भारत हेवी इलेक्ट्रिकल्स लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)

TCN – 05

Ref: PSER:SCT:KLN-C1984:TCN-05 Date: 21-09-2019

Sub	Tender Change Notice (TCN) - 05.	
Job	PACKAGE 14C: CIVIL & ARCHITECTURAL WORKS FOR CHP,AHP & MISC.WORK FOR 2X660 MW MAITREE RAMPAL PROJECT, BANGLADESH.	
Ref	1.0	Tender no PSER:SCT:KLN-C1984:19.
	2.0	BHEL's NIT, vide reference no PSER:SCT:KLN-C1984:7559, Date: 13-09-2019.
	3.0	BHEL's TCN-01, vide reference no PSER:SCT:KLN-C1984:TCN-01 Date: 17-09-2019.
	4.0	BHEL's TCN-02, vide reference no PSER:SCT:KLN-C1984:TCN-02 Date: 18-09-2019.
	5.0	BHEL's TCN-03, vide reference no PSER:SCT:KLN-C1984:TCN-03 Date: 19-09-2019.
	6.0	BHEL's TCN-04, vide reference no PSER:SCT:KLN-C1984:TCN-04 Date: 20-09-2019.
	6.0	Other References, if any.

With reference to above, following points/ documents, relevant to tender, may please be noted and complied with while submitting offer.

1) Revised "Technical Specification for SWM (Rev-01)" and subsequent Changes/ Modifications/ clarifications as per Annexure-A to TCN-05 attached herewith, superseding earlier Technical Specification for SWM (SPECIFICATION NO. PE-TS-421-158-A001) issued along with NIT.

2) Revised `No deviation certificate' as per enclosed Annexure-2. Bidder shall submit no deviation certificate as per enclosed format only.

3) All other terms & conditions shall remain unchanged.

Thanking you,

Yours faithfully,
for BHARAT HEAVY ELECTRICALS LTD

Dy. Mgr. (SCT)

Encl: As Above.

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)
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BANGLADESH-INDIA FRIENDSHIP POWER CORPORATION (PVT) LTD (BIFPCL)

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

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VOLUME – II B

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TECHNICAL SPECIFICATION
FOR
SOLID WASTE MANAGEMENT

SPECIFICATION NO.: PE-TS-421-177-A001

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, INDIA

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		SECTION: I	
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		REV. No. 00	DATE : 06.02.2018

SECTION I

SPECIFIC TECHNICAL REQUIREMENTS
SUB SECTION IA - SPECIFIC TECHNICAL REQUIREMENTS - MECHANICAL
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	TITLE : **2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT**	SPECIFICATION NO. PE-TS-421-177-A001	
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SUB SECTION IA

SPECIFIC TECHNICAL REQUIREMENTS - MECHANICAL

	TITLE: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
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		REV. No. 00	DATE : 06.02.2018

SUB-SECTION IA

1.0 GENERAL

Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for SUPPLY PART, SERVICES PART & MANDATORY SPARES comprising of design (i.e. Preparation and submission of drawing/ documents including " As Built " drawings and O&M Manuals) engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables, chemicals, mandatory spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in site transportation, assembly, minor civil works, erection & commissioning, trial run at site, preparation of drawings in 3D (if applicable) and carrying out performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/ client, operation & Maintenance & final handing over to end customer in flawless condition for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.

2.0 SCOPE OF SUPPLY

2.1 SCOPE OF SUPPLY FOR SOLID WASTE MANAGEMENT

Following below mentioned scope of solid waste management shall be in scope of bidder:

2.1.1 One (100) nos. of manual sweeping sticks of reputed make along with required accessories. The sweeping sticks shall be provided of suitable length so that sweeping of roads shall be done easily with these sweeping sticks.

2.1.2 Bidder to consider necessary Waste baskets/bins for streets and distributed on the streets, at least one waste basket at 50-meter distance. These baskets shall be provided for roads and streets of Residential Township (3000 persons), Maitree Power plant & Jetty area. The bins shall be of MOC PVC and enable for compactor handling and tentative quantity of bins shall be 400 nos. each of minimum capacity 120 liters. However actual quantity of bins shall be calculated based on the criterion specified elsewhere in this technical specification.

2.1.3 Bidder to consider necessary Waste baskets/bins for all buildings of Maitree TPP and jetty area as mentioned in the Plot plan. Capacity of the bins shall be decided based on the criterion mentioned in Section –IA of this technical specification. Bidder to consider capacity and number of bins/ containers accordingly. The bins shall be of MOC PVC and enable for compactor handling.

2.1.4 Bidder to consider necessary Waste baskets/bins for all buildings of Residential Township (3000 persons) area as mentioned in layout of township. Capacity of the bins shall be decided based on the criterion mentioned in Section –IA of this technical specification. Bidder to consider capacity and number of bins/ containers accordingly. The bins shall be of MOC PVC and enable for compactor handling.

2.1.5 Two (2) nos. Refuse Collector Cum Compactor vehicle (RCV) with automatic compaction cycle of 8 cum effective capacity on 12-ton chassis vehicle along with all necessary accessories for the vehicle. Each vehicle shall also be equipped with suitable Announcement/ public address system along with required accessories.

2.1.6 One (1) no. Tipper truck of effective capacity of 3.0 m3 capacity along with hydraulic unloading system. The tipper truck shall be provided with all other accessories required for tipper truck. Vehicle shall also be equipped with suitable Announcement/ public address system along with required accessories.

2.1.7 One (1) no. Vacuum suction machine mounted on truck of effective storage capacity of 3 m3 along with all necessary accessories for the vehicle.

2.1.8 Two (2) nos. of backhoe loader of specification JCB-3DX-XTRA Model or equivalent reputed make & model along with necessary accessories for the handling of residual and recycle waste and compost turning.

2.1.9 One (1) no. vibratory compactor of specification JCB 116 model or equivalent reputed make & model along with necessary accessories for landfill area compaction.

2.1.10 One (1) no. trommel of trommel screen size of 100 mm (Body cover & Screen MOC –MS). The trommel shall consist of feed, process/Undersize and reject lines which shall be chain conveyor belt type and electrically operated. The trommel shall be semi-automatic and shall be provided with all other accessories required for the same. The trommel shall be designed to handle minimum 1.5 tons waste per hour.

2.1.11 One (1) no. trommel of trommel screen size of 20 mm (Body cover & Screen MOC –MS). The trommel shall consist of feed, process/Undersize and reject lines which shall be chain conveyor belt type and electrically

operated. The trommel shall be semi-automatic and shall be provided with all other accessories required for the same. The trommel shall be designed to handle minimum 1.5 tons waste per hour.

2.1.12 One (1) no. trommel of trommel screen size of 4 mm (Body cover & Screen MOC –MS). The trommel shall consist of feed, process/Undersize and reject lines which shall be chain conveyor belt type and electrically operated. The trommel shall be semi-automatic and shall be provided with all other accessories required for the same. The trommel shall be designed to handle minimum 1.5 tons waste per hour.

2.1.13 One (1) no. trommel of trommel screen size of 2 mm (Body cover & Screen MOC –MS). The trommel shall consist of feed, process/Undersize and reject lines which shall be chain conveyor belt and electrically operated. The trommel shall be semi-automatic and shall be provided with all other accessories required for the same. The trommel shall be designed to handle minimum 1.5 tons waste per hour.

2.1.14 One (1) no. semi-automatic, manual feed, double shaft, electrically operated screw shredder of capacity 100-150 kg/ hr. shall be provided. The shredder shall be capable of Shredding all form of organic waste.

2.1.15 One (1) no. semi-automatic Density Separator with Aspirator/ Destoner with feed conveyor belt system of 1.5 tons/hour for separation of metal, dust and other particles form the final compost after screening from 2 mm trommel.

2.1.16 One (1) no. semi-automatic, manual feed hydraulic bale press horizontal/ vertical shall be provided to compact the sorted plastic materials, paper and cardboard all materials in one machine. The minimum throughput capacity of this bale press shall be 1 ton /hour. The machine should have provision of tiding the bales with wire/ plastic ribbons inside the machine itself while pressing the materials in machine.

2.1.17 Two (2) Nos. (1W+1S) cleaning system (Bosch or equivalent make) shall be provided for wheel washing of all vehicles so that dirt and litter originating from the site is not dispersed onto public roads and the surrounding land. The cleaning system have to utilize water and air both for cleaning of wheels of vehicles provided for solid waste management.

2.1.18 The sorting area shall be provided with a long sorting table of approx. 5 x 1.5 m (of MOC: SS-304) and 20 nos. of 240 liters storage capacity bins for the sorted fractions. Sorted fraction bins 12 nos. of shall of MOC plastic and 8 nos. of MS construction.

2.1.19 A Weighbridge of 20 tons capacity shall be provided within the WMC for measurement of the different incoming & outgoing waste to Waste management center (WMC).

2.1.20 Complete basal liner system for land fill site (for 30 years) shall be in scope of supply of bidder. The landfill shall be provided with a basal liner in accordance with Annex-1 of the European Union COUNCIL DIRECTIVE 1999/31IEC on the landfill of waste. It shall be assumed, that no geological barrier does exist. The complete barrier shall be designed artificially with the basal liner system. No slope of the basal liner shall be steeper than 1:2. All liners shall be in bidder's scope of supply.

2.1.21 A leachate drainage system for complete land fill site (for 30 years) shall be installed above the basal liner. The leachate shall be collected to a leachate pond (MOC: RCC not in bidder's scope) sealed with an impermeable liner. The complete leachate drainage system design & mechanical, electrical and instrumentation supply shall be in bidder's scope. All liners required for land fill site as well as leachate treatment & drainage system shall be in bidder's scope. The leachate pond shall have a capacity to receive the average leachate quantity of 20 consecutive days or the quantity after 3 days continuous heavy rainfall, whatever is larger. The leachate pond capacity shall be selected based on the leachate generated from the land fill area as well as leachate generated from WMC. For rain fall data bidder to refer sub section IA, Annexure-XI.

2.1.22 Two (2) Nos.(1W+1S) vertical submersible type leachate transfer pumps for transfer of leachate from leachate collection sump (collection sump civil work in BHEL scope) provided near WMC to leachate pond along with complete instrumentation, valves, piping, fitting and flanges etc. The MOC of the pumps, piping, valves, flanges & fittings shall be compatible to handle leachate.

2.1.23 Two (2) Nos. (1W+1S) vertical submersible type leachate transfer pumps for transfer of leachate from leachate pond (leachate pond civil work in BHEL scope) to leachate treatment system along with complete instrumentation, valves, piping, fitting and flanges etc. The MOC of the pumps, piping, valves, flanges & fittings shall be compatible to handle leachate.

2.1.24 Bidder to provide a RO based leachate treatment system of suitable capacity for the treatment of leachate generated from various areas of Waste management center (WMC) comprising the landfill site (which is outside WMC), composting and Recycling plant. The treated water quality coming out from the leachate treatment system shall be as per environmental & pollution norms and under all operating conditions shall comply with all local and national acts and regulations of Bangladesh and shall be suitable to discharged to surface water. Sumps & civil work required for the same shall be in BHEL scope. However, any pump required for pumping for clear water or pumping of leachate other than specified above along with the motors, valves, piping, instruments, along with fitting and flanges shall be in bidder's scope of supply. RO reject shall be

collected in an evaporation pond of suitable capacity; the design of evaporation pond shall be in bidder's scope. The control of Leachate collection, treatment & disposal shall be microcontroller based.

2.1.25 Bidder to consider 3 nos. groundwater monitoring wells around the landfill area. One (1) of the well shall be located up- stream of the groundwater flow in order to receive quality data of clean groundwater and two nos. (2) Wells shall be located downstream. Civil work of groundwater monitoring wells shall be in BHEL scope. However, design of groundwater monitoring wells & mechanical, electrical & C&I items scope of supply for groundwater monitoring system shall be in bidder's scope.

2.1.26 The land fill site shall be separately surrounded by a fence of 2 m height and 3 rows of protecting wire and a gate, which can be locked during hours of no operation. The same shall be in bidder's scope.

2.1.27 An appropriate drainage system shall be implemented for rain water coming from those parts of the land fill site where no waste is handled. The rain water retention basin (civil work in BHEL scope) shall be designed to ensure storage of all rainfall from the site at a defined discharge of no more than l0 Lit/sec. For this overall mechanical design shall be in bidder's scope.

2.1.28 All environmental control and monitoring equipment and systems required for solid waste management plant shall be in scope of Bidder.

2.1.29 Bidder shall carryout all required environ-mental studies, site investigation, and geological and hydrogeological as well as topographical survey as requested by the responsible environmental authorities for the selected site. Bidder is responsible to get approval for the selected site from all responsible authorities.

2.1.30 Complete system design of Solid waste management plant shall be in bidder's scope. As soon as the site for the WMC has been selected and approved by all responsible authorities, the Bidder shall prepare a preliminary overall design for the possible complete lifetime (30 years) of this Waste Management Centre(WMC) comprising the landfill site (which is outside WMC), composting and Recycling plant.

2.1.31 Bidder shall prepare the detailed design only for the 1st cell required for the first landfill operation which is required for a period of 5 years. The landfill body shall be developed during the operation in such a way that geometry shall ensure long-term stability. The design of the same shall be submitted for owner approval.

2.1.32 Bidder shall establish a control and monitoring system as requested by local authorities. Minimum requirements are a monitoring system for all incoming waste, indicating at least source of waste, quantity (weight) and date.

2.1.33 Bidder to consider operation and maintenance of WMC until the handover of the Solid waste management package to end customer (BIFPCL). Further after handover of SWM package to end customer (BIFPCL) additional 1-year O&M of solid waste management plant shall be in bidder's scope.

