cables for use Fire Alarm systems

Sl no	Stage/ Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming Material like copper, Al, PVC,PE, Jelly compound,Armour Material etc.	Dimensional , purity,physical, chemical properties, test on jelly compound as per DOT spec	Sample	Sub Supplier TC/ Supplier's test record / Third party Lab	P	P/R	-
2	Manufacturing Stage	Dimensions at various stages, spark test, stage inspection	100%	Supplier's test record	-	P	-
3	Final inspection on completed cables	Visual, drum details, size, end cappings, drum condition, marking on outer sheath, (incremental	100% for drum details and sample	Inspection witness test records	-	P	W

		length, voltage grade, manfr's name ,) color coding of cores etc.	drum for balance details				
4	Final inspection on completed cables (Non jelly filled cables)	Acceptance Test:- • Dimension • Insulation and sheath • Continuity of conductors , absence of crossed pairs and absence of contact with Poly-al Tape • Continuity in poly-al tape • Color coding • Conductor resistance, resistance unbalance in pair • Mutual capacitance • Cross talk • Dielectric strength • Insulation resistance/volume resistivity • Tensile and elongation • Conductor annealing • Armour galvanization • Test on insulation and sheath as per IS5831	As per sampling Plan	Inspection witness records	-	P	W
5	Final inspection on completed cables (Non jelly filled cables)	Special Test:- • Oxygen index test • Flammability test as per IS 10810 • Test for Rodent and termite repultion • Surface finish and drum lemgth checking by	1 sample per lot				

		wiring •					
6	Final inspection on completed cables (Non jelly filled cables)	Type Test:- • Type test on conductor as per spec • Type test on insulation and sheath as per spec	Sample	Supplier's Test record			
7	Final inspection on completed cables (jelly filled cables)	Acceptance Test:- • Dimension • Insulation and sheath • Continuity of conductors , absence of crossed pairs and absence of contact with Poly-al Tape • Continuity in poly-al tape • Color coding • Conductor resistance, resistance unbalance in pair • Mutual capacitance • Cross talk • Dielectric strength • Insulation resistance/volume resistivity • Tensile and elongation • Conductor annealing • Armour galvanization • Attenuation • Drip Test	As per sampling Plan	Inspection witness records	-	P	w
8	Final inspection on completed cables (jelly filled cables)	Type Test:- • Type test on Insulated conductor as per DOT spec • Type test on composite sheath and jacket as per DOT spec	Sample	Supplier's test record	-	P	R

		• Oxidation Induction Test • Water penetration test • Cable bend test					

* Pressure Test may be witnessed by PURCHASER / END CUSTOMER on one or two samples of enclosures during final acceptance stage after removing internal components

13.4.10. Inspection and Test Requirements for Restriction Orifice Plates and Multistage Orifice Assemblies

Sl no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming Material	Material Identification, chemical and Mechanical Properties	100 %	MTC/Test Lab Certificates	P	W/R/H *	R
2	Machining Plates	Dimension, smoothness verification	100 %	Supplier's Test Records	-	P	-
3a	Final Inspection	• Certificate of Radiography/ X-Ray for any welded joint and any casting of 600# and above • Hydrostatic test for complete multistage restriction orifice assembly • Dimensional test	100% by supplier	Supplier's record	-	P	R
3b	Final Inspection	• Orifice smoothness verification • Correctness of punching • Physical dimensional verification • Liquid penetrant check for all welds • Hydro test of complete multistage Restriction Orifice assembly	100% by supplier , at random by Purchaser / End Customer	Supplier's Inspection witness Record	-	P	W, H
		• IBR (if applicable)	100%	IBR stamp	-	W	R

				and certificate			
4	Submission of certificates:-	• Material test certificates • Traceability of records	100%	Supplier record	-	P	R
5	Packing and Painting	• Visual	100%	Packing List	-	W	-

13.4.11. Inspection and Test Requirements for PRESSURE SWITCHES

Sl no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming Material Like pressure sensors, flanges, housings, capillary, switches etc.	Material Identification, chemical and Mechanical Properties , switch rating	100 %	MTC/Test Lab Certificates	P	P	R/ W*
2	Machining of components	Dimension, visual	100 %	Supplier's Test Records	-	P	-
3a	Final Inspection	• Visual • Correctness of Tag plate • Physical dimensional verification	100%	Inspection witness record	-	P	W
3b	Final Inspection	• Performance test including set point calibration, repeatability, switch differential and over range • I.R. test on switch assembly	100% by supplier , at random by Purchaser / End Customer	Inspection witness record	-	P	W
		• IBR (if applicable)	100%	IBR stamp and certificate	-	W	R
4	Submission of certificates:-	• Certificate of statutory approval authority like CCOE/PESO as applicable • Degree of protection certificate as	100%	Supplier record	-	P	R

		applicable • Type test report from testing agency like CIMFR,ERTL, ERDA,ATEX, BASEEFA . FM/UL, PTB etc, if asked					
5	Packing and Painting	• Visual , PACKING List	100%	SUPPLIER 'S Test record	-	P	-

13.4.12. INSPECTION AND TEST REQUIREMENTS FOR PRESSURE RELIEF VALVES

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

	Inspection	• Hydrostatic test • Cold bench set pressure • Seat leakage test • Valve lift test • Blow down/Relosing pressure test	supplier , at random by Purchaser / End Customer	s Test record/Inspection witness record			
		• IBR (if applicable)	100%	IBR stamp and certificate	-	W	R
4 c		• Post weld heat treatment/Radiography/Magnetic particle Testing og weld joints	100%	PWHT reports/ Radiography Reports/ MPI Reports	-	P/R	R
4d		• Capacity test as per ASME	Sample	Type test reports	-	R	R
5	Packing and Painting	• Visual check on completely assembled valves and accessories • Special cleaning and packing for O2 and Cl service • Suitable protection to prevent entry of foreign material	100%	Packing List/supplier's record	-	P	-

13.4.13. INSPECTION AND TEST REQUIREMENTS FOR SOLENOID VALVES.

Sl no	**Stage/ Activity**	**Characteristics**	**Quantum of check**	**Record**	**Scope of Inspection**		
					1	**2**	**3**
1	Incoming Material Like body, conductor material etc.	• Mechanical identification, conductor resistance and insulation of conductors	100 %	MTC/Test Lab Certificates	P	W/R	R
2	Solenoid valve	Visual, dimensional, connection size	100%	Supplier's Test record	-	P	-
3	Final Inspection	• Visual and Dimensional check • HV Test • Seat leakage test by	100%	Inspection witness record	-	P	W

		air/N2 • Correctness of Tag plate • Verification of required accessories • Connection size • Insulation resistance Test • Pneumatic Test by Air/N2 • Operational test including verification of pickup and drop voltage					
4	Submission of certificates:-	• Certificate of statutory approval authority like CCOE/PESO for use in electrically hazardous area. • Degree of protection certificate as applicable • Type test report from testing agency like CIMFR, BASEEFA . FM/UL, PTB etc, for suitability in specified Hazardous area • Valid BIS license for indigenous supply. • Material test report for body and trim. • Traceability of records	Prototype for each module	Statutory approval certificates/ Type Test certificate	-	R	R
5	Packing and Painting	• Visual • Proper packing to prevent any damage during transportation • Suitable protection to prevent entry of foreign material	100%	Packing List/supplier's record	-	W	-

13.4.14. INSPECTION AND TEST REQUIREMENTS FOR JUNCTION BOXES AND CABLE GLANDS.

Sl no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming Material	• Mechanical identification,	100 %	Material Test	P	W/R	R

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	Like CASTINGS, Terminal etc.	pressure test on castings for hazardous area junction boxes		Certificates /Test Lab Certificates			
2	Machining of components	Visual, dimensional,	100%	Supplier's Test record	-	P	-
3a	Final Inspection	• Visual, Dimensional clearance & Paint shade check for all items • HV and insulation resistance Test • Air leakage test report on pneumatic JBs • Bill of material verification • Warning plate for junction boxes and marking on cable glands, adapters plugs etc. • Pressure test on castings for flame proof junction boxes.	100%	Inspection witness record	-	P	W
3b	Final Inspection	• Physical dimensional verification and workmanship • HV and insulation resistanceTest • Air leakage test report on pneumatic JBs	100 % by supplier and and on sample basis by PURCHASER / END CUSTOMER	Supplier's test record and inspection witness report	-	P	W, H
4	Submission of certificates: -	• Certificate of statutory approval authority like CCOE/PESO for use in electrically hazardous area. • Degree of protection certificate for instrument housing • Type test report from testing agency like CIMFR, BASEEFA. FM/UL, ATEX, PTB etc, for suitability in	Prototype for each module	Statutory approval certificates/ Type Test certificate	-	R	R

		specified Hazardous area • Traceability of records					
5	Packing and Painting	• Visual • Suitable protection to prevent entry of foreign material	100%	Packing List/supplier's record	-	W	-

13.4.15. INSPECTION AND TEST REQUIREMENTS FOR LOCAL CONTROL PANEL AND ACCESSORIES (ELECTRONIC/PNEUMATIC).

Sl no	Stage/Activity	Characteristics	Quantum of check	Record	Scope of Inspection		
					1	2	3
1	Incoming steel sheet for panel fabrication	• Surface finish, dimensions, chemical treatment	100 %	Material Test Certificates /Test Lab Certificates	P	W/R	R
2	Boughtout components like indicators, relays, controllers, annunciators, lamps, recorder. Switches, push buttons, zener barriers, Isolators, Power supplies , pressure indicator, pressure switch etc.	Make , model no, calibration test certificate	100%	Material Test Certificates /Test Lab Certificates	-	P/R	R
3a	Final Inspection	• Dimensional test report • HV and insulation resistanceTest • Calibration test report • Performance test report including wiring scheme checks,	100% by supplier	Supplier's record	-	P	R

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

		ferruling & continuity check • Wiring scheme check & functional check of instruments and accessories. • For pressurized panels, required volume change & pressurization check.					
4	Submission of certificates: -	• Certificate of statutory approval authority like CCOE/PESO for use in electrically hazardous area. • Degree of protection certificate for instrument housing • Type test report from testing agency like CIMFR, BASEEFA . FM/UL, PTB etc, for suitability in specified Hazardous area . • BIS approval for instruments manufactured indigenously for use in specified hazardous area • Traceability of records	100 % by supplier and and on random basis by PURCHASER / END CUSTOMER	Statutory approval certificates/ Type Test certificate	-	R	R
5	Packing and Painting	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation	100%	Packing List/supplier's record	-	W	-

Legends:

CCE or CCOE- Chief Controller of Explosives, DT-Destructive Test, DP or DPT-Dye Penetration Test, HT-Heat Treatment, H-hold(Do not proceed without approval) ID- Inside Diameter, PMI- Positive Material Identification, IBR-Indian Boiler regulation, ITP- Inspection and Test Plan, M- Monitor, NDT Non Destructive Testing, P-Perform, PO-Purchase Order, PR- Purchase Requisition, PQR-Procedure Qualification Record, QAP- Quality Assurance Plan, Random-10% (min 1 no) of each size and type of bulk item, R-review, RT-Radiography Testing, RW-Random Witness, TC-Testing Certificate, TPIor TPIA-Third party Inspection Agency, VDR- Vendor data Requirement, WPS-Welding Procedure Specification, WPQ- Welder's Performance

Qualification, W- Witness (Give due notice, work may proceed after schedule date). MT or MPT- Magnetic particle Test, MTC-Manufacturer Test Certificate , UT –Ultrasonic Test, VDR-Vendor Data Requirement,1: Sub- Supplier, 2: Bidder ,3: Purchaser / End Customer

NOTES:

19 The above guidelines are the minimum requirements. ITP shall be developed by bidder based on this specification requirements / codes and statutory requirements and shall be submitted to Purchaser for approval during detail engineering stage.

20 Bidder at no point of time shall be eligible to raise any extra claim on account of any requirement necessitated as a part of approval of QAPs/ ITPs.

13.5. **INSPECTION**

13.5.1. Bidder, to ensure that the equipment and material supplied, meet all the specifications laid down in the contract

13.5.2. In case bidder find any deviation or non- conformity with respect to the agreed specifications, during manufacturing of the item and where corrective action is not feasible, the bidder shall report the same to Purchaser and / or in the designated "Waiver / Deviation Request" format and seek prior approval from Purchaser / before proceeding with the job.