2.1.34 Initial charge of all lubricants, grease, RO plant chemicals & fuel (diesel & petrol) etc. shall be in bidder's scope. Bidder to also consider all lubricants, grease & fuel (diesel & petrol) in their scope till handover of the SWM package to end customer (BIFPCL) and additional one-year requirement of lubricants, grease, RO plant chemicals & fuel (diesel & petrol) etc. For solid waste management plant.

2.1.35 All piping related to solid waste management plant package shall be in bidder's scope (leachate pumping, leachate transfer, leachate treatment, RO-based leachate treatment plant & treated waste disposal etc.)

2.1.36 Bidder to note that for solid waste management system covered under the scope of this specification, minimum requirements has been specified. However, to meet the system and outlet guarantee requirements as specified in the specification, any additional equipment if required, shall be in the scope of bidder.

2.1.37 Bidder to ensure that no single fault shall lead to a total plant failure for solid waste management package and accordingly bidder to envisage the redundancy of equipment, instrumentation and any other item over and above the specified requirements in the technical specification.

2.2 OTHER TECHNICAL REQUIREMENTS/ SCOPE (APPLICABLE FOR SOLID WASTE MANAGEMENT PACKAGE)

2.2.1 Bidder to note that the equipment, valves, piping, control & instruments required as per system requirement and technical specification of solid waste management package are minimum and are in bidder's scope. During detailed engineering, bidder to furnish complete and detailed scheme in all respects including all valves, equipment's etc.as required for smooth, safe, efficient, trouble free operation and completeness of solid waste management plant, meeting the specification requirement.

2.2.2 Pipe racks shall be provided by BHEL wherever available, wherever pipe racks are not available, pipe shall be laid on pedestal to be provided by BHEL. If buried piping is required, Wrapping, coating and protection of all the buried pipe is also in bidder's scope & shall be as per AWWA C 203. However, all auxiliary steel structure (U-clamps, nuts, bolts, channels etc.) for fixing pipes on pedestal or racks shall be in bidder's scope. Inputs for pipe pedestals as per requirement and layout shall be furnished by bidder during detailed engineering.

2.2.3 Pipe sizes are not indicated for solid waste management package, Bidder to select the pipe sizes for solid waste management package based on the technical specification requirement and shall be subject to BHEL/ customer approval during detailing engineering without any price and delivery implication to BHEL/ Customer.

2.2.4 Wherever terminal points between BHEL and bidder indicated, bidder shall provide pipes with counter flange. All blank flanges/counter flanges, isolations valves, tees etc. to interconnect the pipes at all terminal points.

2.2.5 Bidder to take care of the length of piping as included elsewhere in the technical specification for solid waste management package. Pipe routings shall be decided during detailed engineering. However, bidder will consider 10 m static head + 10% margin during pump selection for outside area for solid waste management package as applicable.

2.2.6 All steel inserts plates with lugs, rungs, ladder, puddle pipes, bolts, edge angle in desired shape, nuts, sleeves, gaskets and all other embedding components etc. as required to grout in BHEL civil works and to support/hold the equipment being supplied under this specification shall be in bidder's scope. Rungs/ ladder provided by bidder in any sump shall be coated with suitable material w.r.t. water/ liquid handled.

2.2.7 All pipes, fittings etc. required for hand railing, platforms, and ladders shall be in the scope of bidder. All ladders shall be non-civil work. Supply and erection of Hand railing as required for safety purpose will be in bidder's scope. All handrails shall be of 32 mm nominal bore MS pipes (medium class) as per ASTM A 500 or equivalent international standard galvanized using 750 gm. / sq. m of zinc. Hand railing shall be a two-rail system with the top rail 1000 mm above the walkway surface and the intermediate rail 450 mm below the top rail. Handrail post spacing shall be limited to 1500 mm as far as possible but can be proportioned to the length of the opening. In such a case spacing shall not exceed 1850 mm center to center of posts. Hand railing shall be shop fabricated for specific locations and field welded or bolted to the erected structural steel. Railings shall be provided with 100 mm wide and 8 mm thick MS strip at bottom as toe guard all along the length of railing in horizontal plane. For RCC stairs, hand railing with 20 mm square MS bar balustrade with suitable MS flat and Aluminum/ Teakwood handrail shall be provided, unless specifically mentioned otherwise.

2.2.8 All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc. shall be in bidder's scope.

2.2.9 Hangers and supports for all the piping as per the requirement shall be in bidder's scope.

2.2.10 All necessary drains, vents, breathers, CO_2 absorbers, seal pots, fume absorbers and sampling points with valves as specified and as required for the complete solid waste management plant Package are in bidder's scope.

2.2.11 All the sumps, tanks, reservoirs and other water retaining structures shall be provided with access ladders/rungs from operating platforms/ground level as the case may be and de-watering pits one for each section (civil work by BHEL).

2.2.12 All necessary structural steel for pipe supporting structure, platforms, walkways and access stairs, mechanical plant and equipment, mechanical services and pipe work associated with solid waste management plant package.

2.2.13 One set of all special tools & tackles of reputed make necessary for proper maintenance or adjustment of the equipment being supplied by the bidder for solid waste management plant Package, packed in permanent box.

2.2.14 One set of maintenance and repair tools including all special tools and tackles required for the installation and maintenance of equipment for solid waste management plant Package for commissioning, testing, calibration, modification and maintenance.

2.2.15 Finish paints for touch up painting of equipment after erection at site in sealed container.

2.2.16 All the first fill and one Year's topping requirements or 15% of first fill quantity, whichever is more, of consumable such as greases, oil, lubricants, servo fluids/ control fluids, which will be required to put the equipment covered under the scope of specifications, into successful commissioning/ initial operation and to establish completion of facilities shall be furnished by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

2.2.17 Monitoring gadgets, instruments and equipment required for maintenance (till demonstration/ PG test and plant handover).

2.2.18 Instrument hook up material shall be in bidder's scope.

2.2.19 Any item/ work either supply of equipment or erection material which have not been specifically mentioned in but are necessary to complete the woks for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification and shall be in bidder's scope and will be supplied by bidder without any commercial, technical and delivery implication to BHEL and customer.

2.2.20 All other items are also included in scope of supply as specified in other parts of the technical specification.

2.2.21 Any statutory requirement / clearance required for any of the packages from government / local body shall be in bidder's scope. Bidder to also comply local body / government norms.

2.2.22 All motorized valves shall be provided with integral starter.
2.2.23 Start-up and commissioning spares as required.
2.2.24 Mandatory spares for solid waste management plant Package as per the list attached in ANNEXURE-VI/ Sub Section IA & specified elsewhere in the technical specification.
2.2.25 Electric hoist and chain pulley block as per specification requirement.
2.2.26 Electrical scope shall be as per 'Electrical Scope between BHEL and Vendor' enclosed elsewhere in the technical specification. Scope of cables indicated in 'Electrical Scope between BHEL and Vendor' is applicable for control and instrumentation cables also. Screen control cable is meant for electrical as well as signal/ instrumentation cables.
2.2.27 PRV connection to respective tanks shall be provided by bidder for all dosing (metering/ positive displacement) pumps.
2.2.28 Recirculation lines for pumps shall be provided by bidder along with valves, instrumentation, fittings as per system requirement.
2.2.29 Bidder to note that Chinese Standards and codes are not allowed for any items/ equipment. In case bidder proposes any IS code, it shall be verified by reputed institutions like IIT that the proposed code is equivalent or superior to the codes mentioned above. Comparison report shall be established and provided to BHEL/Owner for information. Such report shall highlight the main items of the code, including material composition, material properties, design clauses and others as required. Report shall identify deviations of both codes and give justification for this deviation. No cost or time implication will be acceptable for any delay on account of non-acceptance by customer of justification for deviation by bidder. In case equivalence is not established, bidder has to provide material as per specified codes only.
In case International standards like IEC or ISO is available, this shall be followed.
2.2.30 Latest version of all codes and standards to be followed. Further in case of any contradictory requirement in design codes, the more stringent one to be followed and acceptable to BHEL & Customer. Wherever Indian or Chinese Standards/ codes have been remained mentioned in this specification, bidder to design/ provide items/ equipment as per equivalent or superior international standards/ codes acceptable to BHEL and Customer.
2.2.31 Bidder can use SA/IS2062 standard for structural steel for general structural purpose.
2.2.32 All the equipment and items shall be properly packed as per requirements stipulated in sea worth packing specification enclosed as Annexure-XIV/ Sub Section IA and shall be transported in containers.
2.2.33 Apart from package specific design requirement indicated in this technical specification, design of various systems/ sub-systems and all equipment/ items will also strictly meet stipulations of Part-B0, PART-B6 & B12 –part-9 of Customer's Technical Specification (included in Annexure-XI/ Sub Section IA) as relevant to solid waste management Package.
2.2.34 All Valve, piping, fitting, and instrument shall be of minimum PN 10 rating.
2.2.35 The MOCs indicated in the Technical Specification, Datasheet and P&IDs for various items/ equipment/ piping/ valves/ fittings are minimum requirement and to be complied by the bidder. However, bidder has to assess it and provide equivalent or better & suitable MOC for sea water applications, wherever applicable.
2.2.36 Initial charge of all lubricants & grease in bidder's scope.
2.2.37 Diaphragm seal for instruments shall be provided by bidder as per technical requirement.
2.2.38 Material handling equipment for submersible & sump sumps.
2.2.39 KKS numbering for all items/ equipment including electrical and control & instrumentation to be provided by bidder during detailed engineering. KKS numbering philosophy shall be furnished during detailed engineering.
2.2.40 Grouting material required for fixing of equipment/ items.
2.2.41 For the complete scope of the system, bidder to note that control of solid waste management package as elaborated in this specification shall be fully automatic. Any additional required instrumentation/ valves for fully automatic, smooth and trouble free operation of the system shall be in bidder's scope and shall be subject to approval during detailed engineering by BHEL and Customer.
2.2.42 Motorized valves shall be selected for solid waste management plant.
2.2.43 All documents, including the installation and operation and maintenance manuals as well as the related software shall be in fluent, legible English. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format.
2.2.44 Bidder to include/ indicate the toilet blocks (gents & ladies) in solid waste management plant building layout and corresponding civil drawing.
2.2.45 Bidder to note that for solid waste management system covered under the scope of this specification, minimum requirements has been specified. However, to meet the system and outlet guarantee requirements as specified in the specification, any additional equipment if required, shall be in the scope of bidder without any price and delivery implication to BHEL.

2.2.46 METERING PUMPS

a. Pumps shall be simplex displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit. Maximum pump stroke speed shall not exceed100 per minute.
b. The stroke shall be continuously adjustable to give a capacity variation 10-100% range while the pumps are running or stopped. Adjustment of capacity shall be done by automatically from remote location and / or manually (micrometric adjusting type) locally for each of the pump as described elsewhere.
c. Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard ± 1% of capacity setting.
d. Pumps shall be provided with an integral relief valve, spring operated, to release pressure when delivery line blockage occurs.
e. Crank case shall be constructed of high quality cast iron which will also house the gear box and guides for cross head.
f. Guided, controlled travel, double-ball check valves or equivalent, shall be provided both on the suction and discharge sides. Suitable gland seal be provided to prevent leakage.

2.3 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical as per specification / details indicated in Sub Sections IB and IIB.

2.4 SCOPE OF SUPPLY (C&I)

Complete C&I as per specification / details indicated in Sub Sections IC and IIC.

2.5 SCOPE OF SUPPLY (CIVIL)

Complete architectural, structural and civil construction work for solid waste management plant package is in BHEL Scope. For solid waste management plant, civil input drawings shall be furnished by the bidder during detailed engineering.

3.0 SCOPE OF SERVICE

The bidder's scope also includes following services for scope under this specification:

a. Unloading, Storage, handling and transportation at site.
b. Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself, excavation & filling of earth for buried pipes if and as required. Vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation.
c. Pre-commissioning work such as flushing, hydraulic testing etc. Necessary tools, consumables and instrumentation as required for inspection and testing at works as well as at site including pre-commissioning activities shall be arranged by the successful bidder at their own cost.
d. Erection and Commissioning of all solid waste management plant Package.
e. Arrangement of all lubricants, instruments, tools, reagents for carrying out trial run, commissioning and performance guarantee/ demonstration test.
f. Monitoring gadgets, instruments and equipment required for maintenance (till performance guarantee/ demonstration test & Plant Hand over).
g. All personnel required during commissioning, trial run and performance guarantee/ demonstration test.
h. Trial run for requisite period.
i. Performance guarantee/ demonstration test of solid waste management plant package.
j. Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
k. Relevant requirements as per GTR, GCC, ECC & SCC etc.
l. Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system as well as to meet any statutory requirement relevant to the package, unless specifically excluded from scope of services.
m. Painting as per enclosed painting schedule ANNEXURE V/ Sub Section IA. However, any variation in the painting schedule as finally approved by customer / BHEL shall be taken care by bidder without any commercial and delivery implication. Colour-coding scheme shall be intimated to vendor during detailed engineering.
n. Any statutory requirement / clearance required for any of the packages from government / local body shall be in bidder's scope.

o. Operation and maintenance of solid waste management plant (WMC) until the handover of the Solid waste management package to end customer (BIFPCL). Further after handover of SWM package to end customer (BIFPCL) additional 1-year O&M of solid waste management plant shall be in bidder's scope as per guarantee /demonstration test parameters.

p. Bidder to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned engineering representatives along with the project manager for discussion and approval of engineering drawings/ documents during detailed engineering to meet project's various milestones and completion schedule, without any price implication to BHEL and Customer. Meeting can be held at site also.

q. Obtaining clearance from Bangladesh government authority/department & Bangladesh statutory requirements for complete solid waste management plant.