13.5.3. Bidder shall notify in writing to the Purchase, at least two weeks (Ten working days) in advance of the date and the place at which the items will be ready for witnessing of inspection / testing by Purchaser and / or In case any postponement becomes necessary, the CONTRACTOR shall provide written notification at least 48 hours prior to the original scheduled date.

13.5.4. Bidder after satisfying that all inspection requirements as per approved ITP and applicable specifications / documents have been taken care by TPIA, shall submit copy of the Inspection Certificate and all Quality control records to Purchaser in requisite copies along with Statutory Certificates if any, such as IBR, CCE etc. duly endorsed by their Quality Control Manager.

13.5.5. The bidder shall ensure that all items covered by IBR/CCE regulations are inspected at the manufacturer's works and duly certified by competent authority.

13.5.6. Purchaser and / or – End customer reserve the right to carry out surprise checks on all material either at manufacturer's works or at site. In case of any rejection at site, the whole lot will be rejected and bidder shall get the entire lot replaced without any time or delivery implication to the purchaser.

13.5.7. TPIA shall check the calibration status and traceability of all instruments used by the supplier, for testing. In case, TPIA uses their own instruments for testing purposes, similar certification shall be ensured.

13.5.8. Dimensional check up to a minimum of 10% should be done for all pipes and fittings at supplier's shop and witnessed by TPIA. Additionally 1% dimensional check will be carried out at site by the bidder and witnessed by Purchaser /.

13.5.9. In case any non-conformity is noticed, 100% of the lot shall be checked by TPIA and all non-conforming material shall be replaced by the bidder.

13.6. **INSPECTION CERTIFICATE**

13.6.1. TPIA shall issue an Inspection Certificate after satisfactory completion of all required 'H', 'W', & 'R' stages of Inspection by all parties concerned as per approved ITP and after ensuring compliance to specified requirements of all relevant applicable documents. The Inspection Certificate shall give reference of the approved documents including ITP referred for inspection and tests carried out and short supplies, if any.

13.6.2. Bidder shall submit , copy of each Inspection Certificate (IC) / Inspection Release Note (IRN) issued by TPIA, along with all attachments mentioned therein.

The IC / IRN shall include the following as minimum:

a. Job No. / Project Title / PO. No. / Purchase Specification No., Date of inspection and
b. Status of the visit - Initial / Intermediate / Final.
c. Item Tag No. / Name / Total quantity ordered / released / offered for inspection and accepted during the visit.
d. Manufacturer's Name
e. Date & Place of Inspection, name of Inspection Agency and Inspection Authority.
f. Reference of Documents with Revision status.(It shall be clearly indicated in the inspection certificate that "inspection has been carried out based on code 1 drawings and approved ITP".)
g. Verification of calibration documents.
h. Details of Inspection carried out.
    i. Works Certificate with details of Hydrostatic Test and PMI / Leak Tests (if applicable) for Fabricated equipment
    ii. Works Certificate with details of Performance Test, Mechanical Run Test (if specified in PR) and String Test (if applicable) for Rotating Equipment
    iii. Works Certificate with details of acceptance tests witnessed and Certificate of statutory approvals if applicable, for electrical items
    iv. Works Certificate with details of calibration, and Certificates of statutory approvals if applicable, for instruments.
    v. Works Certificate with details of Mechanical tests, PMI and Helium Leak tests if applicable, for all bulk items such as pipes, valves, fittings, fasteners and gaskets.
    vi. Works Certificate accompanied with details of basis for acceptance, for all other items

i. Results of Inspection.
j. Deviations, if any.

13.7. **INSPECTION AGENCY:**

Purchaser / Third Party appointed by purchaser / appointed third party / End Customer / End Customer appointed third party.

The inspection agency shall be indicated in the quality plan and shall be as per the approved quality plan.

13.8. **GUARANTEE:**

The Bidder shall guarantee the performance of the FPS throughout the year.
After completion of the installation, the system shall be balanced and necessary adjustments shall be carried out for all equipment until all guaranteed performance requirements are satisfied.
All instruments and services required for the above tests shall be provided by the bidder.
All the instruments installed and required for conducting acceptance test shall be only calibrated instruments

14. MARKING , PACKING AND DESPATCH

14.1. MARKING

14.1.1. All items shall be marked (stamped/etched) in accordance with the applicable code/standard/specification. In addition, the item code, if available, shall also be marked.

14.1.2. For ease of identification, the color of painted strip (wherever required) shall be as per the applicable standard.

14.1.3. Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinarily or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.

14.2. DESPATCH

14.2.1. All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to the finish. Crates/cases shall have skid bottom for handling.

14.2.2. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchaser order.

14.2.3. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.

14.3. The following minimum packing procedures shall be followed :

14.3.1. All items shall be dry, clean and free from moisture, dirt and loose foreign material of all kinds.

14.3.2. All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.

14.3.3. Rust preventive on machined surfaces to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent.

14.3.4. Ends shall be suitably protected, and the protectors shall be securely and tightly attached.

14.3.5. Each variety and size of item shall be supplied in separate packaging marked with the purchase order no., item code (if available), and the salient specifications.

14.3.6. Carbon steel, LTCS and low alloy steel valves shall be painted with one coat of inorganic zinc silicate primer.

14.3.7. Prior to shipment components of the unit shall be completely cleaned, Flange faces and other machined surfaces shall be protected by coating with easily removable rust preventive. All the equipments shall be properly packed to prevent damage during transit damage, loading, unloading and storage.

14.3.8. All electrical, instrumentation etc, shall be properly packed to prevent damage during transit due to vibration, physical contact, moisture ingress, rainwater and pilferage.

14.3.9. All the items which the Bidders considered liable to be damaged during shipment or storage, shall be packaged for separate shipment. If instruments are removed from the panel, they and their connection shall be suitably tagged to ensure simple re installation at the job site. Each instrument shall be sealed in plastic bags containing moisture absorbing dessicants.

14.3.10. It shall be bidder's sole responsibility to protect all the material during period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and including delays in transit. Bidder shall be responsible for any damage to equipment/material due to above reasons.

14.3.11. Spare parts shall be packaged separately and clearly marked as 'Spare Parts'

15. DOCUMENTATION:

15.1. MASTER DOCUMENT LIST

15.1.1. A master documentation shall be prepared during kick off meeting identifying all the DOCUMENTS / DRAWINGS to be submitted by the bidder as part of documentation.

15.1.2. Bidder shall ensure submission of all documentation as per approved Master Document List.

15.1.3. Bidder to note that the dates of submission of all the documents shall be finalized by him considering the time required for approval of various documents at Purchaser's end. It shall be solely bidder's responsibility to get approval on the entire document from purchaser to meet project schedule.

15.2. DRAWING APPROVAL / REVIEW CATEGORY:

15.2.1. The master document list shall clearly identify the class of review to be performed against each document.

15.2.2. Following classes of review shall be followed for all the documents engineered by the bidder

- APPROVAL (A)
  Approval is mandatory and bidder cannot proceed without obtaining Purchaser's approval.

- INFORMATION / RECORDS (I)
  This type of documents shall be submitted to Purchaser for his information. Bidder can proceed if Purchaser's comments are not received within 14 working days of receipt in Purchaser's office.
  However, if any deviation to contract specification for any design deficiency is detected in the course of review after stipulated period, it shall be the responsibility of the bidder to see that such deviations and deficiencies are corrected to ensure compliance to contract without any cost and time implication to purchaser

15.3. DRAWINGS REVIEW AND APPROVALS

15.3.1. Bidder to understand that efficient handling of drawings and documents to be prepared by him under the contract is the key to the timely completion of the FPS system. By accepting the contract the bidder undertakes to ensure that all drawings and documents to be submitted by him to the Purchaser / End Customer shall be of professional quality and conforming to the contractual requirements.

15.3.2. Bidder to note that the dates of submission of all the documents shall be finalized by him considering the time required for approval of various documents at Purchaser's end. It shall be solely bidder's responsibility to get approval on the entire document from purchaser to meet project schedule.

15.3.3. Computer aided design and drafting shall only be used except in exceptional cases where manual drafting may be resorted to, if unavoidable.

15.3.4. All the dimensions should be in metric units.

15.3.5. Each drawing submitted by the bidder shall be clearly marked with the name of the Owner, the unit designation, the specifications, title, the specification number and the name of the Project with revision No. and date. If standards, catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English.

15.3.6. All documents before forwarding to Purchaser will have to be vetted in detail by bidder. Document received without vetting will be returned without review. Also any inaccuracies/mistakes found will not only be rectified by the bidder but the bidder shall remain liable for bearing charges towards efforts spent by Purchaser for discussing the same. Delay owing to these shall be to the account of bidder

15.3.7. The bidder shall thoroughly review and approve all sub-vendor documents, before forwarding to Purchaser

15.3.8. Only the approved drawings duly stamped and signed by a competent engineer of bidder shall be submitted to purchaser for review.

15.3.9. Documents submitted without meeting pre-requisite requirements will be returned without review.

15.3.10. Review of drawings and documents issued by bidder shall be carried out by Purchaser /End customer.

15.3.11. Approval/ review of the drawings/ documents by the Purchaser /End customer would be only limited to the review of compatibility with basic designs and concepts.

15.3.12. The approval and /or review by the Purchaser /End customer shall not be construed by the bidder as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

15.3.13. The sole responsibility of the correctness of Design, Engineering & supervision of erection and commissioning shall lie with the bidder, irrespective of the fact that the Drawings / Documents submitted are reviewed or not by the Purchaser /End customer.

15.3.14. The bidder shall correct all faulty designs & supervision of erection and commissioning detected at any stage of work (irrespective of the fact whether drawings related to such faulty designs & or constructions are approved by purchaser), without any cost and time implication to the Purchaser.

15.3.15. The Bidder shall be responsible for and shall pay for any alterations of the Work to be accrued out by other agencies due to any discrepancies, errors or omissions in the Drawings or other Particulars supplied by him whether such

drawings or particulars have been approved by the BHEL/ End customer or not.

15.3.16. Revisions in drawings/documents shall be clearly marked within clouds. No revision without clouding shall be recognized and the same shall not be considered reviewed and approved. All revised drawings / documents shall be associated with comments compliance report,

15.3.17. Normally all drawings / documents shall be reviewed by the purchaser with 14 working days of receipt of drawing at Purchaser's end. 14 days shall be reckoned from the date of receiving the hard copies of the documents at purchaser's center.

15.3.18. However, for all documents where multi-disciplinary activity is involved, the bidder, after submission for Purchaser's review, shall in his own interest, visit Purchaser's office for discussion for expeditious review of documents.

15.3.19. In absence of visit of bidder's engineering team at Purchaser's office approval/review time shall be 15 working days.

15.4. **ENGINEERING COMPLETION:**

15.4.1. The Engineering shall be considered as completed after the following activities are finished:

- Final approval of all the Drawings / Documents which are in 'Approval' Category as per Master Document List (MDL)
- After successful review of drawings/documents which are in 'Information' Category as per Master Document List (MDL)
- Final approval of detailed Bill of Quantity (BOQ).

15.5. **ERECTION & COMMISSIONING DOCUMENTATION:**

15.5.1. **ERECTION DOCUMENTATION:**

15.5.1.1 Erection document List shall be prepared during Engineering review meeting (after award of contract) identifying all the DOCUMENTS / DRAWINGS required for completion of Erection activities of the complete system, to be submitted by the bidder as part of documentation.

15.5.1.2 The Bidder shall submit for Purchaser's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following :

- Instructions for packing, shipping, receiving, handling, ware-housing and storage.
- Part number/Dispatch link-up of all the equipments/items supplied and also their co-relation with system/drawing/approved BOQ.
- Instructions for location and installation of equipment furnished by this specification.
- Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.
- Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.
- Check lists and quality assurance hold points.
- Formats for all related documentation.
- The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.
- The Bidder shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg.