4.0 TERMINAL POINTS

a. Service Water pipeline (50 NB) will be provided by BHEL at 5 m distance from solid waste management plant package area. Further distribution inside solid waste management plant area will be in bidder's scope. Bidder to note that pressure available at terminal point for service water will be approximately 1-2 kg/cm^2. Hence, bidder will take care for their pump lubrication/ cooling accordingly.

b. Potable water connection shall be provided by BHEL for Solid Waste Management at 5 m distance from solid waste management plant area. Further distribution inside the solid waste management plant package area will be in bidder's scope.

5.0 EXCLUSIONS

5.1 All civil construction works including foundation of equipment, structural shed, excavation & back filling.
5.2 Main pipe trestles.
5.3 Ventilation, Air conditioning & firefighting facilities.
5.4 Other exclusions are mentioned in the Electrical & C&I parts of this specification.
5.5 Service water, Potable Water up to terminal points.
5.6 Monorail beams for electric hoists.
5.7 Hard copies of codes and standards used for designing of various systems/ items/ equipment.

6.0 QP AND SUBVENDOR APPROVAL:

6.1 Minimum QP requirements are specified in Annexure I/ Sub Section IA. In addition to the requirements indicated in Annexure-I, bidder to refer Annexure-XI/ Sub Section IA also for quality assurance requirements. However, any additional comments as given by BHEL/Customer shall be adhered by the bidder without any commercial & delivery implication to BHEL.

6.2 The sub vendor list (Annexure- II/ Sub Section IA) enclosed is indicative only and is subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

6.3 Bidder to assess the capability of their proposed sub-vendors in terms of preparation of drawings, calculations, documents, quality assurance, supply of material etc. as per project schedule before placing the order on them.

7.0 DESIGN/ CONSTRUCTION REQUIREMENTS FOR SOLID WASTE MANAGEMENT

7.1 SOLID WASTE MANAGEMENT SYSTEM

7.1.1 PLANT DESCRIPTION/ DESIGN

Solid waste management shall consist of waste collection, recycling, treatment and disposal as required for the waste collected from the Maitree-STPP, the Jetty and the adjacent Township.

Waste collected shall be transported/ transferred manually through vehicle to waste management center (WMC).

WMC consist of composting, Sorting, Recycling facility and Land filling facility as required for different type of solid waste.

Composting facility in a first step shall include only green waste (150 kg/day –Grass, leaves, and branches etc. of park waste) and at later stage expanded to treat organic and kitchen waste from house hold and canteen etc. During erection and commissioning of the plant it shall be treating the composting of green/park waste and when the canteen and township will become functional it shall treat their organic waste also. So compost facility sizing shall be =80% of Household Waste from township and plant+50% of Bulky Waste+ 50% of Commercial Waste+50% Waste from Power Plant+100% of Green / Park Waste= 0.8*2.4+0.5*0.25+0.5*0.72+0.5*0.13+0.15=2.62 t/ day and hence considered as 2.7 t/ day. Taking appropriate margins and considering future expansion of plant composting facility shall be provided of 3 tons per day.

The sorting facility shall be designed to sort the mixed fraction (paper, cardboard, plastic, glass and metal) collected from the township, Maitree STPP (power plant site). This facility can be extended to sort other recycling fractions, in case there are other fractions that can be sold on the market. There shall be a bin/ container catering to these materials placed in each building of plant and township. Materials like paper, card board, plastic, glass, metal, batteries, tubes, bulbs need to be collected from the individual building once a week and brought to the sorting and recycling facility of WMC. There the same shall be sorted, segregated and packed separately for recycling and selling in the respective market as applicable.

The residual waste shall be collected and transported to the landfill in the WMC. The landfill shall be designed for a running or operational lifetime of 25 - 30 years. This residual waste shall be screened from 100 mm & 20 mm trommel screen. Residual waste (more than 100 mm and 20 mm size) after screening from trommel & 20 mm trommel reject after manual inspection shall be sent to landfill along with this bulky waste and commercial waste generated from the Maitree STPP & township. But bulky waste and commercial shall be segregated in WMC before disposing it in to landfill.

It is assumed that following waste streams will be generated:

1) Township (from residents and commercial enterprises)
2) Power Plant site (Maitree STPP)
3) Jetty (waste from the transfer barges)
4) Green areas (Grass, leaves, branches, etc.)

Waste Quantities generated from different sources (approximately) will be as mentioned below:

For the design of the facilities, an amount of 0.8 kg waste / capita/day is to be assumed to be generated.

Table -1

Waste Producer	Township Population - 3000 Power Plant Personnel - 160					
	T/Day	T/Year	Cum/Day	Cum/year	Mode of Treatment	Suggested
Household Waste from township and plant	2.4	876	12	4380	Waste for disposal to landfill	Household waste from township and plant can be composted so the same shall be sent to the windrow composting facility and reject from the same after passing through trommels/ Vibro screens should be sent to landfill.
Bulky Waste	0.25	91	1.6	584	0.2 t/day is used for disposal to landfill	Shall be used for Disposal for landfill. However based on the type of bulky waste, the same can also be used for selling or composting.
Commercial Waste	0.72	263	4.8	1752	0.7 t/day is used for disposal to landfill	Shall be used for Disposal for landfill. However based on the type of commercial waste, the same can also be used for selling or

						composting.
Waste from Power Plant	0.13	47	0.64	234	Waste for disposal to landfill	Shall be used for Disposal for landfill. However based on the type of waste, the same can also be used for selling or composting.
Waste from barges	0.02	7.3	0.08	29	Waste for disposal to landfill	Shall be used for Disposal for landfill. However based on the type of waste, the same can also be used for selling or composting.
Green / Park Waste	0.17	62	0.34	124	0.15 t/day is used for composting.	Shall be used for composting.
Total Waste Generation	3.69	1346	19.46	7103		
Out of total Waste generation waste for composting calculated =						2.7 tons / day

a. Out of 0.17 t/day, 0.15 t/day of green/park waste (grass, leaves, and branches) shall be used for composting generated in the township and power plant site in the beginning and at a later stage expanded to treat organic and kitchen wastes from households, canteens, etc. So taking appropriate margins and considering future expansion of plant windrow composting facility shall be provided for 3 tons per day.
b. Out of 0.72 t/day only 0.70 t/day of commercial waste shall be sent to WMC. This commercial waste shall consist of recycling materials (papers, cardboard, metal and, plastics) are to be transported to the waste recycling center located in the WMC.
c. Out of 0.25 t/day only 0.20 t/day of bulky waste shall be sent to WMC. If required, the same shall be further processed to landfill after screening of the material in WMC.
d. About 4.0 t/day of residues shall be transported and disposed off at the landfill area located outside the waste management center (WMC).

7.1.2 SYSTEM DESCRIPTION

Solid Waste Management System comprises of the solid waste segregation at the source, waste collection, recycling, treatment and suitable disposal.

Waste generated is broadly classified as organic waste, recyclable waste and residual waste. Organic waste which includes green waste (leaves, branches etc.) from plant can be treated through windrow composting facility. Recyclable waste including plastics, paper, cardboard, glass and metal can be sorted out and sold in market. Residual wastes (all other wastes) can be treated suitably. The wastes that cannot be treated (recycled & composted) shall be disposed off to land fill site.

The system shall have the following major components

7.1.3 WASTE COLLECTION AND TRANSPORTATION

I. Door to door collection means collection of segregated solid waste from the door step of households, shops, commercial establishments, offices, institutional or any other non-residential premises and includes collection of such waste from entry gate or a designated location on the ground floor in a housing society, multi stories building or apartments, large residential, commercial or institutional complex or premises.
II. Dry waste other than biodegradable waste and inert street sweeping and includes recyclables and non-recyclable waste, sanitary napkins and diapers etc.
III. “Inerts” means wastes which are not bio-degradable, recyclable street sweeping or dust and silt removed from the surface drains
IV. “Informal waste collector” includes individuals, associations or waste traders who are involved in sorting, sale and purchase of recyclable materials.
V. "Leachate" means the liquid that seeps through solid waste or other medium and has extracts of

dissolved or suspended material from it.

VI. "Recycling" means the process of transforming segregated non-biodegradable solid waste into new material or product or as raw material for producing new products which may or may not be similar to the original products.

VII. “Residual solid waste” means and includes the waste and rejects from the solid waste processing facilities which are not suitable for recycling or further processing.

Wastes shall be collected from Maitree STPP and township (as & when applicable) and from jetty area. The system shall include:

- Necessary number of Sweeping sticks for road sweeping provided in the township, Maitree STPP & jetty area.
- Public litter bins/containers shall be provided in the township, Maitree STPP & jetty area.
- Separate waste collection containers for recycling waste and residual waste shall be provided.
- Waste collection vehicles [Refuse Compactor Vehicle (RCV)] shall be provided to collect the waste from Public litter bins/ containers from respective area as mentioned above.
- Open tipper truck to collect bulky waste and green/park waste from the township and to transport the waste to the treatment facility.
- Vacuum suction machine mounted on truck for collection of green waste (leaves) from the road corners.

7.1.4 WASTE COLLECTION AND TRANSPORTATION FOR THE TOWNSHIP

Waste collection and transportation from the township with an estimated population of about 3,000 persons shall be provided. All the waste collected will be transferred to waste management center:

One (1) container to collect recycling materials from each building within the township. The size or volume of the containers shall be provided based on the number of persons accommodated for the residential accommodation in each building and shall be calculated based on 1.2 liters per resident and day. The collection frequency for the recycling waste collection bins/containers shall be according to the requirement, but not less than once per week.

One (1) container to collection of residual waste from each building within the township. The size or volume of the containers shall be provided based on the number of persons accommodated for the residential accommodation in each building and shall be calculated based on 6 liters per resident per day. The collection frequency for the residual waste collection bins/containers shall be daily.

Waste baskets/bins shall be provided for streets and distributed on the streets, at least one waste basket at 50-meter distance.

Two (2) nos. waste collection vehicles (i.e. Refuse compactor vehicle with automatic cycle) shall be provided to collect waste from containers & bins from each building of township, Maitree STPP and jetty area. The size of each waste collection vehicle shall be provided of minimum of 8 m^3. The waste collection vehicles shall be able to collect all types of containers/bins distributed in the township, Maitree STPP and jetty area.

One (1) open truck (i.e. Box tipper LCV) shall be provided to collect bulky waste and green/park waste from the township and to transport the waste to the waste management center (WMC). The size of the open truck shall be calculated based on the bulky waste quantities as per table defined in the design memorandum of solid waste management and shall be provided with minimum capacity of 3.0 m^3. The Collection of bulky waste and green waste shall be upon request of the waste generator.

1 no. Vacuum machine mounted on mini truck of capacity 3 m^3 for collection of sweeping waste from road and streets throughout the Township, Power plant, Jetty area.

Suitable Public address system for announcement of collection of bulky waste & green waste shall be provided with the vehicle.

For calculating the required volume for waste storage from different types of buildings, following data shall be referred.

Building use	Waste storage requirements
Residential Building	6 litres per person and day
School	2 litres per pupil and day
Restaurants	2 litres per dining space and day
Commercial Enterprise	15 litres per 10 m² of floor space and day
Offices	3 litres per 10 m² of floor space and day
Mosque	120 litre bin per mosque for residues 120 litre bin per mosque for paper
Hotel	11 litres per room and day

For consideration of the waste storage area required in each waste collection point, following data shall be referred. Following container/ bin sizes shall be selected for the project only. The wheeled bins/ containers shall be compactor compatible and of MOC-Plastic.

Bin / Container size	Waste storage area requirements
120 litres	0.5 x 0.6 m per bin
240 litres	0.6 x 0.8 m per bin
660 litres	1.6 x 1.2 m per bin
1,100 litres	1.6 x 1.6 m per container

7.1.5 WASTE COLLECTION FROM MAITREE STPP AND JETTY AREA

Sufficient number of containers/bins to collect and store the waste generated in the MAITREE STPP (estimated population of 160 persons) as well as for Jetty area shall be provided. Each building in the Power Plant and as required for the Jetty area shall be provided with each type of containers/bins mentioned below:

One (1) container to collection of residual waste from each building within Maitree STPP. The size or volume of the containers shall be provided based on the waste storage requirements given in the table below. The collection frequency for the residual waste collection bins/containers shall be daily.

One (1) container to collect recycling material (i.e. papers) from each building within Maitree STPP. The size or volume of the containers shall be provided based on the waste storage requirements given in the table below. The collection frequency for the recycling material (i.e. papers) collection bins/containers shall be according to the requirement, but not less than once per week.

Waste baskets/bins shall be provided for streets of Maitree STPP & Jetty area and distributed on the streets, at least one waste basket at 50-meter distance shall be provided for the same. The bins/ containers shall be compactor compatible wheeled of plastic.

Building	**Waste storage requirements**
Canteen	1.500 litres per 20 dining spaces
Offices Residual Waste	3 litres per 10 m² of floor space and day
Papers/cardboard	240 litres per 100 m² of floor space 750 litres per 250 m² of floor space 1,100 litres per 500 m² of floor space
Mosque	120 litres bin per mosque for residues 120 litres bin per mosque for paper

7.1.6 WASTE MANAGEMENT CENTRE (WASTE RECYCLING, COMPOSTING AND DISPOSAL CENTRE)

Preparation of site selection study and identification of the best suitable site for this center shall be done by Bidder. The site selection study shall consider the existing local and national environmental legislations as well as World Bank standards. The selected site shall be suitable and available for 25 -30 years. The area required for the WMC is estimated to be 15 ACRE.

Bidder shall undertake all required environ-mental studies, site investigation, and geological and hydrogeological as well as topographical survey as requested by the responsible environmental authorities for the selected site. Bidder is responsible to get approval for the selected site from all responsible authorities.