15.5.1.3 Erection Manuals

The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

- Erection strategy.
- Sequence of erection.
- Erection instructions.
- Critical checks and permissible deviation/tolerances.
- List of tool, tackles, heavy equipments like cranes, dozers, etc.
- Bill of Materials
- Procedure for erection.
- General safety procedures to be followed during erection/installation.
- Procedure for initial checking after erection.
- Procedure for testing and acceptance norms.
- Procedure / Check list for pre-commissioning activities.
- Safety precautions to be followed in erection all equipments and electrical supply distribution during erection

15.5.2. **COMMISSIONING DOCUMENTATION:**

15.5.2.1 The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules,

commissioning schedules and commissioning networks for various Equipment / systems covered under the contract, for the approval of employer.

15.5.2.2 Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking.

15.5.2.3 The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system. Commissioning schedule is a document envisaged for commissioning of a system. The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is as per the following:

Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices.

Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting.

Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self contained one:

a) Plant Details/Design data
b) Testing Objective/Proposals
c) State of the Plant required prior to commissioning
    - Erection Status with respect to Mech. Elect and C&I
    - Services required
    - Safety requirements

d) Test method including completion/acceptance criteria
e) Results
f) Testing Programme
g) Mech/Elect/C&I –Plant item completing list
h) List of Drawing/documents required for carrying out the testing.

15.5.2.4 The contractor shall submit the list of commissioning documentation to be submitted by him, alongwith their submission schedule for various equipment/systems covered under the contract, with in 6(six) month from the date of award of contract, for the acceptance of employer.

15.5.2.5 The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least 12 months before the scheduled date of commissioning of the equipment/systems.

15.6. **FOLLOWING MAY BE NOTED WRT THE DRAWING SUBMISSION SCHEDULE:**

SL NO.	DESCRIPTION	NUMBER OF COPIES TO BE SUBMITTED	WHEN TO SUBMIT
1.	Initial drawings/documents under approval and information category.	4	As per approved Master document list
2.	Revised drawings/documents incorporating BHEL's comments.	4	Within 1 week of receipt of commented Drawings from BHEL
3.	Final Drawings/documents	17	Within 2 months of placement of order.
4.	Erection Documentation	8	1 Month before dispatch of equipment, The list of documents identified under master document list for erection to be furnished in 5 nos. of folders.
5.	Draft O & M Manuals with out test certificates	2	2 months before the delivery date of equipment
6.	Revised O & M Manuals with Test Certificates to be submitted to BHEL (Hyderabad)	17	Within one month after dispatch of equipment
7.	Final O&M Manuals in a CD	3	Within one month after dispatch of equipment

15.7. **DOCUMENT SUBMISSION PROCEDURE**

15.7.1. All Drawings/Datasheet/Design calculation etc. shall be submitted in soft as well as hard copy. Soft submission of all drawings/documents is mandatory.

15.7.2. All drawings/ shall be submitted in Autocad format & all documents in MS office/PDF

15.7.3. Bidder shall furnish all documents in A4 Size (210 mm x 297 mm) paper or folded in A4 size unless otherwise specified. All drawings and sketches shall be in multiples of A4 size like A3 (297 mm x 420 mm) or A2 (420 mm x 594 mm) etc., but folded to 'A4' size. Final documentation shall be submitted in bound volumes and softcopy shall be furnished in non - writable CD.

15.7.4. It has been observed that at times mails fails to deliver because of problem in sender's /receiver's server .Hence it is recommended that bidder shall intimate concerned BHEL personal about any soft copy submission over phone immediately after any drawing / document is submitted for BHEL's review / approval.

15.7.5. Hard copies of all the documents shall be forwarded to the following address:
Name: (Name will be intimated during detail engineering)
Address: Bharat Heavy Electrical Limited
New Engineering Building
PE&SD
RC Puram Hyderabad- 32

15.7.6. Date of receipt of hard copies shall be considered as date of submission of any document. Soft copy submission shall be considered as advance submission of drawing/document

15.7.7. BHEL's normal working hour is 7.00 AM to 3.15 PM from Monday to Saturday.

15.7.8. Bidder to ensure that all documents are received with in BHEL working hours. Any submission done after normal office hour/ weekly Off/Public Holidays shall be deemed as submitted on next working day.

15.7.9. BHEL shall furnish Approval/Observation of Drawings/Datasheet/Design calculation etc. on Soft Copy only.

15.8. **INPUT DRAWINGS**

15.8.1. On receipt of order, it shall be solely the bidder's responsibility to spell out the requirement of the base engineering drawings/documents required by him to go ahead with the engineering of the package, and shall not expect the Purchaser to automatically supply the same after order placement – the required base drawings/documents shall be furnished to the Bidder within reasonable period of receipt of such requisition from Bidder. Any ultimate delay arising out of the delay by the successful bidder in putting up such a requisition shall solely be to the bidder's account.

15.8.2. Drawings attached with this specification are preliminary in nature & are not exhaustive. These drawings may get revised and /or new drawings will be

furnished to bidder during detail engineering .Bidder to however note that they will not be eligible to raise any extra charges on account of this.

15.8.3. All relevant input drawings will be made available to the bidder during detail engineering stage as when they are revised or prepared.

15.8.4. Bidder to note that they shall not be eligible to raise any extra claim on account of furnishing of new drawings or revised drawings by purchaser during offer execution stage.

15.9. **REVIEW MEETINGS & KICK OFF MEETING:**

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

15.9.2. Bidder in his own interest may visit Purchaser's office to expedite the approval of critical drawings, which may affect the progress of project.

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

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

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

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

15.10. **The following minimum documentation shall be submitted by the vendor during detail engineering stage:**

a. Billing Breakup
b. P & ID of the Foam system

c. Equipment layout for Foam pump house
d. Foam protection system layout
e. List of equipments
f. All equipment GA drgs
g. All equipment data sheets
h. Foundation drawing for all the equipment supplied by the bidder
i. Civil interface details
j. Field alignment diagram
k. Piping specifications
l. Valve Material specification
m. Line schedule and line list
n. Foam system piping layout
o. Isometrics of all piping layouts. All isometrics shall have support markings and bill of materials
p. Piping support details
q. Control / annunciation panel drawings
r. Instrument data sheets with hook up drgs
s. Instrument Index
t. Instrument sizing calculation
u. Logic diagram
v. Instrument loop diagram
w. Instrument cable schedule.
x. Wiring drawing
y. Cable schedule
z. Utility list
aa. Motor load list
bb. Operation & Control philosophy
cc. Welding specification charts
dd. Nondestructive Testing specifications
ee. Shut down and start up sequence
ff. List of consumables
gg. Operation write up
hh. Quality plan
ii. Painting schedule & procedure (shop painting & site painting)
jj. Packing procedure
kk. Erection drawings
ll. Site storage procedure
mm. Erection procedure
nn. Testing procedure
oo. Pre commissioning procedure
pp. Commissioning procedure
qq. Field quality plan
rr. Supply quality plan

ss. List of major vendors along with Proven Track Record (wherever applicable)

tt. O & M Manuals

uu. Any other document, as deemed necessary by Purchaser, at any stage of contract execution.

15.11. **AS BUILT DRAWINGS**

15.11.1. As built drawings and documents will be generated within one month of completion of activities on respective items of work.

15.11.2. Bidder shall furnish reproducible and electronic files of all the drawings under their scope to Owner/ certified as "As Built Issue."

15.11.3. Upon completion of identifiable units or components of the fabrication, construction and installation phase of the project, the bidder will complete all the related plans to the "as built" stage including all Sub-Vendor drawings and furnish Purchaser with the following :

a. 6 complete sets of full size prints of the drawings and 4 sets of reduced size prints.

b. 6 complete bound sets of Manufacturer's specifications including design calculations.

c. As Built drawings generated specifically for this job in electronic media (AutoCAD 10 or above).

d. All vendor drawings & documents either in AutoCAD or in scanned images stored in electronic media.

e. 6 complete sets of all operating & maintenance instructions in electronic media or in scanned images converted in electronic media.

f. 6 complete sets in hard binders of the Manufacturer's data book including certified prints and data for all items including test reports. Data Book shall be complete with index as tag numbers associated with Manufacturer's data shown. Equipment data shall include as a minimum requirement the principal and description of operation, drawings and dimensions, spare parts lists and unpriced purchase orders and bill of materials.

g. 6 bound copies each of the Spare Parts data book and the Lubricants inventory schedule.

h. 6 complete sets of field records shall be signed by the CONTRACTOR'S and Owner's representatives at the site.

i. Original approvals and related drawings and documents from the statutory authority.

j. 3 Copies of correspondence with the statutory authorities.

15.12. Drawings/documents with following titles shall contain as a minimum the following Information:

15.12.1. Drawing and Document Schedule

This document lists out drawings and documents prepared and/or submitted by bidder to purchaser either during engineering or as a part of final documentation. This document shall be submitted as first document of submission for review after award of contract. Following information shall be available in this document:

a) Name , Category of approval and number of each drawing and document listed.

b) The schedule for the document submission considering the project schedule.

15.12.2. Utility Requirements

This document lists out the following information regarding utilities required by the bidder

a. List of utilities required i.e. Power (UPS, Non UPS), Instrument air, Cooling water, Steam for tracing, Nitrogen etc.
b. Location and estimated/actual requirement at each location. The requirement shall be listed as minimum/normal/maximum.
c. In case of AC power, the In-rush current with duration and power factor shall also be indicated for each location.

15.12.3. General Arrangement Drawing

A general arrangement drawing shall indicate:

a. Outline dimensions (minimum three views) (All principal dimensions).
b. Allowable forces and moments on suction and discharge nozzles.
c. Location (in all three planes), size, type, rating and identification of all purchaser's interface connections including those of vents, drains lubricating oil, sealing fluid, cooling water, steam & Electrical Instrumentation.
d. Direction of rotation viewing from the driving end.
e. Weight of each assembly/component.
f. The weight & location of center of gravity of the heaviest assembly/components that must be handled for erection.
g. Identification and weight, dimensions of the heaviest assembly / subassembly / component required to be handled for maintenance.
h. Maintenance clearances and dismantling clearances.
i. Speeds of Driven Equipment and driver and driver rating. Location of driver terminal box (in case of Electric Driver)
j. Layout of auxiliary equipment and operating platform.
k. Make, Type and Size of couplings and the location of guards and their coverage.
l. A list of reference drawings if any.

m. A list of any special weather-protection and climatic features.

15.12.4. Foundation Drawings

A foundation drawing shall indicate complete information required for foundation design by purchase including the following:

a. Foundation bolt sizes, pipe sleeve details, pocket sizes and locations and also distance between the first/ nearest anchor bolt and pump suction and discharge nozzle centerlines.
b. Grouting thickness and other necessary technical details.
c. Static weight of each skid/independently grouted item and location of center of gravity of each of such skid/items in all three planes.
d. Weight distribution for each bolt/sub sole plate location and total static weight.
e. Dynamic loading caused due to various items grouted independently.
f. The direction and magnitude of unbalance forces and moments generated by each such item at the worst operating condition and short circuit moments of motor drivers at the C.G. of the pump-motor base plate.
g. GD2 value of each item resolved to driver speed.
h. Maximum permissible amplitude of vibration on the foundation at base level.
i. Total mass of rotating parts.
j. Total mass of reciprocating parts.
k. Suggested dynamic factor and ratio of foundation weight to weight of skid/equipment as per vendor experience.

15.12.5. Layout Drawing

This drawing shall include at least the following:

a. Layout of all skid/equipment and their auxiliaries, vessels, control panels, exchangers etc. Vendor shall furnish an optimized layout (considering the space allocated, site wind conditions, area classification, the type of equipment located in the vicinity etc.) indicating elevation and dimension of skids/equipment.
b. Minimum spacing required between the various skids/equipment and between the skids and the walls/columns/roof for an easy accessibility and maintenance.
c. Recommended Horizontal clearances:
Equipment spacing

- Small pumps (3.7 kw & less) : Mounted on common foundations with suitable centre to centre distance.
- Medium pumps (22.5 kw & less) : 900 mm clear aisle

d. Layout for water piping, trenches for water piping, cable tray/trenches layout.

e. Piping arrangement and piping support arrangement/ location for Layout for auxiliary equipment and operating platform details.

f. Erection & Construction schedule: Erection scheme and schedule of all equipments must be considered during equipment layout to have smooth erection

g. Platforms with ladder access shall be provided for Items that require occasional operating access including valves, spectacle blind and motor operated valves, sampling points etc.

h. Constructability, Operation & Maintenance Requirement:

- Overhead and side clearance for exchangers and pumps
- Provision of Heat Exchanger tube bundle pulling area
- Clearances for easy movement of working personnel
- Provision of monorails for pumps and exchangers

i. Pumps:

- Pumps shall be arranged in rows with the center line of the discharge nozzle on a common straight line wherever practicable.
- Gap between each pump foundation/ and foundation of technical structure should be sufficient for easy removal of equipment after piping.
- Clearance between two adjacent pumps shall be such that clear 900 mm aisle is available.
- All pumps not open to sky with motor rating >=75 KW shall be provided with monorail.
- No monorail should normally be provided for pumps open to sky and sufficient space below rack shall be available for pump maintenance.

j. Pumps Piping:

- Pump drives shall have clear access.
- Pump suction piping shall be as short as possible and shall be arranged to avoid vapour pockets.
- Reducers immediately connected to the pump suction shall be eccentric type with flat side up to avoid the accumulation of gas pocket.