Waste management center shall consist of Recycling plant (consist of Recyclable waste sorting area & sorted recyclable waste storage area), Residual waste storage area, windrow composting area, final manure storage area & office space for waste management center and disposal center/ landfill area which is outside the waste management center. In addition to that waste management center shall be provided with a depot for parking of all mobile vehicles (Refuse collection vehicle & open truck, Vacuum machine mounted on truck, backhoe loader & vibration compactor etc.) provided for Waste management center. Further a wheel washing facility shall be provided inside waste management center for cleaning of all vehicles.

I. One recycling plant shall be provided to separate the content of the recycling bins in the different fractions papers, cardboard, plastics, glass and metals. The capacity of the plant shall be about 700 kg/day (256 t/year) and shall be designed to allow future extension as needed. The generated recyclables shall he marketed by the Bidder.
II. One windrow composting facility for green (grass, leaves, branches, etc.) and park wastes. The capacity of the plant shall be in the beginning about 150 kg per day and at a later stage expanded to treat organic and kitchen wastes from households, canteens, etc. So taking appropriate margins and considering future expansion of plant windrow composting facility shall be provided for 3 tons per day. The generated compost shall be used as fertilizer for the green areas and parks in the township and power plant.
III. A depot for all mobile equipment used for operation of the waste management system.
IV. All environmental control and monitoring equipment and systems including laboratory equipment as required to meet the applicable Bangladesh statutory requirements shall be in bidder's scope of supply.
V. All infrastructures/ civil work required for access and operation of the WMC shall be designed by bidder and civil work of the same shall be BHEL scope except liner.
VI. One landfill for the disposal of the waste which cannot be recycled or composted. The capacity of the landfill shall be designed for 4.0 t/day or 1460 t/ year.

7.1.7 COMPOSTING PLANT

Organic waste can be treated through Windrow composting facility wherein input material shall be converted into a high quality compost using the Windrow Technique (a non-mechanized aerobic and thermophile composting procedure).

A community composting plant with a design capacity of about 150 kg per day for green (grass, leaves, branches, etc.) and park wastes generated in the township and power plant site in the beginning and at a later stage expanded to treat organic and kitchen wastes from households, canteens, etc. So taking appropriate margins and considering future expansion of plant windrow composting facility shall be provided for 3 tons per day.

The composting plant shall consist of 3 main components: the mechanical treatment (shredding), the intense composting section and the post composting section with refinement of the compost product.

As the composting plant incoming material majorly consist of green waste (grass, leaves, branches, etc.) and park wastes & later on organic and kitchen wastes from households, canteens etc. A semi-automatic manual-feed motor operated shredder shall be provided for cutting of the higher sizes of green waste (tree branches etc.).

The input material shall be converted into a high quality compost using the Windrow Technique (a non-mechanized aerobic and thermophile composting procedure). During the thermophilic phase, which commences very rapidly, the compost piles are turned frequently to regulate their temperature and ensure an equal decomposition level throughout the pile. 1 no. backhoe loader for handing of recyclable and residual waste in WMC & 1 no. backhoe for turning of the compost piles shall be provided. The incoming residual waste shall be screened first from 100 mm and 20 mm screen trommel. For screening of residual waste 1 no.100 mm sieve size trommel & 1 no. 20 mm sieve size trommel shall be provided by bidder. Further mature compost shall be screened from 4mm and 2 mm mesh trommel and prepared for further use and marketing. For screening of the mature compost 1no. of 4 mm sieve size trommel and 1 no. of 2 mm sieve size trommel shall be provided by bidder. The intense composting time shall be at least one month and the post composting time shall be of 6 months.

The composting area shall be covered by lightweight construction (By BHEL). The floor shall be constructed of concrete (civil work by BHEL) with a surface fall towards the collection pit. In the discharging areas where the trucks are unloaded, all around drain shall be provided for drainage purposes for collection of leachate of this area in the leachate collection pit. For this overall mechanical design shall be in bidder's scope.

The windrow composting plant and its process shall be designed & selected in such a way that it will generate a minimum of environmental pollution and under all operating conditions to comply with all local and national acts and regulations.

7.1.8 RECYCLING PLANT

Recyclable wastes shall be separated to content of the recycling bins in the different fractions papers, cardboard, plastics, glass and metals.

A community sorting plant with a design capacity of about 700 kg/day in order to sort the mixed fraction of recycling waste consists of papers, cardboard, plastics, glass and metals from the township, Maitree STPP & jetty area.

The sorting plant shall consist of 3 main components: the receiving area, the sorting area and the balling area. A semi-automated manual feed hydraulic bale press 1 no. shall be provided to compact the sorted plastic materials, paper and cardboard. The minimum throughput capacity of this bale press shall be 1 ton /day.

The sorting area shall be covered by lightweight construction (By BHEL). The floor shall be constructed of concrete (civil work by BHEL) with a surface fall towards the collection pit. In the discharging areas where the trucks are unloaded, all around drain shall be provided for drainage purpose. For this overall mechanical design shall be in bidder's scope.

The sorting area will have a long sorting table of approx. 5 x 1.5 m and 20 nos. of 240 liters storage capacity bins for the sorted fractions.

The recycling plant and its process shall be designed & selected in such a way that it will generate a minimum of environmental pollution and under all operating conditions to comply with all local and national acts and regulations.

Further Bidder shall conduct a marketing study for waste recycling. In this study the possibility of selling the waste fractions (paper, cardboard, plastic, glass and metals) shall be investigated and the revenues generated from selling those fractions to recycling companies shall be studied by bidder.

The scope of supply shall cover all parts which are necessary for the safe operation of the sorting facility to avoid noise and dust emissions and give protection against bad weather.

Bidder shall submit general layout and arrangement drawings (plan views of all operating levels, sections, etc.) of the sorting plant offered during detail engineering. The local site conditions shall be shown in general Lay-out Drawing.

7.1.9 LANDFILL

Landfill shall be designed for the disposal of the waste which cannot be recycled or composted. The capacity of the landfill shall be divided into cells. Each cell shall be designed for a specific lifetime.

As soon as the site for the WMC has been selected and approved by all responsible authorities, the bidder shall prepare a preliminary overall design for the possible complete lifetime of this Waste Management Centre comprising the landfill site (which is outside WMC), composting plant and Recycling plant which consist of sorting plant. The. Landfill shall be designed to receive 4 t/day or 1,460 t/year and shall be divided into cells. Each cell shall be designed for a lifetime of approx. 5 years. The preliminary design shall demonstrate the, final shape of the complete Landfill as it might be after the possible complete lifetime. The Bidder shall develop only those cells, which are needed for a period of 5 years.

The Bidder shall prepare the detailed design only for the 1st cell required for the first landfill operation which is required for a period of 5 years. The landfill body shall be developed during the operation in such a way that geometry shall ensure long-term stability. The height of the landfill body will rise in accordance with the emplaced waste. Thus, the maximum slope of the waste body must be 1:3 to allow long-term stability. The waste body shall be designed accordingly. This design of the same shall be submitted for owner (BIFPCL) approval.

Waste shall be deposited in layers not exceeding a thickness of 0.5 m. Each layer has to be compacted thoroughly prior to deposition of the next layer. In total the emplaced waste shall have an average density of more than 800 kg/m3.

The landfill shall be provided with a basal liner in accordance with Annex-1 of the European Union COUNCIL DIRECTIVE 1999/31IEC on the landfill of waste. It shall be assumed, that no geological barrier does exist. The complete barrier shall be designed artificially with the basal liner system. No slope of the basal liner shall be steeper than 1:2.

A leachate drainage system shall be installed above the basal liner. The leachate shall be collected to a leachate pond sealed with an impermeable liner. The leachate pond shall have a capacity to receive the average leachate quantity of 20 consecutive days or the quantity after 3 days continuous heavy rainfall, whatever is larger. The leachate pond capacity shall be selected based on the leachate generated from the land fill area as well as leachate generated from WMC. The leachate generated from respective areas shall be pumped to leachate pond of land fill area. Bidder to provide RO based leachate treatment system of suitable capacity as per system requirement for the treatment of leachate generated from various areas of Waste management center (WMC) comprising the landfill site (which is outside WMC), composting and Recycling plant. The leachate treatment shall be done prior to discharge to meet the quality permitted by local regulations to be discharged to surface water.

After being filled each cell shall be covered provisionally, until a final capping will be installed. Each completed cell shall have a sloped surface not exceeding a slope of 1:3. Until construction of the final capping a provisional capping need to be added to all closed areas. The final capping with a sealing impermeable to water to prevent infiltration of rain shall be installed.
The construction of an access road to connect the Township and the Power Plant to the waste management center (WMC) shall be provided. Temporary landfill roads shall be constructed to allow use by the vehicles delivering waste or any other material to be landfilled at any season and weather conditions. Separate roads shall be provided for landfill compactors and bulldozers. Bidder to provide one (1) no. vibratory compactor of specification JCB 116 model or equivalent reputed make & model along with necessary accessories for landfill area compaction.

An appropriate drainage system shall be implemented for rain water coming from those parts of the land fill site where no waste is handled. The rain water retention basin (civil work in BHEL scope) shall be designed to ensure storage of all rainfall from the site at a defined discharge of no more than l0 Lit/sec. For this overall mechanical design shall be in bidder's scope.

The land fill site shall be separately surrounded by a fence of 2 m height and 3 rows of protecting wire and a gate, which can be locked during hours of no operation. The same shall be in bidder's scope.

Bidder shall ensure at all times a sufficient number of equipment and vehicles required for the operation of the WMC will be available.

The waste management center shall be provided with a wheel washing facility so that dirt and litter originating from the site is not dispersed onto public roads and the surrounding land.

A control and monitoring system shall be established which shall consist of minimum requirements of a monitoring system for all incoming waste, indicating at least source of waste, quantity (weight) and date. For measurement of the waste quantity a weighbridge shall be provided within the WMC of 20 tons capacity.

Bidder shall take appropriate measures to prevent water from precipitation entering into the landfill body.

Delivered waste has to be covered with soil or other suitable material and sloped at the end of each working day.

It is prohIbited under any circumstances to burn waste at the site or at any waste collection point outside the Centre.

Around the landfill area 3 nos. groundwater monitoring wells shall be provided. One (1) of the well shall be located up- stream of the groundwater flow in order to receive quality data of clean groundwater and two no. (2) Wells shall be located downstream. Groundwater samples shall be taken at least once a month and analyzed. BHEL sub-contractor/Authorized Agency shall install, operate and maintain groundwater monitoring wells. In case of indication of pollution of the ground water, the same shall be immediately inform to the responsible authorities.

After final filling, a covering system on the final waste surface shall be constructed. This system consists of a drainage gravel layer overlaid by a top soil layer. For both components, the applied slopes of 1:3.

7.1.10 OPERATION OF WASTE MANAGEMENT SYSTEM INCLUDING THE WMC

1. Bidder is responsible to operate the entire waste management system comprising also the waste collection and transportation system, the WMC as specified above until the Hand-Over of the Maitree-STPP to the Owner (BIFPCL).

2. Bidder shall keep all facilities used for performing the services in good repair, appearance and sanitary condition and ensure a sufficient supply of spare parts on hand to ensure the timely and continuous performance of the services.

3. Bidder shall renew any equipment or component of equipment at its own expenses whenever needed for proper performance of the Services.

4. All Facilities shall be operated by qualified and skilled operators. Bidder shall ensure, that sufficient operating staff is available at the site at any operating time required.

5. In case of any long term unscheduled outages of the disposal facility bidder shall ensure alternative disposal of waste in accordance with the applicable regulations at its own expenses until operation of WMC can continue.

6. Bidder shall immediately purchase, rent, or lease vehicles and equipment to satisfy additional demand in transportation capacity or replace retired vehicles and equipment.

7. Treatment of delivered waste shall be carried out in less than 12 hours upon delivery in order to prevent degradation, odor, formation of leach-ate. wastewater and attraction of vermin and insects.

8. Bidder shall take adequate measures to prevent the attraction of vermin and rodents.

During the operation phase Quarterly and Annual Reports shall be submitted by bidder on the technical performance of the Services one month after the end of the respective quarter or year. These reports shall include any information in relation to the Services and issued to the Owner(BIFPCL).

The report shall include the following Table of Contents:

1. Landfill operation:
   - Emplaced waste types and quantities
   - Quantities of leachate collected and treated
   - Results of analysis of discharged leachate
   - Results of surface water and ground water monitoring data
   - Results of annual survey (only in annual report)
   - Remaining volume and lifetime of landfill
   - Replacements of vehicles or staff
   - Log of problems, outages, breakdowns etc.

2. Composting Facility:

   - Received waste types and quantities
   - Compost quantities produced
   - Compost quantities on store
   - Compost quantities sold/taken off (broken down per use and off taker)
   - Results of compost analysis
   - Quantities of waste water collected and treated
   - Analysis of discharged waste water
   - Replacements of vehicles, machinery or staff
   - Report on marketing activities
   - Log of problems, outages, breakdowns etc.

3. Recycling Facility:

   - Received waste types and quantities
   - Material types separated, products produced and their quantities, (broken down per use and off taker)
   - Replacements of vehicles, machinery or staff
   - Report on marketing activities
   - Quantities of waste water collected and treated and results of analysis
   - Log of problems, outages, breakdowns etc.

8.0 PAINTING

Painting schedule shall be prepared in line with the details indicated in Annexure V/ Sub Section IA of technical specification. However, any additional comments as given by BHEL/Customer shall be adhered by the bidder without any commercial & delivery implication to BHEL.

Internal painting of the equipment shall be suitable for withstanding effect of fluid being handled. Outer painting shall be as per technical specifications. Supporting documents shall be furnished in support of suitability of the lining offered for the duty conditions by bidder during detailed engineering.

Bidder to note that painting shall be as per approved painting schedule to be finalized during detailed engineering.