- For end suction pumps elbows shall not be directly connected to the suction flange. A straight piece minimum 3 times the line size shall be provided at the
- suction nozzle.
- Pump discharge check valve if installed in vertical lines shall be fitted with a drain connection as close as possible downstream of the valve.
- Unless otherwise specified, T-type strainers shall be used on pump suction piping for sizes 2" and above.
- Y-type strainers shall be used for all sizes in steam services and for pump suction lines below 2”.
- All small bore piping connected to pump (drain to OWS & CBD, seat and gland leak drain) shall have break up flanges for removal of pumps.
- Piping shall be so arranged that the forces and moments imposed on the pump nozzle do not exceed allowable values of API610/manufacture recommended values.
- Pump discharge should be preferably routed away from the pump rather than towards the motor side.
- Pump cooling water connection shall be taken from the top of circulating cooling water header.
- Suction & discharge valves shall be located at operable height.

15.12.6. Field Alignment Diagram

The diagram shall indicate the relative displacement to be kept between the centerlines of various equipments at the time of installation, so that under normal running conditions the equipments get fully aligned. This relative displacement should be decided on the basis of centerline temperature rise data of driver, gear box/transmission system, driven equipment.

15.12.7. P&I Diagrams (with Bill of Materials)

a. Bidder shall supply P&I Diagrams along with Bill of Materials of each system in the bidder's scope of supply or specified in the order.
b. P&I Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve sizes and class shall be clearly marked on the P&ID.
c. Bidder's scope and purchaser's scope shall be clearly demarcated.

d. Each item shall be identified by an item No./item tag no., which shall correspond to the item no. shown on the bill of materials.
e. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable.
f. Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing.
g. The legends shall be as per ISA.

15.12.8. Cross-sectional Drawing (with Bill of Materials)

a. The bidder shall supply cross-sectional or assembly type drawings for all equipment furnished showing all parts, design assembly and running clearances, and balancing data required for erection and maintenance.
b. Each part shall be numbered which shall correspond to the part number on the bill of materials.
c. The bill of materials shall include the part no., name of component, materials quantity installed per unit & sizes where applicable (say for bolts, nuts, rings, gaskets etc.).
d. All boughtout items shall also be indicated with make and brief specifications.
e. A separate cross-sectional drawing showing installation and setting dimensions for the seals shall be furnished.

15.12.9. Performance Characteristic Curves

a. Bidder shall provide complete performance curves to encompass the map of operations, with any limitations indicated thereon.
b. All curves submitted prior to final performance testing shall be marked "PREDICTED". Any set of curves resulting from a test shall be marked "TESTED".
c. Certified test curves and data shall be submitted within 15 days after testing and shall include head, power recalculated to the proper specific gravity and efficiency plotted against capacity. If applicable, viscosity corrections shall be indicated. If NPSHR test is specified, the water NPSHR curve (drawn upto minimum continuous flow) shall also be included.
d. The curve sheet shall include the maximum and minimum diameters of the impeller design supplied the eye area of the first stage impeller, the identification number of the impeller or impellers and the pump serial number.

15.12.10. Data Sheet

Bidder shall provide completely filled in data sheets, first for "as purchased" and then for "as built". This shall be done by the bidder correcting and filling out the data sheets and submitting copies to the purchaser.

15.12.11. Piping Layouts

a. All piping layouts shall have clearances, loops, equipment foundations, columns, beams, technological structures, platforms, gratings, hand rails, anchors, sections, guides, supports, connections to equipments, orientation, coordinates etc.
b. Blow up details wherever required for clarity shall be made.
c. All dimensions shall be in millimeters whereas all levels and coordinates shall be in meters.
d. Vital installations and battery limits shall be marked with coordinates.
e. Dimensioning shall be done with equipment centerlines or main structural columns as reference grids.
f. GADs shall be printed in 1:33 1/3 scale for unit piping
g. All the information regarding instruments, equipments and line identification, direction of flow for lines, Insulation Type and Thickness, elevations and locating dimensions shall be clearly marked on piping plans. Information including operating platforms, ladders, staircase, and monorails with capacity shall also be marked wherever applicable.
h. Davit drop out areas, maintenance areas shall be clearly marked on the GADs.
i. Electrical cable and instrument trays etc. shall be shown in piping plans to avoid reference to other drawings.
j. Nozzles on equipments shall be shown in double line thin and firm. Actuators, valves hand wheels shall be drawn to scale for valves 2" and larger.
k. Piping plans shall show all lines indicated in P&ID’s and also lines generally not covered in P&ID.
l. Nozzle schedule table giving nozzle number, size, rating, facing, projection, elevation and orientation shall be inserted in the GADs.
m. Isometric shall be drawn on A3 size sheets. System Isometrics, if required by IBR authorities shall be prepared on AO size. BOM and all support requirements shall be shown on the Isometric by using symbols and designations in accordance with Piping Support Standard.
n. All vessel mounted instruments, items i.e. trims shall be detailed in isometrics.
o. Each line on the piping GADs and isometrics shall be clearly marked to denote the complete line designation as marked in P&ID’s.
p. Following symbols shall be used in Piping drawing:-

- Bottom of the pipe level: BOP.
  (Above Grade/ Platform/ Floor etc. shall be 500mm minimum for un-insulated lines and to be suitably raised for insulated lines to maintain clearance of min. 500mm from bottom of insulation.)
- Center of the Pipe Level: C/L EL.
- Top of Steel/Top of Rod: T.O.S./T.O.R.
- Platform Elevation/Highest Paved Point Elevation: TOG EL/HPP EL

15.12.12. Instrument work Specifications

This document details out the procedures and methodologies adopted by the bidder to carry out complete instrumentation work. The document apart from others shall include:

- Agencies involved for carrying out design, detailing, engineering, procurement, installation, loop checking and commissioning of Instrumentation with specific reference to various systems.
- Scope of work and responsibilities of various agencies involved.
- Interface requirement and co-ordination between various agencies.
- Co-ordination between various engineering disciplines viz. Electrical, Mechanical Equipment, Piping, Process/Operations etc.
- Experience of various agencies in carrying out respective jobs.
- Inspection and testing requirements and co-ordination procedures for the same.
- Co-ordination requirements and procedures for co-ordination with outside/statutory authorities.
- Quality control and assurance procedures to ensure proper quality.

15.12.13. Instrument Index

Instrument Index lists out all instruments those appear on the P&ID without any exception.

It is a basic instrument document, which is necessary for the smooth execution of a job and is also a reference document after the completion of job. Instrument Index shall be prepared. JOB STANDARD

record. In addition to this, all field bus instruments shall be registered with Foundation

fieldbus and clearance of ITK latest version test for device test and DD/CFF test.

15.12.14. Instrument sizing calculations, selection requirements

Instrument sizing calculations provide information regarding sizing (as per standards specified elsewhere in this document), type, selection and other related information.

15.12.15. Functional Schematics (FS)

Functional Schematics details out the functionality of all the loops shown on the P&ID including their correlation. The schematic shows all the hardware necessary to configure a loop including their physical location, their interconnection and important software/ functional blocks with location of execution as applicable to make a loop complete. Similar loops may be combined under the same functional schematic.

15.12.16. Logic Diagrams

Logic diagram is a logic representation of process interlock and shutdown system and details out the functionality, in a schematic form, based on either process cause and effect table shown on the P&ID or in a separate write-up. The schematic shall be prepared based on ISA S5.2 – "Binary Logic Diagrams for Process Operations" and shall show the physical location of Input/output devices, their interconnection with functional blocks,
bench status of all electrical devices etc. The schematic shall also be supplemented with operational requirements like startup and process bypasses, reset and shut down push buttons, selector switches, status lamp etc.

15.12.17. Instrument Loop drawings

Each loop shall have a separate Instrument Loop drawing which shall show each component from field device to final receiver including physical location, initiating device, its terminal number, junction box with its terminal number, cable number with pair number/polarity, receiver instrument terminals/cabinet terminals, system functional blocks of loop in simplified manner (without configuration details).

15.12.18. Panel Front Arrangement

This drawing shall show the arrangement of Panel mounted instruments like indicating instruments, alarm annunciator, indicating lamps, push buttons/switches etc. including their approximate sizes and their mounting locations.

15.12.19. Configuration Diagram

This drawing is a graphical representation of all major hardwares required in a configurable control system which are necessary to meet all the expected functional requirements.

15.12.20. Dynamic Graphic Display Drawings

These drawings provide a graphic representation of P&ID's arranged in a sequence which when displayed on the TFT, shall provide easy and logical operational views.

15.12.21. Input/Output Assignment

This document indicates the physical assignment of various I/O modules and their respective channels to various physical inputs and outputs.

15.12.22. Instrument Duct/Tray/Trench Layout

Instrument duct/tray layout drawing shows the routing of main instrument duct/tray layout in the unit/plant. The drawing shall be prepared on plot-plan and shall show the size, cross-section at various locations, general notes, symbols, reference drawings and the control room entry.

15.12.23. Instrument Cable Schedule (For conventional loops)

a. The instrument cable schedule shall show all instrument and power cables required for instrumentation. The document shall show, tag number, cable number, type, length and size of cables, type of junction box, identity of local panel, control room panel/cabinet location etc.

b. Fieldbus Instrument Cable Schedule (For Fieldbus loops)

c. The Fieldbus instrument cable schedule shall show all instrument cables required for complete instrumentation in segment wise. The document shall show, tag number, spur number, segment number, cable type, cable length and size of cables, identity of wiring/ terminal block/ junction box, type of power supply, control room panel/cabinet location etc.

15.12.24. Technical Data Manual/Mechanical Catalogues

a. Technical Data Manual/Mechanical Catalogue is a compilation of "as built" drawings and data, manufacturing and test records, installation, operating and maintenance instructions.

b. Not later than two weeks after successful completion of all specified tests, bidder shall furnish the required number of Technical Data Manual/Mechanical Catalogues for the equipment, any auxiliaries and instruments that the vendor is providing. The Technical Data Manual/Mechanical Catalogue shall include the following documents as a minimum:

- All drawings and data as listed in the bidder data index & schedule. (For drawings, where purchaser's approval is required, the final certified drawings shall be attached.) Sections shall be organized in a manner that data & drawings related to one subject is grouped together such as Mechanical, Electrical, Instrumentation etc.

- All manufacturing, inspection and test data and records.

15.12.25. Installation and Instruction Manual :

a. Bidder shall provide sufficient written instructions, including a cross-reference list of all drawings for correctly installing the equipment and prepare the equipment for start-up.

b. It shall include any special information required for proper installation that is not on the drawings, special alignment or grouting procedures, utility specifications (including quantity) and all installation data.

c. It shall also contain the following information:

- Instructions for erecting, piping, aligning (including the expected thermally induced shaft centerline shift between normal site ambient temperature position and that at normal equipment operating temperature).
- A description of rigging procedures, including the lifting of the assembled equipment, and methods of disassembly, repair, adjustment, inspection and reassembly of the equipment and auxiliaries.
- Pre-commissioning/commissioning/functional test procedures and acceptance criterion.