9.0 OUTLET GUARANTEE PARAMETERS

Bidder to refer Annexure III/ Sub Section IA for Performance/ outlet guarantee requirements of Solid waste management package.
Guarantee has been included in this sub section IA/ Annexure III. However, in case the guaranteed parameters as per the latest Bangladesh Pollution Control board (BPCB) and other applicable statutory norms of Bangladesh

Government is more stringent than the specified parameters then the requirement of BPCB and other applicable statutory requirement of Bangladesh must be followed and guaranteed.

10.0 DRAWING/ DOCUMENTS REQUIREMENT

10.1 For the Drawings/Documents distribution Procedure, please refer attached Annexure-IV/ Sub Section IA. Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The numbers of soft copies & hard copies of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-IV/ Sub Section IA.

10.2 After award of LOI/LOA, drawing/documents to be submitted by the bidder for BHEL/Customer approval has been indicated in Annexure VII/ Sub Section IA. However, any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

10.3 Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per the Annexure IV/ Sub Section IA of this specification. Bidder would be provided access to the DMS for drg./doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end:

- Internet explorer version – minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link. (http://124.124.36.198/wrenchwebaccess/login.aspx)
- DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
- For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

11.0 MATERIAL HANDLING EQUIPMENTS - ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

11.1 DESIGN CRITERIA

All necessary lifting equipment and hoists (hooks and provisions for chain blocks to be provided for repair work where loads exceed 50 kg, hoists to be provided for repair work where loads exceed 200 kg, and electrical operated hoist for loads exceeding 2,500 kg)

i.e. for 50 kg to < 200kg - hooks and provisions for chain blocks to be provided
for 200 kg to < 2500 kg – Chain pulley block with travelling trolley
for 2500 kg and above – Electric hoist to be provided

Capacity of electric and manual (Chain pulley block) hoists shall be decided keeping 25% margin over equipment to be handled.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical hoist with the help of floor operated pendant

Note;

a. Travel and Lift are layout dependent and shall be finalized during detail engineering without any commercial implication.
b. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

11.2 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.
Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

11.2.1 Electric hoist shall include but not be limited to the following: -

a. Hoisting and CT drive arrangement
b. All electrical equipment including cables (as per electrical scope matrix) and panels.
c. PVC insulated shrouded bus bar DSL
d. Earthing arrangement.
e. Initial fill of lubricant.
f. Painting of electric hoist and accessories.
g. Maintenance tools & Tackle
h. Erection & Commissioning spares
i. Power cable from isolator switch to DSL
j. Isolating switch in enclosure at operating floor for disconnecting supply to DSL while maintaining the electric hoist.

11.2.2 Erection and Commissioning spares (ELECTRIC HOIST)
The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.

11.2.3 Services to be provided by the bidder
Packing, forwarding and transportation to site, storage and handling at site.

11.2.4 Erection and Commissioning

11.2.5 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant design standards)

11.2.6 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

11.3 INSPECTION AND TESTING

As per quality plan approved during detail engineering. Prime inspection agency shall be BHEL. Equipment supplied shall be strictly in accordance with nomenclature & technical specification.

11.4 RUNWAY BEAM

Shall be supplied by civil contractor

11.5 PAINTING SPECIFICATION

Manufacturer standard

11.6 PACKING

Refer technical specification

11.7 DEMONSTRATION TEST

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as per QAP approved during detail engineering.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

11.8 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client.

11.9 TESTING AT SITE

A) ELECTRIC HOIST:

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per relevant design standard.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

a. The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
b. The correctness of all circuits and interlocks and sequence of operation; and
c. The satisfactory operation of all protective devices.

B) MANUAL HOIST:

As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

11.10 MAINTENANCE TOOLS AND TACKLES

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S. No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5.	Grease gun	1 No.
6.	Oil gun	1 No.
7.	Line tester	1 No.

Note: - The tools shall be supplied in one tool box .Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

12.0 SPARES

The Bidder shall include in his scope of supply all Mandatory spares (Initial Spares), start up and commissioning spares as indicated in the relevant sections of specifications. Requirements of mandatory

spares, start-up & commissioning spares and recommended spares are indicated in Annexure VI/ Sub Section IA for bidder's adherence.

13.0 ADDITIONAL REQUIREMENT

I. Bidder to submit BBU during detailed engineering after approval of basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL/ customer for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be reviewed by BHEL.

II. Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval shall be taken from BHEL. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

III. All drawings/documents shall be approved by BHEL/Customer during detailed engineering stage. Successful Bidder shall comply with the comment of the customer/BHEL without price & delivery implication.

IV. Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.

V. Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by bidder, BHEL reserves the right to debit cost of such rework to bidder.

VI. In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

VII. Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

VIII. Bidder to adhere Format of operation and maintenance manual requirement as per Annexure IX/ Sub Section IA during detailed engineering.

IX. Bidder to adhere site storage and preservation requirement as per Annexure X/ Sub Section IA during detailed engineering.

X. Bidder to adhere site General technical requirement as per Annexure XI/ Sub Section IA during detailed engineering.

XI. Bidder to adhere Annexure VIII, XII and XIII of Sub Section IA.

XII. Bidder to refer Plot plan attached in Annexure XII/ Sub Section IA

14.0 GENERAL TECHNICAL INSTRUCTIONS

I. The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the vendor from the responsibility of providing such facilities to complete the supply and erection & commissioning of complete solid waste management plant**.**

II. It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.

III. The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

IV. The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

XIII. While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under VOL-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication to BHEL / Customer.

XIV. Deviations along with cost of withdrawal (positive or negative), if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with tender specification & there is no deviation. (Price to be given in sealed envelope only.)

XV. In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

XVI. The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL/Customer.

XVII. BHEL's/Customer's representative shall be given full access to the shop in which the equipment are being manufactured or tested and all test records shall be made available to him.

11.2.7 PLANT OPERATION AND CONTROL

Required instrumentation and auto valves shall be provided by bidder for leachate collection, pumping, RO based treatment & disposal for automatic control through microcontroller based system. Microcontroller based control system for Solid Waste Management Package is in bidder's scope.

The bidder shall establish a control and monitoring system as requested by the local authorities. Minimum requirements are a monitoring system for all incoming waste, indicating at least source of waste, quantity (weight) and date.

The control philosophy of various systems is described below. However, for all the systems, following basic process related interlocks, alarms/ pre-warning signals shall be implemented in the control system as per system requirement.

a) Among the equipment, it shall be possible to select a specific pump or tank or sump for working/standby/ maintenance etc. through control system.

b) Permissive & Interlocks:

(i) Starting & tripping of pumps with respect to liquid level in the respective sump/ tanks or liquid pressure in the suction lines.

(ii) Starting & tripping of agitators with respect to liquid level in the respective sump/tanks.

(iii) Starting & tripping of pumps (which are provided with forced water lubrication) with respect to lubricating water flow (through low pressure/ low flow signal as the case may be).

(iv) Tripping of pumps when the discharge pressure is very high to avoid operation of the pump under shutoff head.

(v) Stopping/ tripping of equipment due to abnormal parameters related to safety of equipment like

high vibration, very high bearing lubrication water (and /or oil) temperature to the drive/pumps, very high bearing temperature of the of pump/drive etc. as applicable based on the recommendations of Equipment Supplier.

(vi) Automatic opening of the re-circulation valve to pre-set percentage, in case of failure of opening of pump(s) discharge valve to ensure minimum flow through the pump, as per the recommendation of manufacturer.

(vii) Automatic starting of standby pumps upon failure of starting of selected pump or tripping of running pump as the case may be.

(viii) Capacity of the metering pump shall be controllable from 10-100% continuously by adjusting the stroke length manually by a micro meter dial calibrated for 0–100% of pump capacity integral with the pump.

(ix) Various annunciations related to low level of the chemical tanks & sumps shall be provided.

(x) Alarms/ signals

(xi) Abnormal parameters such as low & high level in tanks/sumps, high pressure at pump discharge, low header pressure, low lubrication water flow to pumps (provided with forced water lubrication system) etc.

(xii) Failure of starting of equipment such as pumps, blowers etc. upon start command.

(xiii) Tripping of equipment due to protection logic.

In addition, the control system shall facilitate the operator to know the status of various equipment (Whether equipment is running or stopped or tripped etc., whether the equipment is selected for operation/ standby duty /maintenance mode etc. as the case may be).

ANNEXURE- I

QUALITY PLANS

QUALITY ASSURANCE

Items / Components \ Tests/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Test as per relevant Std/ Appd. Data Sheets	Other Tests	Remarks
1. Horizontal Centrifugal Pumps				Y	Y			Y^{1}	Y		**LEGENDS:**
1.1. Casing	Y^{a}		Y^{b}				Y				Y Applicable
1.2. Impeller	Y^{a}		Y^{b}							Y^{d}	Y^{a} One per Heat/Heat Treatment batch./Lot
1.3. Shaft	Y^{a}		Y						Y^{c}		Y^{b} On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds.
2. Vertical Pumps				Y	Y			Y^{1}	Y		Y^{c} UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 20 mm or above.
2.1. Casing	Y^{a}		Y^{b}				Y				Y^{d} Dynamic Balancing per ISO: 1940, Grade 6.3 minimum.
2.2. Impeller	Y^{a}		Y^{b}							Y^{d}	
2.3. Shaft	Y^{a}		Y						Y^{c}		Y^{1} As per HIS, USA.
2.4. Fabricated Parts	Y^{a}	Y	Y^{b}			Y^{2}	Y				Y^{2} 10% RT to be conducted on butt welds for Thk $\geq$10 mm.
3. Dosing/ Metering Pumps	Y^{a}						Y	Y^{1}	Y		Y^{3} Seat Leakage Test for actuator operated valves shall be done by closing the valve with job actuator.
4. Gate/ Globe/ Check Valves	Y^{a}		Y^{b}		Y		Y	Y	Y	Y^{6}	Y^{4} Tests on Rubber Diaphragms per batch of Rubber mix such as Tensile, Elongation, Hardness, Thickness, Bleed Resistance, Flex Test for 1500 cycles etc. shall be conducted. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted, if not carried out earlier.
5. Dual Plate Check Valves	Y^{a}		Y^{b}		Y		Y	Y	Y	Y^{12}	Y^{5} Seat Leakage Test is required to be done in both directions. Disc strength test as per relevant code shall be carried out.
6 Diaphragm Valves	Y^{a}				Y		Y^{3}		Y	Y^{4}	Y^{6} Blue Matching, Wear Travel for Gate Valves, reduced pressure test for check valves shall be conducted per relevant standards.
6. Butterfly Valves (Low Pr.)				Y	Y		Y^{3}	Y		Y^{5}	
7.1Body (Cast)	Y^{a}		Y^{b}								
7.2Disc (Cast)	Y^{a}		Y^{b}								
7.3 Shaft	Y^{a}		Y^{b}							Y^{c}	
8. Plug/ Ball Valves (Low Pr.)	Y^{a}		Y^{b}	Y	Y		Y	Y	Y		
9. Blowers	Y^{a}		Y^{b}	Y	Y		Y	Y	Y	Y^{dc}	
10. Atmospheric Storage Tanks/ Pressure Vessels	Y^{a}	Y	Y^{b}	Y	Y	Y^{8}	Y		Y^{c}	Y^{7}	

QUALITY ASSURANCE

Items / Components \ Tests/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Test as per relevant Std/ Appd. Data Sheets	Other Tests
11. Rubber lining	Y[a]				Y				Y	Y[9]
12. Reactor Clarifier	Y[a]	Y	Y[b]	Y	Y				Y	Y[10]
13. Clariflocculator/ Plate or Tube Settler	Y[a]			Y	Y				Y	
14. Hoists & Cranes	Y[a]	Y	Y[b]	Y	Y	Y[8]		Y	Y	
15. Chlorine Tonner	Y[a]	Y	Y[b]	Y	Y	Y[8]	Y			
16. Chlorine Evaporator	Y[a]	Y	Y	Y	Y	Y	Y			
17. Chlorinator & injector	Y[a]			Y	Y		Y	Y		
18. Agitators /Flash Mixer/ Flocculator	Y[a]	Y	Y[b]	Y	Y			Y		Y[10]
19. Pipes	Y[a]	Y		Y	Y		Y		Y	
20. Ventilation/Exhaust Fan	Y[a]		Y[b]	Y	Y			Y[11]	Y	Y[dc]

After erection, the complete Piping system along with valves & fittings shall be hydraulically tested.

Remarks

Y[7] Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall be stress relieved as per the requirement of code.

Y[8] RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT.

Y[9] Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted.

Y[10] Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted.

Y[11] One Fan of each type & size shall be routine performance tested as per corresponding code fir air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured.

Y[12] Blue Matching, reduced pressure test for check valves shall be conducted per relevant standards. Dry cycle test on valve spring for 100000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring.

NOTE:- Category of inspection for items / equipment shall be decided by BHEL only during detailed engineering. All the inspection shall be carried out by BHEL or its designated agency only. Bidder to refer Annexure XI/ Sub Section IA for additional Quality requirements.

ANNEXURE II

SUB VENDOR LIST

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

The sub vendor list below is indicative only and is subject to BHEL and customer approval during detailed engineering stage without any commercial & delivery implication to BHEL. Bidder to submit sub vendor list within 4 weeks of placement of LOI. Bidder to provide credentials of proposed sub vendors with back up documents (like experience list, PO/ LOI copies, end user performance certificates as applicable etc.) as per BHEL requirement during detailed engineering. Bidder shall procure all items including plates, structural, flanges, counter flanges etc. from approved sub vendor only. The inspection category will be intimated after award of contract by BHEL/customer. However the same will be adhered by the bidder without any commercial and delivery implication to BHEL/ customer.