15.12.26. Operation and Maintenance Manual

1. Bidder shall prepare and submit draft maintenance manual to Purchaser for review at least three months prior to the mechanical completion.
2. Final maintenance manual incorporating all comments shall be submitted by bidder within one month after issue of comments.
3. This manual shall provide sufficient written instructions and data to enable purchaser to correctly operate and maintain the equipment ordered.
4. It shall include a section to cover special instructions for operation at extreme environmental and/or extreme operating conditions.
5. Maintenance manual shall contain the following chapters as a minimum:

i) Introduction to the system/unit maintenance
ii) Equipment/facilities register
iii) Location and list of all system/unit equipment.
iv) Equipment record card
- Equipment No. and name.
- Equipment serial No. and manufacturer details

- Brief description including details of parameters.

v) Maintenance guidelines
- Maintenance philosophy.
- Maintenance procedures of individual equipment and system.
- Preventive and predictive maintenance schedules.
- Procedures and precautions to be taken for handing over of equipment for shutdown maintenance, viz., vessels, exchangers, boilers, heaters, compressors, blowers, turbines, pumps, agitators, dryers, centrifuges, filters, etc.
- Details of preventive maintenance and predictive maintenance.
- Gasket details with respect to pressure ratings and temperature.
- Coupling details, like, type of coupling and coupling bolts with make, serial No. and dimensional details.

vi) Method for alignment including optical, if required.
- Tightening torque with respect to critical services and sizing of bolts/studs.

vii) Exchanger maintenance
- Tube extraction/tube bundle pull out procedures.

viii) Maintenance trouble shooting
- Trouble shooting guide for critical equipment like compressors, turbines, blowers, screw pumps, heaters, boilers, centrifuges, conveyors, filters etc.

ix) Maintenance store
- Identification and classification of spares and consumables.
- Stock levels to be maintained
- Spare parts requirement for at least 2 years of trouble free operation and insurance spares.
- General tools and tackles including special tools, if any.
- Inspection gadgets including tension device for bolts tightening requirement.

x) Information storage and retrieval system

- Pressure vessels records including as built drawings, data sheets, licenses, approvals etc.
- Piping - as built drawings, test records etc.
- Details of piping support system including type, size, specification and make of spring supports clearly shown on the drawings.
- Lifting tackles/equipment details.
- Lifting equipment - test programme and schedule.
- Safety relief valve - test records & schedule including set values.

xi) Maintenance training

- Training needs and areas identified.
- Instructions covering start-up, normal shutdown, emergency shutdown, operating limits and routine operational procedures.

xii) A description of equipment construction features and the functioning of component parts or systems (such as control, lubrication, sealing systems etc.

xiii) Outline and sectional drawings, schematics and illustrative sketches in sufficient 'details to identify all parts and clearly show the operation of all equipment and components and the methods of inspection and repair. Standardized sectional drawings are acceptable only if they represent the actual construction of the equipment.

xiv) The following maintenance information:

- Maximum and minimum bearing, labyrinth and seal clearances including any other clearance between moving and stationary parts of the equipment affecting proper running and maintenance of the equipment.
- Instructions for measuring and adjusting cold clearances, shaft runout, concentricity etc.
- Rotor float allowance.
- Interference fits on parts that are required to be removed or replaced for maintenance of normally consumable spares.
- Balancing data with permissible tolerances.

- Lubricating schedules indicating recommended grades of oil, their properties, replacement period etc.
- Normal maintenance procedure.
- Preventive maintenance schedules and criterion for replacement of parts.
- Trouble - shooting procedures.

xv) The following reassembly information:

- Bolting sequence and torque values for all bolts affecting equipment performance/integrity/safety.
- Reassembly sequences together with required inspection checks.
- Adjustment procedures to achieve required positions, clearances, float and so forth.
- Detailed procedures for pre-operational checks, including settings and adjustments.
- Seals and coupling installation procedures.
- Parts list indicating cross-sectional drawings of various assemblies and sub-assemblies, part numbers, materials of construction (ASTM) etc. to facilitate identification of parts and for procurement of spares.

xvi) Following information shall also be included In the Technical Data Manual / Mechanical Catalogue:

- Storage instructions for storing and preserving the equipment (including driver and all the auxiliary units) at the plant site before installation of the same.
- Instructions for preserving the equipment after it has been installed. This is particularly required in cases where a long time gap is expected between equipment installations and commissioning.

- Field performance test procedures and acceptance criterion.

xvii) Technical Data Manual/Mechanical Catalogue shall be in hard board folder(s) of size 265 mm x 315 mm (10.5'' x 12.5'') and shall not be more than 90 mm thickness; it may be of several

volumes and each volume shall have a volume number, index of volumes & index of contents of that particular volume.

15.13. REPORTING

15.13.1. The bidder shall submit the following reports on regular basis for Purchaser's information / review.

15.13.1.1. Monthly Progress Report
The report shall be submitted on monthly basis within 5 calendar days from cut-off date covering overall scenario of the project

15.13.1.2. Weekly Progress Report (Overall)
This report shall be prepared by bidder and issued on weekly basis to Purchaser. The report shall include the following:

- Executive Summary
- Project highlights with dates of achievements
- Project exception (work programmed but not achieved with reasons for non- achievement) and work programmed for next week
- Critical areas
- Actions taken/to be taken for slippages
- Progress statistics

This shall cover both for Bidder's Home/Design office activities and construction activities at site.

15.13.1.3. Weekly Progress Report (Construction)
This report shall be prepared by bidder and submitted on weekly basis within 1 calendar day from cut-off date. The report shall cover following items.

- Progress statistics
- Work item wise quantity completed against programme for the week including
- Reasons for shortfall.
- Programme for next week
- Work Front available
- Constraints, if any
- Resources deployed against planned with reasons for shortfall in resource deployed
- List of equipment/materials received at site during the week

15.14. Expediting Report

Bidder shall submit fortnightly expediting report based on his representative's visit to vendor's work for orders where delivery of materials is critical to project completion.
A list of such critical items/vendors shall be specified by OWNER/CONSULTANT during the kick-off meeting or at a later date.

In addition to the above, OWENR/CONSULTANT may request expediting report based on visit of bidder's representative in case of orders which were though not critical at the time of order placement become subsequently critical during project execution due to any reason.

16. SUB VENDOR LIST

16.1. All the equipment shall be sourced from recommended Bidders only as specified in this specification.

16.2. Further the supplied model shall be under regular manufacturing range and have proven track record (Bidder / sub-Bidder shall have supplied minimum 2 no. in last 7 years, out of which at least one shall be in satisfactory operation for minimum 8000 hours).

16.3. Supply items for which no definite "make/brand" is indicated, shall be procured only from makes & models having proven track records and requires purchaser approval.

16.4. Sub vendor list for the bought out items applicable for the project:

Refer **ANNEXURE-I.**

17. PRICE BID FORMAT

17.1. Foam Protection system as envisaged in this bid document shall be executed by the bidder on Lump Sum Turnkey (LSTK) basis.

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

17.3. The equipment supplied shall be complete in all respects. The bidder shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment. Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be in bidder scope Only.

17.4. It will be the bidders sole responsibility to specifically highlight any of the missing equipments / items required for the proper & intended use of the Foam Protection System as a part of their offer. In case nothing is highlighted by the bidder, it will be assumed that all the major items are included in the bidder's scope of supply and supervision of E&C for the desired operation of the FPS system.

17.5. All hardware/software/item/ etc. required as per tender specification or subsequent tender correspondences or for desired satisfactory operation of package or due to good-engineering practice or as prescribed by relevant/applicable code/standard, but not listed exclusively in this specification, shall be deemed to be included in the basic price quoted by the bidder. Also, all mounting hardware / accessories /fittings/conduits/etc. required for above the package shall be included in the basic price of respective item. Bidder, at no point of time, shall be eligible to raise any extra claim in this regard.

17.6. Drawings attached with this specification are preliminary & are not exhaustive in nature. These drawings may get revised during detail engineering. All other inputs required for engineering of the Foam Protection system will be furnished to the bidder during detail engineering stage, as and when the same is available with BHEL. Bidder to note that they shall not be eligible to raise any extra claim on account of revision of input drawings or any other input drawings during detail engineering stage.

17.7. Only main items shall be considered for price bid evaluation. Optional items (RO – rate only)shall not be considered for price bid evaluation

17.8. Prices quoted by the bidder shall remain firm till the successful handing over of the Foam Protection plant to end customer. Any request for upward revision

of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL.

17.9. Bidder to quote only base rates for all the items, Applicable taxes and duties shall be indicated separately.

17.10. The Priced Bid shall be submitted in Original (without any copy) duly signed and stamped on each page in a separate sealed envelope super scribing "Price Bid –Do not Open" This shall not contain any condition whatsoever failing which the Bids shall be liable to be rejected. In case of any correction, the bidder shall put its signature and its stamp. Eraser fluid will not be allowed for making any correction.

17.11. Bidder shall confirm to the unpriced bid as part of their offer.

17.12. **Billing Breakup Methodology:**

17.12.1. Billing break-up (BBU) shall be submitted to BHEL in following methodology:

17.12.1.1. The BBU shall be prepared only for the pro-rata billing purpose.

17.12.1.2. BBU will contain complete list of items required for the completion of the project as per specification and shall be dispatched by bidder irrespective of the items/quantities are indicated in the document or not.

17.12.1.3. Any additional requirement of the item already indicated in the document will be updated in the subsequent revision of this document. All such item will be dispatched as "free item" term to BHEL.

17.12.1.4. Inspection & Testing of all items shall be as per approved quality plan. The entire item shall be dispatched to site only after the completion of Inspection and testing requirement as per approved quality plan. Non-inclusion of any item does not absolve the vendor from meeting the requirement.

17.12.1.5. Vendor shall obtain prior permission from BHEL after submitting all the documents before ensuring dispatch of all main items applicable for project.

17.12.1.6. Inspection & quality: All the items applicable for this project shall be inspected as per approved quality plan. It may be noted that any item shall be dispatched to site only after complying with the Inspection requirements as per approved quality plan.

17.12.1.7. As separate document indicating the details of all the items having SHELF LIFE shall be furnished. Prior permission from BHEL shall be taken before dispatch of any of the item having shelf life.

17.12.1.8. Applicable taxes & duties shall be extra.

17.12.2. BBU shall be a comprehensive document having details of all the items applicable for this project .**There should not be any Non-Billable item to be supplied at site**.

17.12.3. BBU shall be submitted as per "Payment Terms of Annexure-BB"

17.12.4. Wherever Lot items are indicated, same shall be quantified in details in a separate annexure. Similarly all Accessories/ Instruments/ items are to be defined with comprehensive details
It is to be ensured that all fittings, accessories (including Bolts, fittings etc.), Instrument and other items, if any, shall be listed in separate line items or in a separate annexure.

17.12.5. In case requirement of any such item / additional item is detected at any stage of the contract execution, BBU will be revised to reflect the same. However all the additional items will be supplied as a 'Zero Value Item', without any commercial implication to BHEL. All the contractual requirements shall be valid for these additional items also.

18. DEVIATIONS TO SPECIFICATIONS:

18.1. Bidders are advised to quote strictly as per BHEL's specification requirements. In case bidder excludes some components of scope of supply or some features of specification requirements, the bidder will be required to include the same in the scope during offer evaluation stage /contract execution stage without any additional commercial and price implications on account of the same. Bidder to note that they won't be entitled for any price impact on account of withdrawal of deviation taken from BHEL spec during technical scrutiny stage. Price impact will be allowed by BHEL only to the extent of change of specification during tender evaluation stage, if any, from BHEL end.

18.2. In case bidder feels that it is necessary to exclude some components of scope of supply & some features of specification requirements, due to genuine constraints if any, bidder has to clearly bring out the same to the notice of BHEL and take their prior approval before submission of bid. Bidders are requested to bring out only those deviations which are impractical to meet (or) not technically advisable as per the experience of bidder, for BHEL's review before the submission of bid. **All such clarifications required by the bidder shall be intimated to BHEL together as a single notice within a week of receipt of enquiry by bidder.**

18.3. All such deviation or variation from the scope, requirement and/or intent of this specification shall be clearly defined under relevant attachment of the Bid forms irrespective of the fact that such deviations/ variations may be standard practice or a possible interpretation of the specification by the Bidder. Except for those deviations/ variations covered as a part of pre bid clarification, it will be the responsibility of the bidder to fully meet the intent and the requirements of the specification within the quoted price. No other deviation whatsoever from this specification, except for the have been specifically agreed by purchaser as a part of pre-bid clarification shall be considered.