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	**PRESSURE VESSELS**	GLOBAL STRUCTURES & COMPOSITE LTD	-	
		JASMINO POLYMERTECH	TALOJA	
		SYSCON ENGINEERS	AMBERNATH	
		S.V. FABRICATORS	NAVI MUMBAI	
		SPARK FABRICATORS / STEELCON	-	
		ANUP ENGINEERING	AHMEDABAD	
		MURTHAL TANKS & VESSELS	SONEPAT	
		TITAN ENGG.	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		UNIVERSAL HEAT EXCHANGERS	-	
		ATS CHEM	SALEM/HOSUR	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		CRYSTAL ENGINEERING	HOSUR	
		ISHAN EQUIPMENTS	VADODARA	
2.	**ATMOSPHERIC/ STORAGE TANKS**	GLOBAL STRUCTURES & COMPOSITE LTD	-	
		JASMINO POLYMERTECH	TALOJA	
		SYSCON ENGINEERS	AMBERNATH	
		S.V. FABRICATORS	NAVI MUMBAI	
		SPARK FABRICATORS / STEELCON	-	
		ANUP ENGINEERING	AHMEDABAD	
		MURTHAL TANKS & VESSELS	SONEPAT	
		TITAN ENGG.	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		UNIVERSAL HEAT EXCHANGERS	-	
		ATS CHEM	SALEM/HOSUR	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		CRYSTAL ENGINEERING	HOSUR	
		ISHAN EQUIPMENTS	VADODARA	
3.	**RUBBER LINING (AT SHOP)**	TEMSEC	KOLKATA	
		RISHI INDUSTRIES	SONEPAT	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		CORI ENGINEERS	CHENNAI	
		POLY RUBBER	MUMBAI	
		INDUSTRIAL LINING	VADODARA	
		ARUL RUBBERS	CHENNAI	
		JASMINO POLYMERTECH	TALOJA	
		WESTERN RUBBER	NAVI MUMBAI	
		ELASTOMER LINNING	AMBERNATH	
		EMKAY RUBBER	MUMBAI	
4.	**AIR BLOWERS (TWIN LOBE TYPE)**	SWAN PNEUMATIC	NOIDA	
		EVEREST TRANSMISSION	NEW DELHI	
		KAY INTERNATIONAL	NEW DELHI / SONEPAT	
		EVEREST BLOWER	BAHADURGARH	
		KULKARNI POWER TOOLS	KOLHAPUR/ PUNE	
5.	**METERING PUMPS**	VK PUMPS	NASIK	
		MILTON ROY INDIA	CHENNAI	
		SWELLORE	AHMEDABAD	
		POSITIVE METERING PUMPS	NASIK	
		METACHEM	MUMBAI	
6.	**AGITATOR**	REMI PEOCESS PLANT & M/C	MUMBAI	
		FIBRE & FIBRE	MUMBAI / SILVASA	
		CEECONS	CHENNAI	
		STANDARD ENGINEERS	MUMBAI	
7.	**HORIZONTAL CENTRIFUGAL PUMPS**	BEST AND CROMPTON ENGG LTD.	CHENNAI	
		BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWSERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		KIRLOSKAR BROTHERS LTD	PUNE	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		V-FLO PUMPS & SYSTEMS CO. LTD.,	BEIJING-CHINA	
		WPIL LIMITED	KOLKATA	
8.	**VERTICAL CENTRIFUGAL PUMPS**	BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWSERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		SULZER PUMPS INDIA LTD.	THANE	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		WPIL LIMITED	KOLKATA	
9.	SCREW PUMP	UT PUMP		
		ROTO PUMPS		
		TUSHACO		
10.	HORIZONTAL CENTRIFUGAL PUMPS (RUBBER LINED)	KISHORE PUMPS	PUNE	
		SU MOTORS	MUMBAI	
11.	NON METALLIC (PP/FRP) HORIZONTAL CENTRIFUGAL PUMPS	ENGINEERS COMBINE	THANE	
		ANTICORROSIVE	VALSAD	
		LEAK PROOF PUMPS PVT. LTD. (RAJEDIA)	-	
12.	MISC. PUMP VERTICAL TURBINE TYPE	KBL	PUNE	
		M&P	PUNE	
		WPIL	GHAZIABAD	
		KISHORE PUMPS	PUNE	
		FLOWMORE	SAHIBABAD	
13.	BATTERY CHARGER FOR PLC	AMARA RAJA POWER SYSTEMS LIMITED	TRIPUTI	
		CHHABI ELECTRICALS PVT.LTD.	JALGAON	
		CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED	KOLKATA	
		DUBAS ENGG PVT LTD	BANGALORE	
		HBL POWER SYSTEMS LTD	HYDERABAD	
		JEMA ENERGY	SPAIN	FOR STATIC SCR TYPE FULL WAVE FULLY CONTROL TYPE
		MASS-TECH CONTROLS PVT.LTD.	MUMBAI	
		STATCON POWER CONTROLS LTD	NOIDA	
14.	UNDER BED NOZZLE	JONSONS SCREEN	AUSTRALIA/ IRELAND	
15.	COATING & WRAPPING MATERIAL TAPE	IWL LTD.	CHENNAI	
		MP TAR PRODUCT	BHILAI	
		PORWAL INDUSTRIES	RAIPUR	
		RUSTECH	KOLKATA	
		STP	JAMSHEDPUR	
16.	HEATER	ESCORTS	FARIDABAD	
		RACOLDS	FARIDABAD	
17.	CLARIFIER/ THICKENER MECHANISM	CLEAR WATER	DELHI	
		TRIVENI	NOIDA	
		PBJ ASSOCIATE	PUNE	
18.	CENTRIFUGE	HUMBOLT	-	
		HILLER	-	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
19.	**CAST IRON GATE/GLV/NRV/SRV**	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		G.M. DALUI AND SONS PVT.LTD.	HOWRAH	
		H.SARKER AND COMPANY	HOWRAH	
		LEADER VALVES LTD.	JALANDHAR	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
20.	**BALL VALVE (MANUAL /PNEUMATIC/ ELECTRIC) CLASS 150**	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.	DHARWAD	
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	NAVI MUMBAI	
		INTERVALVE (INDIA) LTD.	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	
		VAAS AUTOMATION PVT. LTD.	NEW DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
21.	**ELECTRIC MOTOR**	CROMPTON GREAVES	AHMEDNAGAR	
		LAXMI HYDRAULICS PVT. LTD	BANGALORE / HUBLI*	
		RAJINDRA ELECT INDUSTRIES	FARIDABAD* / BANGALORE	
		GE-POWER		
		BHARAT BIJLEE	MUMBAI	
		SIEMENS	MUMBAI	
		NGEF	BANGALORE	
		KIRLOSKAR ELECTRIC CO LTD.		
		ASEA BROWN BOVERI		
		MARATHON	KOLKATA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
22.	BUTTER-FLY VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
23.	DIAPHRAGM VALVE (MANUAL / PNEUMATIC) CLASS 150	WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
		PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	
24.	DUAL PLATE CHECK VALVES	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	1. DUAL PLATE CHECK VALVE CI - CLASS 150 & UP TO 600NB, 2. DUAL PLATE CHECK VALVE CCS - CLASS 150 & UP TO 500NB
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CI ,CCS & STAINLESS STEEL SPRING ASSISTED DUAL PLATE CHECK VALVES UPTO 700 NB AND 150 CLASS RATING.
25.	Y-TYPE STRAINER	OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		GRAND PRIX	NEW DELHI	
		JAYPEE	NEW DELHI	
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		FILTERATION ENGINEERS (I) PVT. LTD	MUMBAI	
		FLUIDNYE	-	
		SUNGOV ENGINEERING PVT. LTD.	DELHI	
		GRAND PRIX	FARIDABAD	
		JAYPEE INDUSTRIES PVT. LTD.	DELHI	
		BHATIA ENGINEERING CO.	DELHI	
26.	**RUBBER FLAP TYPE CHECK VALVES**	ASHVIK VALVES	-	
		FLOW WAY VALVES	-	
		BDK	-	
		MAJESTIC VALVES (LABLINE INST)	-	
		ADVANCE VALVES	-	
27.	**SOLENOID VALVES**	ROTEX	-	
		AVCON	-	
28.	**PRESSURE GAUGE/ DIFFERENTIAL PRESSURE GAUGE**	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BOSE PANDA INSTRUMENTS PVT.LTD.	KOLKATA	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
29.	**CHAIN PULLEY BLOCK**	ARMSEL MHE PVT. LTD	BANGALORE	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 10 TONNE.
		TRACTEL TIRFOR INDIA PVT. LTD.	FARIDABAD	
		TECHNO INDUSTRIES	AHMEDABAD	
		ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	BHIWADI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	UPTO 20 TONNES
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	CAPACITY UPTO

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
				10 TONS. BOIS BHEL APP.SUB-VENDORS.
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD,	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
30.	**ELECTRIC HOIST**	ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	BHIWADI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	UPTO 20 TONNES
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	CAPACITY UPTO 10 TONS. BOIS BHEL APP.SUB-VENDORS.
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD,	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
31.	**CONTROL VALVE**	SPX CORPORATION, USA	AHMEDABAD	
		CONTROL COMPONENT INC.	CALIFORNIA	
		DRESSER VALVE INDIA PVT. LTD	COIMBATORE	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		DAUME REGELARMATUREN GMBH,	GERMANY	
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	CHENNAI	
		WEIR VALVES & CONTROLS UK LTD.	U.K	
		HOLTER REGELARMATUREN GMBH & CO.KG	GERMANY	
		INSTRUMENTATION LTD.	KERALA	
		KOSO INDIA PRIVATE LIMITED,	NASHIK	
		LESLIE CONTROLS, INC	USA	
		MIL CONTROLS LTD.	KERALA	
		METSO SINGAPORE PTE. LTD.,	SINGAPORE	
		PARCOL S.P.A	ITALY	
		R.K.CONTROL INSTRUMENTS PVT. LTD.	THANE	
		RINGO VALVULAS S.L,	SPAIN	
		SHENJIANG VALVE CO. LTD.	CHINA	
		VALVITALIA S.P.A. ,	ITALY	
		WALDEMAR PRUSS ARMATURENFABRIK GMBH	GERMANY	
32.	**PRESSURE/DP/VACUUM SWITCH**	INDFOSS	GHAZIABAD	
		SOR	USA	
		DRESSOR	USA	
		DELTA CONTROL	UK	
		TRAFAG	RANIPET	
		GIC(GAUGES BOURDON)	PANVEL	
		ASHCROFT INDIA PVT LTD.	USA/GERMANY	
		SWITZER	CHENNAI	
33.	**TEMPERATURE GAUGE**	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BUDENBERG GUAGE CO.LTD.	UK	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.	GOA	
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.		
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
34.	**LEVEL GAUGE (F&B,**	SBEM		

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
	TUBULAR, REFLEX)	CHEMTROL		
		PUNE TECHTROL		
		SIGMA		
		V AUTOMAT		
		GENERAL INSTRUMENTS		
35.	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	PUNE	
		FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		INSTRUMENTATION ENGINEERS PVT LTD	TELANGANA	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
36.	LEVEL SWITCH-CONDUCTIVITY TYPE	BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		HI-TECH SYSTEMS & SERVICES LTD.	KOLKATA-	VENDOR SHALL SOURCE IMPORT CONTENTS OF LEVEL SWITCH (CONDUCTIVITY TYPE) FROM LEVELSTATE SYSTEMS LTD., UNITED KINGDOM.
		LEVCON INSTRUMENTS PVT. LTD.	KOLKATA	
		RAMAN INSTRUMENTS PVT.LTD.	MUMBAI	VENDOR SHALL SOURCE IMPORT CONTENTS OF LEVEL SWITCH (CONDUCTIVITY TYPE) FROM MOBREY MEASUREMENT, AN OPERATING UNIT OF MORBEY LTD., SLOUGH, BERKSHIRE, UNITED KINGDOM.
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SOR INC.	USA	
		SAPCON INSTRUMENT PVT LTD.	INDORE	
		V. AUTOMAT & INTRUMENTS (P) LTD.	NEW DELHI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
37.	LEVEL SWITCH (ALL TYPES)	LEVCON		
		CHEMTROLS SAMIL (INDIA) PVT LTD.		
		SWITZER		
		WAAREE (BAUMER INSTRUMENTS)		
		V AUTOMAT		
		PUNE TECHTROL		
38.	MAGNETIC FLOW METER	ABB	-	
		WAAREE (BAUMER INSTRUMENTS)	-	
		EUREKA	-	
		EMERSON	-	
		YOKOGAWA	-	
		HACH (POTENSE)	-	
		KROHNE MARSHALL	-	
39.	FLOW ELEMENT - NOZZLE	HYDROPNEUMATICS PVT. LTD.	GOA	
		INSTRUMENTATION LTD.	PALAKKAD	
		MICRO PRECISION PRODUCTS PVT. LTD.	FARIDABAD	
		MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	GOA	
		STAR-MECH CONTROLS (I) PVT.LTD.	PUNE	
		SEIKO FLOW CONTROL GMBH	AUSTRIA	
40.	FLOW ELEMENT - ORIFICE	FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		HYDROPNEUMATICS PVT. LTD.	GOA	
		INSTRUMENTATION LTD.	PALAKKAD	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		MICRO PRECISION PRODUCTS PVT. LTD.	FARIDABAD	
		MINCO (INDIA) PRIVATE LIMITED	GOA	
		STAR-MECH CONTROLS (I) PVT.LTD.	PUNE	
41.	FLOW TRANSMITTERS (ALL TYPES)	E & H	-	
		KHRONE MARSHALL	-	
		EMERSON	-	
		ABB	-	
		HONEYWELL	-	
		YOKOGAWA	-	
42.	LEVEL TRANSMITTERS (ALL TYPES)	EMERSON	-	
		E & H	-	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		ABB	-	
		HONEYWELL	-	
		V AUTOMAT	-	
		YOKOGAWA	-	
		SIEMENS	-	
		KROHNE MARSHALL	-	
43.	PRESSURE TRANSMITTERS (ALL TYPES)	EMERSON	USA/PAWANE	
		LAXONS AUTOMATION	DAMAN	
		YIL	BANGALORE	
		SIEMENS	THANE	
		FUJI	CHINA	
		YOKOGAWA	JAPAN	
		HONEYWELL	USA/PUNE	
44.	TEMPERATURE TRANSMITTERS	EMERSON	-	
		E & H	-	
		ABB	-	
		HONEYWELL	-	
		V AUTOMAT	-	
		YOKOGAWA	-	
		SIEMENS	-	
		FORBES MARSHALL	-	
45.	PH TRANSMITTERS	EMERSON	-	
		YOKOGAWA	-	
		HONEYWELL	-	
		ABB	-	
		HACH	-	
		FORBES MARSHALL	-	
46.	ANALYSERS (ALL TYPES)	ABB	-	
		EMERSON	-	
		YOKOGAWA	-	
		HONEYWELL	-	
		HACH POLYMETRON	-	
		SIEMENS	-	
		FORBES MARSHALL	-	
47.	PROGRAMMABLE LOGIC CONTROLLER	GE INTELLIGENT PLATFORMS PRIVATE LIMITED	BANGALORE	
		HONEYWELL AUTOMATION INDIA LIMITED ,	PUNE	
		ROCKWELL AUTOMATION INDIA LTD	SAHIBABAD	
		SIEMENS LIMITED	MUMBAI	
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	NEW DELHI	
48.	UPS	HITACHI-HIREL	GANDHINAGAR	
		APC	BANGALORE	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		DELTA	GURGAON	
		EMERSON	MUMBAI	
		DB POWER	PUNE	
		APLAB	MUMBAI	
49.	INSTRUMENT FITTINGS	AURA INCORPORATED	NEW DELHI	
		ASTEC VALVES & FITTINGS PVT. LTD.,	MUMBAI	
		ARYA CRAFTS & ENGINEERING PVT. LTD.	MUMBAI	
		COMFIT & VALVE PVT. LTD.	GUJARAT	
		FLUIDFIT ENGINEERS PVT. LTD.	MUMBAI	
		FLUID CONTROLS PVT. LTD.	MUMBAI	
		HP VALVES & FITTINGS INDIA PVT. LTD.	CHENNAI	
		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA) PVT. LTD.	MUMBAI	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
50.	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	METAL TYPE JUNCTION BOX ONLY
		K.S.INSTRUMENTS PVT.LTD.	BANGALORE	
		SUCHITRA INDUSTRIES	BANGALORE	
		SHRENIK & COMPANY,	AHMEDABAD	
51.	CABLE GLAND	COMET	-	
		DOWELL	-	
		CHETNA	-	
52.	CABLE LUGS	ELECTRO BILLETS	-	
		COMET	-	
		DOWELL	-	
		CHETNA	-	
53.	MS PLATES	SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		LLOYD		
		ISPAT		
		INDIAN IRON & STEEL CO. LTD		