18.4. Bidder to note that all such applicable deviations /clarification shall be listed and submitted to BHEL as a part of pre-bid query. All such applicable deviations /clarification shall have cross reference to page number /section / clause /para etc. of this specification or its annexure with proper reasons for the deviations for purchaser's consideration. Any such applicable deviations /clarification not listed under the above section, even if reflected in any other portion of the bidder's proposal shall not be considered applicable.

18.5. In case the bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, he shall recommend the same along with reasons in a separate section as a part of pre-bid query to enable purchaser take a suitable decision on the requirement of the same.

18.6. Information like Bill of materials (BOM), Instrument list, datasheets, and typical specifications enclosed by the bidder as a part of their bid, shall be retained for information only and shall not be referred by contractor as contractual agreement. No implication shall be admissible on the basis of these documents during any stage of contract execution. System wise BOQ shall be finalized based on approved drawings during detail engineering stage.

19. DEFINITIONS

19.1. BIDDER: Bidder means the party supplying Foam Protection system for this project.

19.2. SUB VENDOR : Sub vendor means any party on whom bidder suborders materials and items (like tubes, forgings etc)

19.3. QUALITY ASSURANCE PLAN (QAP) / INSPECTION AND TEST PLAN (ITP) :

It is a document generated by the supplier with complete listing of various inspection stages, tests, material certification requirements and parties involved with their respective roles in inspection; indicating the requirements of Hold (H), Witness (W) Inspection, and Review (R) of Quality control documents / records for an item. QAP and ITP are considered synonymous.

19.4. HOLD POINT: A Hold Point is a stage designated in the ITP/QAP, which requires Witness Inspection by TPIA and / or OWNER before supplier can proceed with further processing, except where prior written permission for further processing or waiver of Witness Inspection by OWNER is obtained.

19.5. WITNESS POINT A Witness point is a stage designated in the ITP/QAP, which requires witness inspection by TPIA, and / or Owner. EPCC/LSTK CONTRACTOR / Supplier shall perform the activity after proper notification has been given to TPIA / and OWNER for witnessing the activity. The CONTRACTOR/ Supplier is not obliged to hold further processing, if TPIA and / or OWNER are not available to witness the activity or does not provide the comments before the date notified with proper notification period.

19.6. REVIEW POINT A review point is a stage designated in the ITP/QAP which requires the concerned agencies i.e. CONTRACTOR / TPIA / OWNER, to verify the documents for their correctness and to confirm that the said documents meet the requirements laid down.

19.7. THIRD PARTY INSPECTION AGENCY (TPIA) Third Party Inspection Agency means an inspection agency appointed by the EPCC/LSTK CONTRACTOR for carrying out Inspection and witness of tests of equipment and material being procured by the CONTRACTOR for the Project.

19.8. INSPECTION CATEGORY Inspection category determines the scope of Inspection for the Supplier, TPIA, OWNER for various equipment and material depending upon their use, serviceability, safety criteria and complexity.

19.9. MECHANICAL COMPLETION :Mechanical Completion of systems shall mean that all installation works of the system have been completed and hydro tested in accordance with approved construction drawings, approved specification, applicable code as defined in the document, accepted international good engineering practices and all the activities have been completed in a comprehensive manner by the bidder.

19.10. PRE-COMMISSIONING Activities: Pre commissioning activities, which are required to be performed after completion/ installation, inspection, hydro testing etc. of an equipment/ system to make it ready for commissioning.

20. LIST OF ANNEXURES:

LIST OF ANNEXURES		
Sl No	**Drawings/Documents**	**Drg/Doc No**
1.	Sub-Vendor List	Annexure-I
2.	Painting	Annexure-II
3.	Price Bid	Annexure-III
4.	Master Document List format	Annexure-IV
5.	Guidelines for QA QC plan	Annexure-V
6.	Manufacturer quality Plan	Annexure-VI
7.	Bill of Material Format	Annexure-VII
8.	Pre Bid Query Format	Annexure-VIII
9.	Plot Plan	PE-DG-374-100-M001-R6
10.	Equipment Layout For Foam Pump House	13810105642-S00-R00
11.	Interface diagram for various packages for Fire Protection system	PEMC-03892

NOTES:

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

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Prepared By	Reviewed By	Approved By
00	20.04.13	ORIGINAL ISSUE	--SD---	--SD---	---SD---

Ref. Doc.

ANNEXURE-1

SUB-VENDOR LIST

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

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

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

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

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

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

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

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

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

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

SL. NO.	ITEMS	MAKES	REMARKS
		K.S.B PUMPS LTD.	
		BHARAT HEAVY ELECTRICALS LTD	
87.	VALVES-GATE/GLOBE/REG.CLOBE/NON-RETURN; PR.CL.:#1500; MAT.CS/AS/SS, SW ENDS-FOR SIZES1/2" TO 1-1/2"; FL ENDS - FOR SIZES 2-1/2"	FOURESS ENGINEERING (I)PVT.LTD	
		WEIR BDK VALVES	
		NSSL LIMITED	
		MICON VALVES (I) PVT. LTD.	
		NITON VALVE INDUSTRIES LTD	
		LEADER VALVES LIMITED	
		K.S.B PUMPS LTD.	
		BHARAT HEAVY ELECTRICALS LTD	
88.	VALVES-GATE/GLOBE/REG.GLOBE/NON-RETURN; PR.CL.:#2500:MAT.CS/AS/SS;SW ENDS - FOR SIZES 1/2" TO 1-1/2"; FL. ENDS-FOR SIZES 2-1/2"	FOURESS ENGINEERING (I)PVT.LTD	
		WEIR BDK VALVES	
		NSSL LIMITED	
		MICON VALVES (I) PVT. LTD.	
		NITON VALVE INDUSTRIES LTD	
		LEADER VALVES LIMITED	
		K.S.B PUMPS LTD.	
		BHARAT HEAVY ELECTRICALS LTD	
89.	VALVE-BUTTERFLY; ;S-#150-WITH SOFT SEAT- FLANGED/WAFER TYPE-FOR ALL SIZES	DURGA ENGINEERING COMPANY	
		BOTELI VALVE GROUP COMPANY LTD.	
		INSTRUMENTATION LTD	
		FOURESS ENGINEERS (INDIA)	
		WEIR BDK VALVES	
		UNIQUE VALVES LIMITED,	
		INTER VALVE (INDIA) PVT.LTD.	
		LEADER VALVES LIMITED	
		GALAXY CONTROLS PVT LTD.,	
		ADVANCE VALVES PVT.LTD.	
		KAMALA VALVES & ENGINEERING	
90.	PIPE FITTINGS	FLASH FORGE PVT LTD	
		U I PIPE FITTINGS PVT. LTD.	
		TUBE PRODUCTS INCORPORATE,	
		GUJARAT INFRAPIPES PVT.LTD.,	
		SAWAN ENGINEERS PVT. LTD.	
		TOPAZ PIPING INDUSTRIES	
		TRUE FORGE PVT.LTD.,	
		DEE DEVELOPMENT ENGINEERS LTD.,	
		TRUE FAB ENGINEER (P) LTD.	
		P.K. TUBES & FITTINGS PVT. LTD.	
		K. S. PIPE FITTINGS PVT. LTD.	
		TUBE TURN (INDIA) P. LTD.	
91.	BOLTING MATERIAL	JAI FASTENERS (P) LIMITED	
		ATLAS FASTENERS	
		RATNESH METAL INDUSTRIES	
		BOLTMASTER (INDIA)PVT.LTD.	

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

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

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

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

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

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

VOLUME – III

ANNEXURE- II

PAINTING SCHEDULE

1.0 GENERAL PAINTING REQUIREMENTS

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

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

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of piplines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:6278	:	Code of practice for white washing and colour Washing
IS:158	:	Ready mixed paint, brushing, bituminous, black, leadfree, acid, alkali, water and heat resisting
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel , synthetic, exterior (a) undercoating (b) Finishing

1.3 **Preparation of Surfaces**

All surfaces to be painted shall be thoroughly cleaned of all grease , oil, loose mill scale , dust , rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out sand scrapping may be permitted with steel wire brushes and /or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER/OWNER RESPRESENTATIVE. The sheet steel of electrical and instrumentation panels shall be pre-treated through chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphating and rinsing. However, in case mechanical cleaning is also required the Contractor shall carry out the same to get a smooth finish.

1.4 **Primer Paint**

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

1.5 **Finish Paint**

Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade shall be as approved by the OWNER. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.

1.6 **Painting and Corrosion Protection for Pipes & Fittings**

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

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

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

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

1.7 **Painting and Corrosion Protection for Valves & Specialties**

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

1.8 **Suggested Colour Codes for Painting**

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

1.9 **Approved Paint Makes**

i) Asian Paints (I) Ltd.
ii) Berger Paints India Ltd
iii) Goodlass Nerolac
iv) Jenson & Nicholson (I) Ltd
v) CDC carboline (I) Ltd.
vi) Shalimar Paints Ltd.
vii) Addison Paints Ltd.
viii) Grand Polycoat
ix) Bombay Paints

2.0 **PAINTING SCHEDULES**

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

PAINTING SCHEDULE

2X250 MW BARAUNI TPS

Annexure-I

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

Notes:

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

ANNEXURE –II

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

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

ANNEXURE –II

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

ANNEXURE-III

SUGGESTED COLOUR CODES FOR PAINTING

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

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

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

Notes :

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

PRICE BID FORMAT FOR
FOAM PROTECTION SYSTEM
PROJECT- 2 x 250 MW UNIT # 8 & 9, BARAUNI-TPS, BEGUSARAI
SPEC NO: PEMC 03845 Rev 00

Sl. No.	Description	Qty.	Unit	PRICE in INR or US $ (Refer notes below)	
				Unit Price (INR or US $)	Total Price (INR or US $)
1.	Lump sum price for complete Foam Protection System (FPS) as per BHEL Specification	1	Lot		
2.	Per diem rate for the supervision of erection, testing, commissioning & performance testing for the supplied system.	50	Days		
3.	Travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer per visit for supervision of erection & commissioning of FPS system.	7	Visits		
		Grand Total			

Notes:
1. Bidder to quote strictly as per BHEL's specification requirements
2. Bidder to note that the complete supply of the package (Refer Sl. No. 1) is a LUMP SUM Turn-Key Order. Any additional claim on any account, after placement of order will not be entertained under any circumstances.
3. For the purpose of tender total no of 50 man days to be covered in 7 visits have been considered. However, either or both of the number of man days or number of visits may change on either side based on the actual site requirement. Bidder to note that payment against Sl. No.2 & 3 above shall be made as per the total number of visits and man days required for the supervision of the complete E&C activities.
4. Offer will be evaluated based on total price for Sl. No. 1, 2 & 3 of price format.
5. Bidder to quote the base rates only. Applicable taxes and duties to be indicated separately. (As per Split Value format Vol IIIB of price formats). Indian bidders to quote in Indian Rupees & Foreign bidders to quote in US $.

BIDDER'S SIGNATURE
NAME:
DATE
COMPANY SEAL

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

ANNEXURE-IV

MASTER DOCUMENT LIST (MDL)

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

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

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

ANNEXURE-V

GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.
2. Each page of QAP shall contain the following information.

   a) Vendor's name & address.
   b) Customer: BHEL, Hyderabad.
   c) Project.
   d) BHEL Product Standard Number/revision number as referred in P.O.
   e) BHEL Purchase Order Number & Date.
   f) Product as per P.O. description.
   g) QAP Number (unique and shall not repeat)/revision number/date.
   h) Page number and number of pages
   i) Vendor signature & stamp

3. QAP shall contain four parts / stages as follows.

A) Raw materials and bought out items.
B) Inprocess Control / Inspection.
C) Final assembly, Inspection & Testing.
D) Painting, preservation & packing.

4. Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc).
5. Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc), Hydrostatic test, calibration check etc.)
6. Under 'Class', indicate minor, major or critical depending on the importance of characteristic.
7. Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.)
8. Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)
9. Under 'Reference document' and 'Acceptance norms', appropriate National & International standards, BHEL standards, approved drg references etc should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practise etc". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.
10. Under 'Format of record', indicate appropriately supplier's Test certificate, calibration certificate, lab report, inspection report etc.
11. Please refer 'Agency' in QAP format.
    "Under P: Perform, W: Witness, V: Verify
    Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR
    2: (Vendor / Sub vendor)
    Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, under Witness (W) column use 1. Under 'Verify' column, use code1
12. Under 'D' please put (✓Tick) against each characteristic where vendor proposes to submit test certificate/report etc OR as required as per BHEL Spec.
13. Vendor's signature & stamp should be available on each page of QAP.