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
54.	CS PIPE (ASTM A 106 GR. B)	INDIAN SEAMLESS METAL TUBES	AHMEDABAD	UPTO 150 NB
		MAHARASHTRA SEAMLESS	RAIGAD	UPTO 350 NB
55.	MS PIPES	SAIL	ROURKELA	
		JINDAL	GHAZIBAD/HISSAR	
		SURYA ROSHNI	BAHADUR GARH	
		TATA TUBE	JAMSHEDPUR	
		PSL	CHENNAI/VIZAG/KUTCH/DAMAN	
		LALIT PROFILE	THANE	
		SAMSHI PIPES INDUSTRIES	VADODARA	
		MUKUT PIPES	RAJPURA	
		INDUS TUBES	G B NAGAR	
		MANN IND	INDORE	
		SURENDRA ENGG	RAJPURA	
		PRATIBHA PIPES & STRUCTURE PVT LTD	THANE	
		JCO GAS PIPE	CHINDWARA	
		NUKAT TANKS AND VESSELS	TARAPUR	
		DADU PIPES	SIKRANDRABAD	
		GOOD LUCK TUBES	SIKANDRABAD	
		ADVANCE STEEL TUBES	SAHIBABAD	
		BIHAR TUBES	SIKANDRABAD	
		HI TECH PIPES	SIKANDRABAD	
		RATNAMANI	KUTCH/AHMEDABAD/CHHATRAL	
		MAHARASHTRA SEAMLESS	RAIGAD	
		WELSPUN	ANJAR/BHARUCH	
56.	SS PIPES/ TUBES	APEX TUBES	BEHROR (ALWAR)	
		RATNAMANI	CHATTRAL	
		REMI	TARAPUR	
		PRAKASH STEELAGE	-	
57.	POWER/CONTROL/INSTRUMENT CABLE	CORDS CABLE	BHIWADI	
		RADIANT CABLES	HYDERABAD	
		POLYCAB	DAMAN	
		KEI	BHIWADI	
		NICCO	KOLKATA	
		RAVIN CABLES	PUNE	
		INCAB	PUNE	
		HVPL	FARIDABAD	
		TORRENT CABLE	NADIAD	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		HAVELLS	ALWAR	
		PARAMOUNT	KHUSHKHERA	
		SRI RAM CABLES	BHIWADI	
		THERMOCABLES	HYDERABAD	
		TORRENT CABLE	NADIAD	
		UNIVERSAL CABLES	SATNA	
		GEMSCAB	BHIWADI	
		DELTON	FARIDABAD	
58.	**SAFETY SHOWER**	UNICARE	-	
		MOHAN INDUSTRIES	-	
		SUPER SAFETY SERVICES	-	
59.	**FRP TANKS & FITTINGS**	GLOBAL COMPOSITE	-	
		EPP	-	
		DEEPA COMPOSITE	-	
		COROSEAL INDUSTRIES	-	
		CHEMICAL PROCESS & EQUIPMENT PVT LTD	-	
		J.R FIBRE INDUSTRIES PVT LTD	-	
		POLYPLAST	-	
60.	**EJECTOR**	ESSEM TECHNOLOGIES	-	
		RATNA PRASAD	-	
61.	**LOCAL CONTROL PANEL**	INDUSTRIAL SWITCHGEAR & CONTROL	-	
		POSITRONICS	-	
		DELTA CONTROL	-	
		L & T	-	
		GE POWER	-	
		PYROTECH	-	
		C& S	-	
62.	**TANK (FRP)**	INDUSTRIAL SERVICE	KOLKATA	
		SUNRISE	BARODA	
		GANDHI & ASSOCIATES	AHMEDABAD	
		MODERN EQUIPMENTS	CHENNAI	
		EAGLE PLAST	PUNE	
		OMEGA PLAST	MUMBAI	
63.	**STROKE CONTROLLER**	V K PUMPS	NASIK	
		METACHEM	MUMBAI	
		SWELORE	AHMEDABAD	
		MILTON ROY INDIA	CHENNAI	
64.	**SAFETY VALVES/RELIEF VALVES**	METACHEM	MUMBAI	
		KEYSTONE	BARODA	
		V K PUMPS	NASIK	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MILTON ROY	CHENNAI	
65.	DUPLEX STRAINER	JAYPEE INDUSTRIES PVT. LTD.	NEW DELHI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI	
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		SUNGOV ENGINEERING PVT. LTD.	CHENNAI	
66.	ORIFICE PLATE	MICRO PRECISION	FARIDABAD	
		INSTRUMENTAION LTD	PALGHAT	
		CARLO DYNAMICS	HYDERABAD	
67.	STEEL GATE/GLOBE/NR VALVES	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON STEEL GATE VALVES & NON RETURN VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150)
		FLUIDLINE VALVES COMPANY PVT.LTD.	KAUSHAMBI	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.	NAVI MUMBAI	LIMITED TO RANGES & CLASSES AS AVAILABE IN VD FILE.

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT-UPTO300NB CL UPTO600,SCNRV-BBT-UPTO600NB CL UPTO150,SCNRV-BBT-UPTO300NB CL 300,SCNRV-PSBT-UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE-GV/150/900,GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300,GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
68.	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	-	
		YASHWANT INDUSTRIES	-	
69.	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
70.	PLUG VALVE(MANUAL)	BDK	HUBLI	
		HAWA ENGINEERS / MARCK & CARE	-	
		MICON VALVES	-	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
71.	FITTINGS (CS/SS)	M.S. FITTINGS	KOLKATA	
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		TUBE PRODUCTS	BARODA	
		NL HAZRA	KOLKATA	
		GUJRAT INFRA PIPES	BARODA	
		EDWARDS	USA	
		PIPEFIT ENGINEERS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
72.	FLANGES (SS/CS)	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	
		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	
		JAI AMBE	MUMBAI	
73.	PIPE & FILLTING (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
74.	VALVES (GATE/GLOBE/NRV/BALL)- (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
75.	AIR FILTER REGULATOR	SHAVO NORGEN	-	
		PLACKA INSTRUMENTS	-	
76.	FILTER MEDIA	GLOBAL ABSORBENT	KOLKATA	
		BHARAT MINERALS		
77.	DC LEAD ACID / NI-CD BATTERIES	AMCO SAFT INDIA LTD	BANGALORE	NI-CD BATTERIES ONLY
		EXIDE INDUSTRIES LTD	NEW DELHI	LEAD ACID BATTERIES

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
				ONLY.
		HBL POWER SYSTEMS LTD	HYDERABAD	NI/CD AND TUBULAR TYPE FOR LEAD ACID
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
78.	DC LEAD ACID BATTERIES	EXIDE INDUSTRIES LTD	NEW DELHI	
		HBL POWER SYSTEMS LTD	HYDERABAD	TUBULAR TYPE
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
79.	DC NI CD BATTERIES	AMCO SAFT INDIA LTD	BANGALORE	
		HBL POWER SYSTEMS LTD	HYDERABAD	
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
80.	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	CHENNAI	
		BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		INSTRUMENTATION ENGINEERS PVT LTD	TELANGANA	
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
		TELACE EQUIPMENT PVT.LTD.	CHENNAI	
81.	PAINT	ASIAN PAINTS (I) LTD.		
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		JOTUN PAINTS		
82.	PNEUMATIC ACTUATOR	PROCON ENGINEERS	-	
		TYCO	-	
		CRANE PROCESS	-	
		BDK	-	
		INTERVALVE	-	
		BRAY CONTROL	-	
83.	MOTORISED ACTUATOR	ROTARK	-	
		AUMA	-	
		LIMITORK	-	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
84.	**UF MEMBRANE**	DOW	-	
		HYFLUX	-	
		GE	-	
		MEMBRANE HITECH	-	
85.	**RO MEMBRANE**	DOW CHEMICALS – FILMYECH	USA	
		HYDRANAUTICS	USA	
		KOCH MEMBRANE- FLUID SYSTEM	USA	
		TOREY	JAPAN	
86.	**RO PRESSURE TUBES (FRP)**	PENTAIR WATER	GOA	

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - PEM, HYD, Trichy, PC, EDN	VENDOR AS APPROVED BY	DATE : 12/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
23	Temperature Transmitter	III				EMERSON	U.S.A/Pawane / Singapore	A			
		III				Yokogawa	Japan	A			Final testing at M/S YIL,Bangalore is also acceptable
		III				Moore	USA	A			
		III				M System	JAPAN	A			
		III				ABB	GERMANY/Faridabad	A			
		III				ENDRESS & HOUSER	Aurangabad	A			
		*				Khrone		DR			M/s BHEL will forward only two proposals after details review of BIFPCL Technical specification requirements.
		*				Tokyo Keiso	Japan	DR			
		*				INOR	Sweden	DR			
		*				P & F	India	DR			
		*				Siemens		DR			
		*				Yamatake	JAPAN	DR			
		*				Yamari	JAPAN	DR			
		*				Foxboro		DR			
25	Electronic transmitters (pressure, DP)	III				EMERSON (Rosemount)	USA/ Pawane	A			
		III				FUJI ELECTRIC	China	A			
		III				YOKOGAWA	JAPAN	A			Testing and Calibration at M/s YIL, Bangalore is also acceptable.
		I				ABB	FARIDABAD	A			Model - 2600 T
		III				ABB	GERMANY / Italy	A			Model - 2600 T
		III				Siemens	France / India	A			
		III				Honeywell	Pune	A			
		*				ENDRESS & HOUSER	Aurangabad/ Germany	DR			
26	Thermocouples, RTD & Thermowell	III				HERAUS SENSOR	GERMANY	A			
	Refer Note - 2	III				WISE Control	Korea	A			
		II				Tempsens	Udaipur	A			
		II				Pyroelectric	Goa	A			

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		CONTRACT NO :									
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		II				Detriv Instrumentation & Electronics Ltd	Mumbai	A			
		III				Minco	USA	A			
		III				OKAZAKI corporation	JAPAN	A			
		III				Yamari	JAPAN	A			
		III				Yamari	Singapore	A			For RTD Reference list and Performance feedback is to be submitted.
		III				ABB(SENSYCON)	Germany	A			
		III				EMERSON (Rosemount)	Germany	A			
		II				EMERSON (Rosemount)	Pawane	A			Imported from Emerson, Germany (make)
		II				Thermal Instruments(GIC)	Savantwadi	A			
		II				Techno Instruments	Ahamadabad	A			
		*				GOA Instrument Industries	GOA	DR			M/s BHEL will forward only two proposals after details review of BIFPCL Technical specification requirements.
		*				WIKA	Pune	DR			
		*				Toshniwal Industries	Ajmer	DR			
		*				E & H	Aurangabad	DR			
		*				Baumer	Vapi	DR			
27	Ultrasonic type level Transmitter	III				E & H	Aurangabad/ Germany	A			
		III				EMERSON	Pawane	A			
		III				SIEMENS MILTRONICS	CANADA	A			
		*				Wega	Germany	DR			
		*				Khrone	France / USA / Pune	DR			M/s BHEL will forward only two proposals after details review of BIFPCL Technical specification requirements.
		*				Yokogawa	Bangalore	DR			
		*				Honeywell	India	DR			
		*				Magnetrol	Belgium	DR			
		*				ABB	Germany	DR			
28	Orifice plate assembly	III				Instrumentation Limited	Palghat	A			
		III				Microprecision	Faridabad	A			
		III				Starmech	Pune	A			
		III				Flow Star	Faridabad	A			
		III				SEIKO	Austria	A			
		III				MINCO (GIC)	GOA	A			