14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drgs.

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

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

ANNEXURE-VI

VENDOR'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN**		QP. NO.:	
	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT:	BHEL P.O.NO.: P.O.DATE: BHEL SPEC: REV:	REV NO:	DATE:
			PAGE 1 OF 1	

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**												
2.0	**INPROCESS INSPECTION**												
3.0	**FINAL INSPECTION & TESTING**												
4.0	**PRESERVATION & PACKING**												

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

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

ANNEXURE-VII

BILL OF MATERIALS

(SUB-VENDOR PACKAGES)

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

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

ANNEXURE-VIII

PRE-BID QUERRIES FROM SPECIFICATION

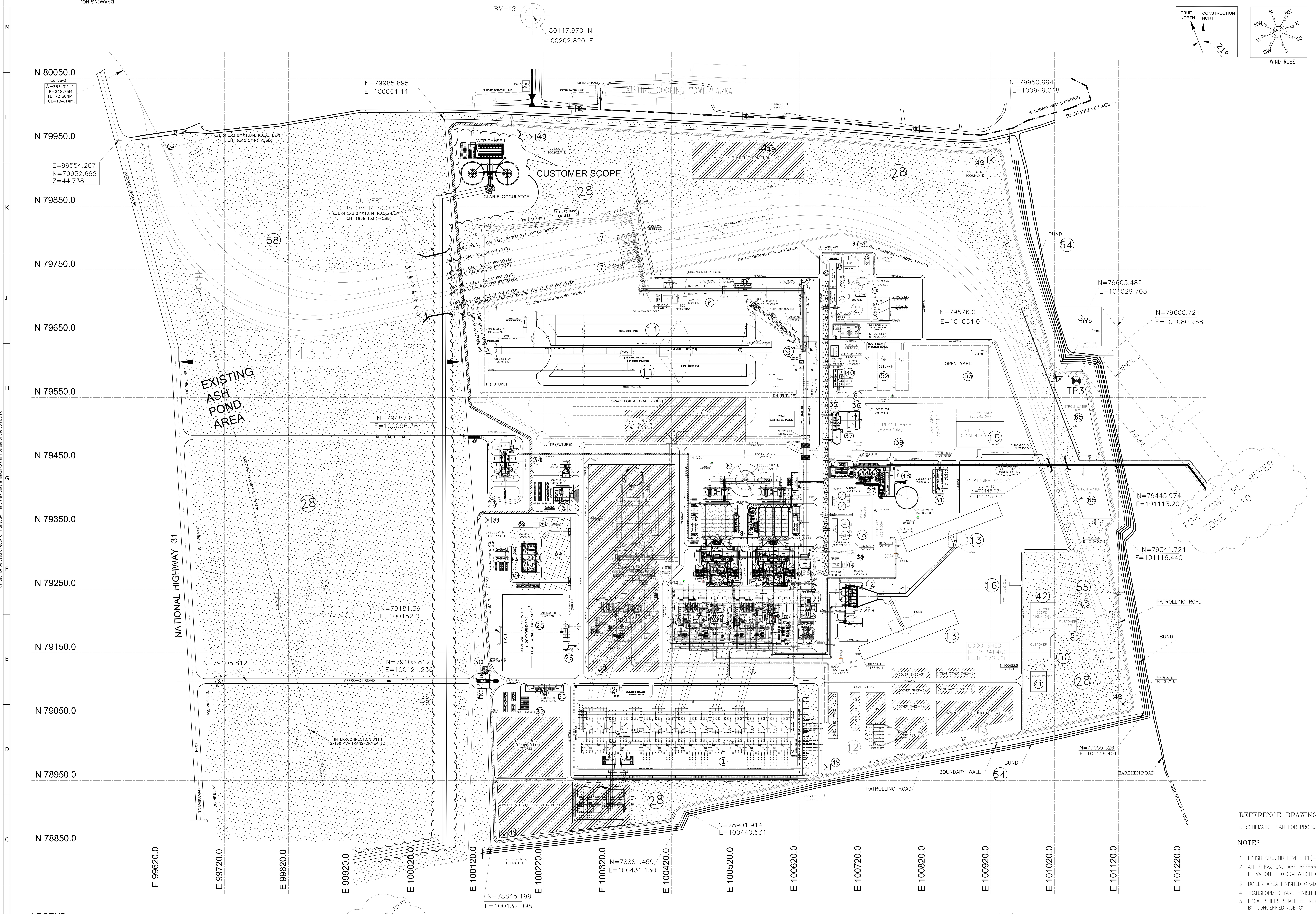
If the proposal submitted has got any Queries from the technical stipulations in the bidding document, the Bidder shall tabulate below the full particulars of such Queries and shall sign below. Additional sheets may be enclosed, if necessary. Queries are to be furnished with mention of specific clause numbers. Technical and commercial Queries to scope of supply and services shall be indicated separately.

SL.No.	Clause No.	Description as per specification	Queries by Bidder

We confirm that all the Pre-Bid Queries to the Technical Specification, Job Specification and enclosures including reference documents attached are listed in this Annexure only. No other Pre-Bid Queries even if mentioned elsewhere shall be considered for any technical/ commercial evaluation or for ordering.

Bidder's Signature…….

Date:……



BUILDING & STRUCTURE:-

1	220 KV. SWITCHYARD
2	SWITCH YARD CONTROL ROOM
3	C.W. PIPE CORRIDOR
4	VACUUM PUMP CUM COMPRESSOR HOUSE
5	E.S.P CONTROL ROOM
6	CHIMNEY
7	WAGON TIPPLER
8	PENT HOUSE
9	CRUSHER HOUSE
10	CHP MCC-1
11	COAL STOCK PILE
12	C.W. PUMP HOUSE
13	COOLING TOWER
14	CW TREATMENT PLANT
15	EFFLUENT TREATMENT PLANT(E.T.P.)
16	HYDROGEN GENERATION PLANT
17	CANTEEN (20M x 20M x 5M)
18	D.M.PLANT
19	COMPRESSOR HOUSE
20	SERVICE BUILDING (30M X 15M)
21	FUEL OIL DYKE AREA
22	UNLOADING PUMP HOUSE
23	ASH SILOS & AHP MCC ROOM
24	DG ROOM
25	RAW WATER RESERVOIR
26	RAW WATER PUMP HOUSE
27	ASH SLURRY P/H CUM MCC CONTROL ROOM
28	GREEN VERGE (CUSTOMER SCOPE)
29	ADMINSTRATIVE BUILDING (40Mx20M)
30	TIME OFFICE & SECURITY (10Mx10M)
31	WORK SHOP
32	CAR PARKING SHED & OPEN AREA(50Mx20M+50Mx20M)
33	FIRE WATER PUMP HOUSE & TANK
34	FIRE STATION
35	CLARIFIED WATER P/H
36	FILTER WATER TANK
37	CLARIFIED STORAGE TANK
38	CHLORINATION PLANT
39	PRE- TREATMENT PLANT
40	CHEMICAL LAB
41	SEWAGE TREATMENT PLANT
42	DIESEL PUMP HOUSE(CUSTOMER SCOPE)
43	FUEL OIL TRUCK UNLOADING AREA
44	FUEL OIL PRESSURISING & HEATING PUMP HOUSE
45	FOAM PUMP HOUSE
46	ACW PUMP HOUSE
47	BUFFER HOPPER
48	AHP CLARIFIER & CHEMICAL HOUSE
49	WATCH TOWER (STANDARD)
50	RAIN WATER HARVESTING SUMP (CUSTOMER SCOPE)
51	HEAVY VEHICLE MAINTENANCE WORKSHOP & GARAGE (CUSTOMER SCOPE)
52	STORE (60M X 20M X 3)
53	OPEN YARD (120M X 84M)
54	BUND (CUSTOMER SCOPE)
55	LOCO SHED (CUSTOMER SCOPE)
56	GANGA RIVER WATER SCHEME (CUSTOMER SCOPE)
57	ASH DYKE AREA (CUSTOMER SCOPE)
58	MARSHALLING YARD (CUSTOMER SCOPE)
59	TRAINING CENTRE (CUSTOMER SCOPE)
60	HEALTH/FIRST AID CENTRE (CUSTOMER SCOPE)
61	POTABLE WATER CHLORINATION SYSTEM
62	TRANSFORMER YARD
63	WEIGH BRIDGE
64	SWITCH GEAR BUILDING (15MX7M)
65	STROM WATER PIT

REFERENCE DRAWING

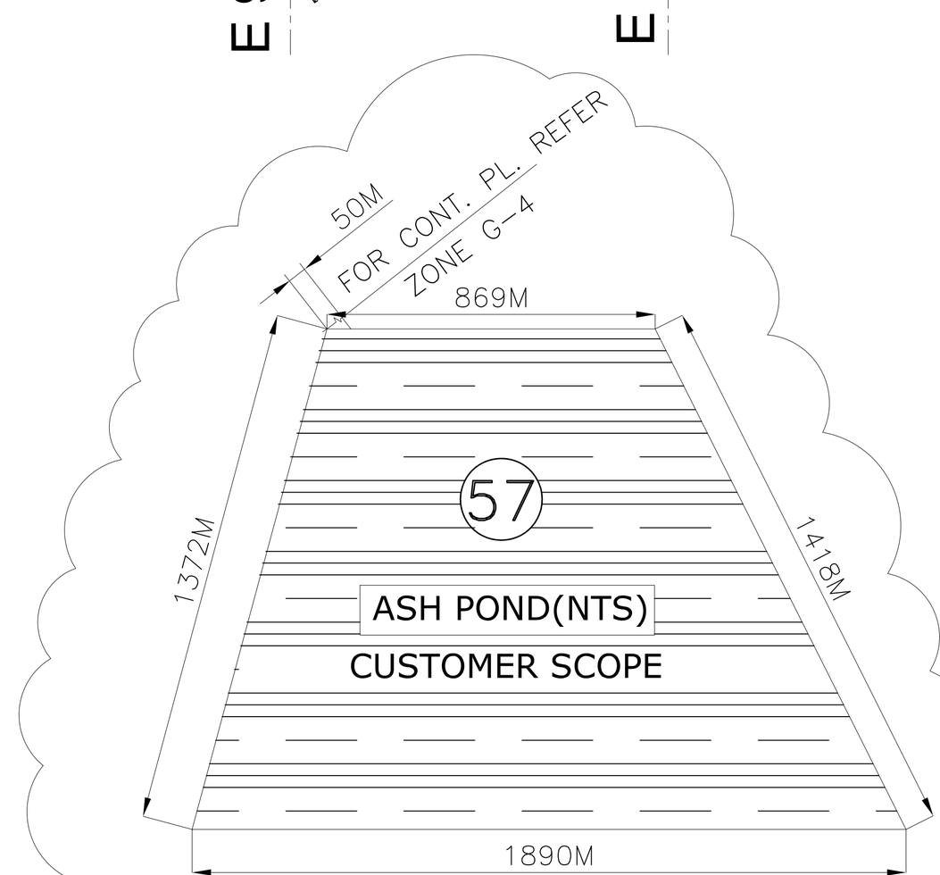
1. SCHEMATIC PLAN FOR PROPOSED RAILWAY SIDING AT BARAUNI --- DRAWING NO. KOL_BARSYL_909_SM_01

NOTES

1. FINISH GROUND LEVEL: RL(+) 45.0M
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION ± 0.00M WHICH CORRESPONDS TO RL(+) 45.5M
3. BOILER AREA FINISHED GRADED LEVEL IS 200MM BELOW 0.0M i.e. RL 45.3M
4. TRANSFORMER YARD FINISHED GRADED LEVEL IS 100MM BELOW 0.0M i.e. RL 45.4M
5. LOCAL SHEDS SHALL BE REMOVED AND AREA CLEARED AFTER VACATION OF SHEDS BY CONCERNED AGENCY.

LEGEND:-

1. PROPOSED BUND	
2. PROPOSED PLANT BOUNDARY WALL	
3. PROPOSED PLANT BOUNDARY WALL(FUTURE)	
4. PATROLLING ROAD	
5. PLANT ROAD	
6. PIPE RACK	
7. FENCING	
8. LOCAL SHEDS	



SCALE 1:20800

TERMINAL POINT DETAIL(T.P)

TP.No.	LINE DESCRIPTION	COORDINATES NORTH(N)	COORDINATES EAST(E)	ELEVATION
01	RAW WATER T.P.	N=79173.5	E=100153.0	
02	ASH PIPING T.P.			
03	PLANT DRAINAGE WATER T.P.	N=79576.0	E=101054.0	

CUSTOMER	BIHAR STATE ELECTRICITY BOARD		
CUSTOMER'S CONSULTANT	STEAG ENERGY SERVICES(INDIA) PVT. LTD.		
JOB NO. 374	2X250MW BARAUNI THERMAL POWER STATION UNIT 8&9		
STATUS CONTRACT			
DISTRIBUTION			

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
M	DRN	GKM	-sd-	10.06.11
	DESN	GKM	-sd-	10.06.11
	CHD	LKJ	-sd-	10.06.11
	APPD	AJ	-sd-	10.06.11

REV.	DATE	ALTD	CHD	APPD
01	19.08.11	GKM/RP	RP/LKJ	AJ

1. MARSHALLING YARD UPDATED AS PER BARSYL DRAWING RECEIVED ON 18.08.2011.
2. BOILER PLAN UPDTAED AS PER TRICHY DWG.
3. DWG UPDATED IN LINE WITH DISCUSSION DURING MEETING ON 09.08.2011.
4. CHP & AHP AREA UPDATED AS PER INPUT DWG FURNISHED BY ISG.

TITLE

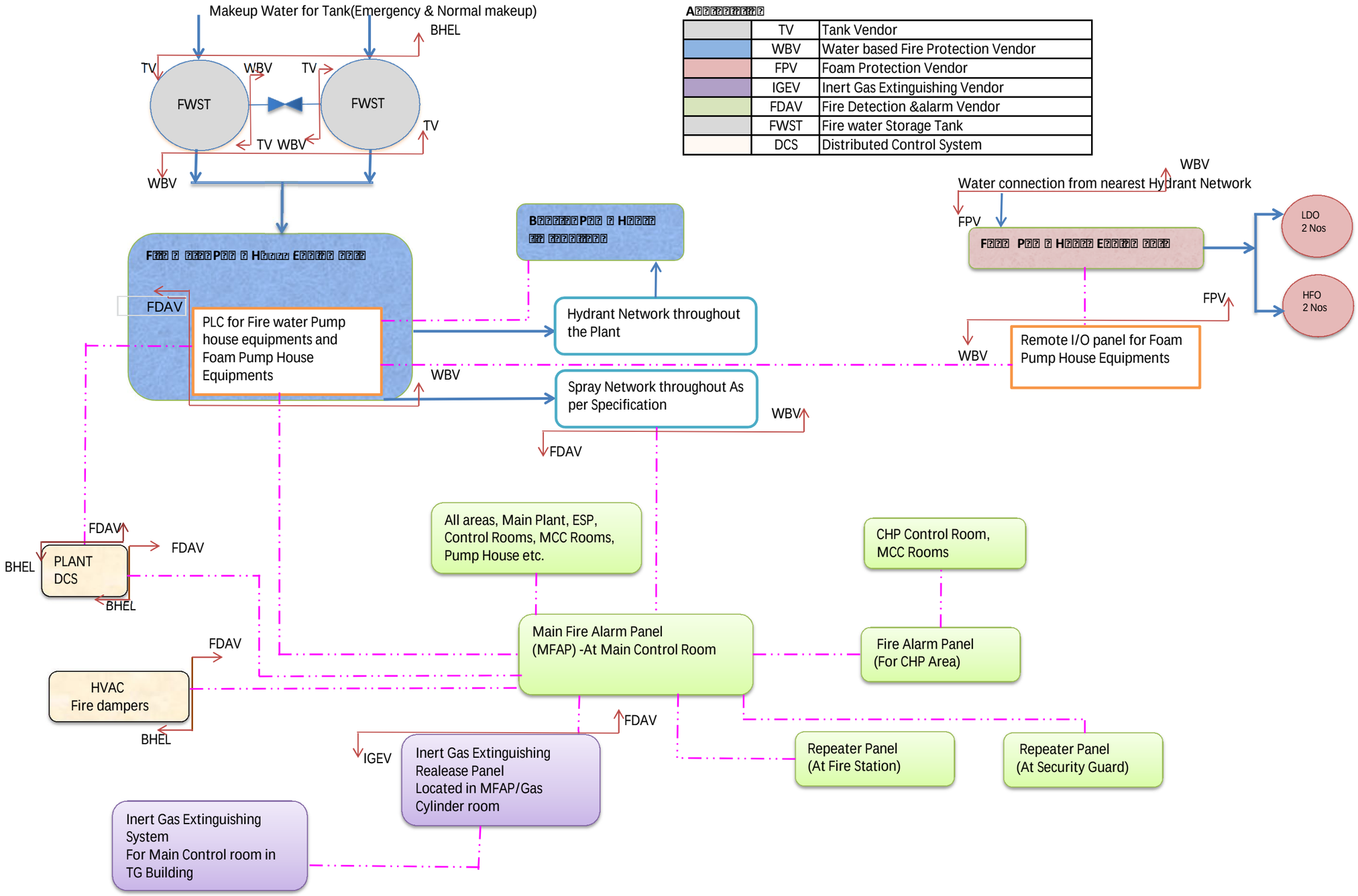
PLOT PLAN

SCALE 1:2080

DRAWING NO. PE-DG-374-100-M001

SHEET 1 OF 1 REV. 06

FORMAT SIZE A0



A[illegible]

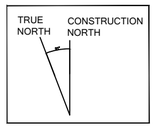
	TV	Tank Vendor
	WBV	Water based Fire Protection Vendor
	FPV	Foam Protection Vendor
	IGEV	Inert Gas Extinguishing Vendor
	FDAV	Fire Detection &alarm Vendor
	FWST	Fire water Storage Tank
	DCS	Distributed Control System

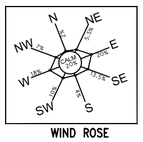
Note:
1. Signal from Pressure Switch & SOV's in all the area shall be connected to MFAP. Cabling between the PS & SOV and MFAP shall in the scope of FDA Vendor.
2. Potential free contact for HVAC fire dampers shall be provided in MFAP, numbers shall be given in detail engineering.
3. Signal from Level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

FIRST ANGLE PROJECTION

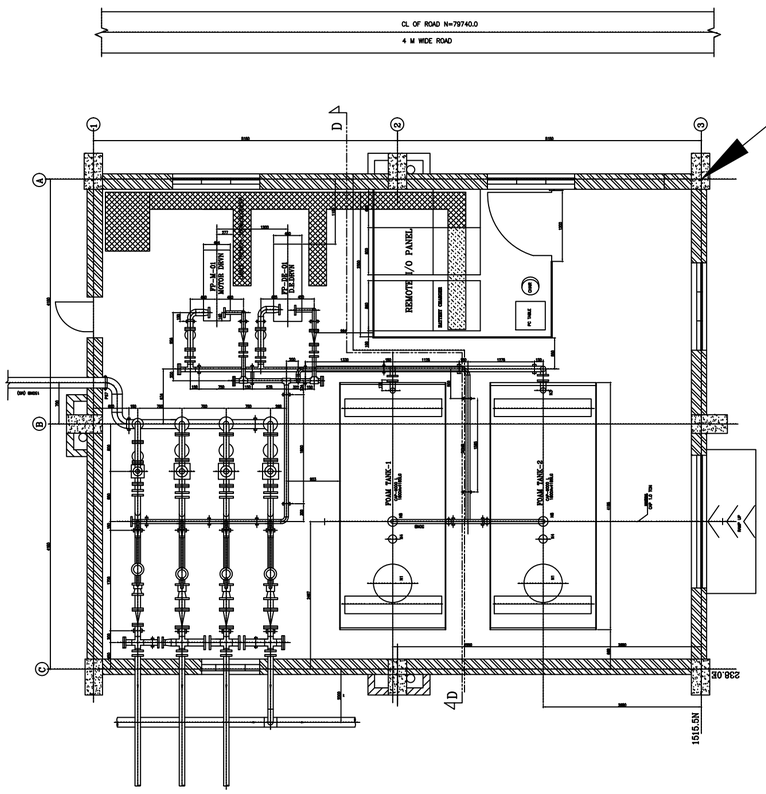
(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-38101-05642 SH. 1 OF 1

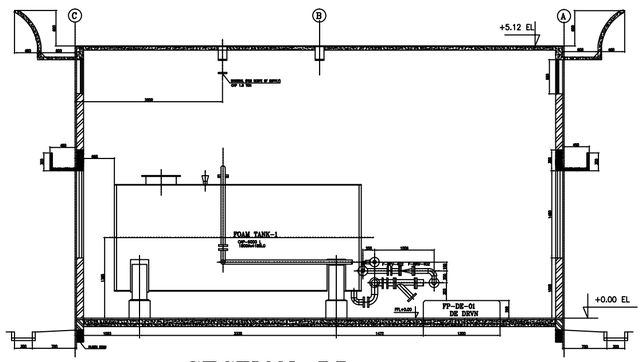




WIND ROSE

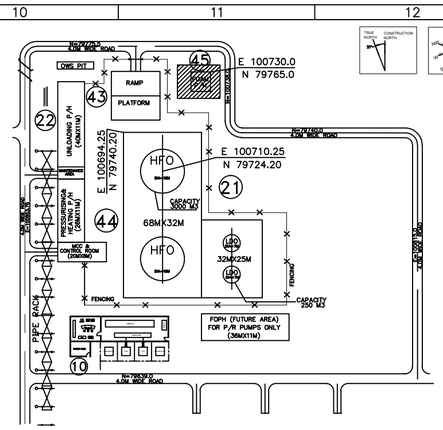


PLAN OF FOAM HOUSE



SECTION–DD

ELEVATION



KEY PLAN

NOTES:–

1. ALL DIMENSIONS ARE IN mm. & ELEVATION ARE IN Mtrs.
2. LOCATIONS AND DIMENSIONS OF CONTROL PANELS AND TRENCHES AROUND IT ARE INDICATIVE ONLY.
3. FOLLOWING(S) WORK ARE IN THE SCOPE OF BHEL.
   a) CABLE TRENCHES.
   b) RCC PEDESTAL FOR PIPE SUPPORTS AND EQUIPMENT FOUNDATION IN AND AROUND PUMP HOUSE
4. FINISH GROUND LEVEL: RL(+) 45.0M
5. EL+0.00 CORRESPONDS TO RL.45.5M
6. FOUNDATION DETAILS OF PUMPS & OTHER FIRE FIGHTING EQUIPMENTS WITHIN PUMP HOUSE ARE KEPT ON HOLD.
7. DIMENSIONS INDICATED IN THE DRG. ARE AS PER DATA BASE & MINOR CHANGES MAY OCCUR DURING DETAIL ENGG.

REFERENCE DRAWING:–

1. PLOT PLAN: PE–DG–374–100–M001– REV06

PRELIMINARY

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME 13810105642-S00-R00

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD

JCS

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	SKB	–SD–	10.05.13	–N.A.–
CHD.	K AMIT	–SD–	10.05.13	
APPD.	K GUNJAN	–SD–	10.05.13	

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

NAME OF CUSTOMER/PROJECT: BIHAR STATE ELECTRICITY BOARD
2 X 250 MW BARAUNI THERMAL POWER STATION
UNIT #8 & #9

NAME OF CONSULTANT: STEAG ENERGY SERVICES(INDIA) PVT. LTD.

DEPT. I.T.D. CODE. 415 | UNTOL. DIMS. GR. ~~C/M/F~~ | SCALE 1:50 | WEIGHT (KG) |
REF. TO ASSY. DRG. | ITEM NO. –N.A.– | NO.OF ITEMS –N.A.–

TITLE: EQUIPMENT LAYOUT FOAM PUMP HOUSE

CARD CODE N.A. | DRAWING NO. 1–38101–05642 | REV. 00

SHT. No 01 | NO. OF SHT. 01