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No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				WISE Control	Korea	A			
		III				T M Technomatic	Italy	A			
		*				IEPL	Hyderabad	DR			
		*				Engg. Specialities	Kolkata	DR			
		*				BALIGA	CHENNAI	DR			
		*				Pyroelectric	Mumbai	DR			
33	Flow switch	III				UNIVERSAL FLOW	USA	A			
		III				Switzer	Chennai	A			
		III				Levcon	Klokatta	A			
		III				DK Instrument	Kolkatta	A			
		III				Khrone Marshal	Pune	A			
		III				Chemtrol	India	DR			
		III				V Automat	NewDelhi	DR			
		III				Gauges Bourdon	Panvel	A			
		III				Magnetrol	Belgium	A			
		III				Ashcroft	Germany	A			
		III				Auxitrol	UK	A			
		III				Mericoid	USA	A			
		III				Delta Control	UK	A			
		III				Merium	USA	A			
		*				Sunag Corporation		DR			
35	Electric to Pneumatic converter	III				IMI NORGEN	India	A			Make : WATSON SMITH
		III				Fair child	USA	A			
		*				ABB	India	A			Subject to meeting the BIFPCL specificaton requirement
		*				SMC Pneumatics	Noida	DR			
		*				P & F	Bangalore	DR			
		*				FESTO	Bangalore	DR			
37	Intelligent Battery charger 24V DC & DCDB /BHMS	I				Chabbi Electricals	Jalgaon	A			~~Modules from EMERSON~~
		I				Eltech	Gurgaon	A			Modules from ELTEK
		I				MasTech	Jalgaon	A			Modules from ELTEK
		*				Emerson	India	DR			

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		*				HBL Power Systems	India	DR			M/s BHEL will forward only two proposals after details review of BIFPCL Technical specification requirements.
		*				Dubas	India	DR			
		*				Chloride Power Systems (caldyne)	India	DR			
		*				Universal Instrument manufacturing co P Ltd	India	DR			
		*				Hind Rectifier Ltd	India	DR			
38	Battery Health Monitoring System	III				Emerson	Mumbai	A			
		III				Eltek SGS Pvt Ltd	Gurgaon	A			
		*				B Tech Inc	USA	DR			
		*				Hitachi Hi Rel	Gandhinagar	DR			
		*				Hopeckee	Germany	DR			
39	Battery(Ni-cd)	I				AMCO SAFT	Bangalore	A			
		II				SAFT	France/Sweede	A			
		I				HBL POWER	Hyderabad	A			
		*				Hopekee	Germany	DR			
40	Battery (Lead Acid Tubular / Plante)	I				Exide	Kolkata	A			
		I				HBL POWER	Hyderabad	DR			Only for tubular
		I				Hopekee	Germany	DR			
41	Impulse pipe & tubes	II				Mahrashtra Seamless	Raigarh	A			Carbon steel only
		II				Sumitomo/kawasaki/Nippon	Japan	A			
		II				TPS TECHNITUBE	Germany	A			
		II				Veluric & manessmann	Germany	A			
		II				BHEL	Trichy	A			
		II				Trouvay and Cauvin	France	A			Makes shall be as per apprvoed list (Sr. No. 41)
		II				ISMT	Ahamadnagar	A			Carbon steel only.
		II				Sandvik		A			For SS only.
		*				Jindal saw	India	DR			
		*				Ratanamani Metal and	Ahamadabad	DR			
		*				Shubhalaxmi Metal and	Mumbai	DR			
46	Local Instrument Enclosure/Rack	I				Pyrotech	Udaipur	A			
		I				Instrumentation Limited	Kota	A			

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		I				Sajas electrical	Trichurapalli	A				
		I				Prammen	Puddukottai	A				
		I				Chemin	Pondicherry	A				
		*				Forbes Marshall	Pune	DR				
		*				Procon	Chennai	DR				
46	Instrument Cables	II				Paramount	Khuskhera	A			PVC,FRLS type,RQP	
		II				Polycab	Daman	A			PVC,FRLS type,RQP	
		II				Delton	Faridabad	A			PVC,FRLS type,RQP	
		II				KEI	Bhiwadi	A			PVC,FRLS type	
		II				Elkey Telelinks	Faridabad	A			PVC,FRLS type	
		II				CORDS	Bhiwadi	A			PVC,FRLS type,RQP	
		II				CORDS	Kaharani	A			PVC,FRLS type,RQP	
		II				Nicco	Kolkata	A			PVC,FRLS type	
		II				TEW & C	USA	A				
		II				Habia cables	Sweeden	A				
		II				Kerpen cables	Germany	A				
		II				Lapp cables	Germany	A				
		II				Thermo elecrta Bv	Netherland	A				
		II				Universal Cable	Satna	A			PVC,FRLS type	
		II				Thermocables	Hyderabad	A				
		II				Finolex Cable	Pune	DR *				
		II				Incab	Pune	DR *				
		*				Lapp cables	India	DR			M/s BHEL will forward only two proposals after details review of BIFPCL Technical specification requirements	
		*				Lioni cable	Pune	DR				
		*				Gupta Cable	Orisa	DR				
		*				CMI	Faridabad	DR				
47	Electrical actuator	III				Auma	Germany	A				
		III				Limitorge	USA	A				
		III				Rotorq	UK	A				
		II				Limitorque	Faridabad	A				
		II				Rotork	Chennai/ Bangalore	A				
		III				Nippon gear	Japan	A				
		II				Auma	Bangalore	A				
		III				Harold Beck	USA	A				
		III				Drehmo	Germany	A				

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		*				Lindco	USA	DR			
		*				Siemens	Germany	DR			
47A	Electrical actuator for ID/FD/PA Blade pitch and Guide vane control	III				Harold Beck	USA	A			
		III				SIPOS Aktronik GmbH	Germany	A			
48	Flow nozzle assembly	II				Mcroprecision	Faridabad	A			DR for P-91 Material
		II				SEIKO	Austria	A			
		II				TECHNOMATIC	Italy	A			
		II				Instrumentation Limited	Palghat	A			
		II				Starmech	Pune	A			DR for P-91 Material
		II				WISE Control	Korea	A			
		*				SAMIL	Korea	DR			
		*				MINCO	GOA	DR			
		*				Engg. Specialities	Kolkata	DR			
		*				Pyroelectric	Mumbai	DR			
49	HIGH Temp. cable (PTFE/FEP)	II				Habia cables	Sweden	A			
		II				Lapp cables	Germany	A			
		II				Kerpen cables	Germany	A			
		II				TEW & C	USA	A			
		II				Thermo-Electra Bv	Netherland	A			
		II				Habia cables	China	A			
		II				Thermocables	Hyderabad	A			
		*				Tempsens	Udaipur	DR			
		*				Delton Cables	Faridabad	DR			
		*				RJ Cables	Roorkee	DR			
50	Fiber optic cable	III				HFCL	Goa	A			
		III				R&M	Switzerland	A			
		III				Aksh Fibre	Bhiwadi	A			
		III				Finolex	Pune/Goa	A			
		III				Birla Ericson	Rewa	A			
		III				Molex	UK	A			
		III				Corning	USA	A			
		*				DIGILINK	GOA	DR			
		*				RPG Cables	India	DR			

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		*				Uniflex Cables	India	DR			
51	Pneumatic Actuator (Power Cylinder e. g. FOR	II				Dong Woo Valve Control Co. LTD	Korea	A			
		II				Shin Hwa Engineering Co. LTD	Korea	A			
		I				Instrumentation Limited	Palghat	A			
		I				Kelton		A			
		I				SMC Pneumatics	Noida	A			Up to 12 inch only
		I				Rotex	Mumbai	A			Conditional
		*				Festo	Bangalore	DR			
53	Transducer	II				AE	Mumbai	A			
		II				Southern Transducer	Chennai	A			
		II				Elster	Mumbai	A			
		III				Camille Bauer	Germany	A			
		III				Metrawat	Germany	A			
		II				Rishab	Nasik	A			
		*				Pyrotech	Udaipur	DR			
59	Coupling / Interposing relays	III				PARAMOUNT	BANGALORE	A			* To be covered in DDCMIS QP
		III				OMRON		A			
		III				OEN		A			
		III				Jyoti	Baroda	A			
		III				ELSTA	SWITZERLAN	A			
		*				Schneider	Germany	DR			
		*				Siemens	Germany	DR			
		*				Phoenix	Germany	DR			
60	Solenoid valve	III				Rotex	Vadodara	A			
		III				Avcon	Mumabi	A			
		III				Herion	Germany	A			
		III				IMI NORGEN	GERMANY	A			
		III				Jafferson	Argentina	A			
		III				Asco	Chennai/USA	A			
		III				Festo	Bangalore	A			
		III				SMC	Noida	A			
		III				Parker	Brand Name	A			
		*				Schneider	Germany				

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		*				Neucon Industries Pvt. Ltd.		DR			
61	Lube oil control valve - Self Regulating	II				NUOVO PIGNONE	ITALY	A			
		II				EMERSON	CHENNAI	A			
		II				SAMSON	GERMANY / PUNE	A			
		II				Forbes Arca	Pune	A			Approved up to 4", 150 Class.
62	Guided waveRadar type level transmitter	III				Magnetrol	Belgium	A			
		III				Endress & Houser	Germany/ Aurangabad	A			
		III				Emerson	Sweden/ PAWANE	A			
		III				ABB(K-Tech)	USA	A			
		*				Yokogawa	Japan	DR			
		*				Khrone	France	DR			
		*				HONEYWELL		DR			
		*				Siemens	India	DR			
63	Maintenance and Calibration Equpiment					Main Contractor will propose the vendors during detail Engineering.					
65	Furniture for computer	III				OTS office tech.	India	NOTE			
		III				Godrej boyce		NOTE			
		III				Fetherlite		NOTE			
		III				PAN Office		NOTE			
		III				Pyrotech		NOTE			
66	Terminal Block (Cage and Clamp type)	III				Weidmuller	Germany	A			
		III				Phoenix	Germany /	A			
		III				Wago	Germany /	A			
		III				Elmex	Vadodara	A			CE Mark only

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - PEM, HYD, Trichy, PC, EDN	VENDOR AS APPROVED BY	DATE : 12/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
68	PLC System (If applicable)	I				GE Intellegent plateforms	Bangalore	A			
		I				ABB	Bangalore	A			
		I				Schneider	Nasik	A			
		I				Rockwell	Sahibabad	A			
		I				Siemens	Nasik	A			
69	SMART POSITIONER	#				ABB		N			# - To be covered in Control Valve QP.
		#				masolenien		N			
		#				Siemens		N			
		#				Smar		N			
		#				Yokogawa		N			
		#				EMERSON (Fisher Rosemount)		N			
		#				MESTO		N			
70	ROTAMETER	III				IEPL	HYDRABAD	A			
		III				TRAC	HYDRABAD	A			
		III				PLACKA	CHENNAI	A			
		III				EUREKA	PUNE	A			
		III				SCIENTIFIC DEVICES	MUMBAI	A			UP TO 300 NB
		III				FLOW STAR	FARIDABAD	A			
		III				TOKOYO KEISO	JAPAN	A			
		*				Flowtech Instrument		DR			
		*				Samil Chemtrol	MUMBAI	DR			
		*				Gauges Bourdon	Panvel	DR			
71	SINGLE AND MULTI POINT TEMPERATURE RECORDER (Micorprocessor based)	III				YOKOGAWA INDIA	BANGALORE	A			Make Yokogawa, Japan
		III				CHINO CORPORATION	JAPAN	A			
		III				EUROTHERM	UK	A			
		III				EUROTHERM	INDIA	DR			
		III				YOKOGAWA	JAPAN	A			
		III				ABB	UK / GERMANY	A			
		III				FUJI	JAPAN	A			

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		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE				REVISION NO : 00
		CONTRACTOR : BHEL - PEM, HYD, Trichy, PC, EDN					VENDOR AS APPROVED BY				DATE : 12/12/2015
		CONTRACT NO :									
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				HONEYWELL	USA / NETHERLAND	A			
72	Reverse Rotation Indicator (RRI)	III				GE BENTLY NEVEDA	USA	A			ALL TSI VENDORS ARE ALSO ACCEPTABLE
		III				SHINKAWA	JAPAN	A			
		*				P & F	GERMANY	DR			
75	pH/ Conductivity Analyser	III				HACH	Switzerland	A			Polymetron brand
		III				YOKOGAWA	Banglaore / Japan	A			Make Yokogawa- Japan
		III				ABB	UK / USA	A			
		III				EMERSON	Pawane	A			
		*				Thermo orion		DR			
76	PADO					Main Contractor will propose the vendors during detail Engineering.					
77	DEW Point Sensor	III				GE Sensing	USA	A			
		III				Michell Instrument	UK	A			
		III				VAISHALA	Sweden /	DR			
		III				DWER	USA	DR			
78	BLANK										
79	BLANK										
80	Blank Panels / Cabinets	III				Rittal	Bangalore	A			
		III				Hoffman	BANGALORE	A			
		III				Pyrotech	Udaipur	A			
		III				Schneider	Bangalore	DR			
		III				MHI / Melco	Japan	DR			
81	CCTV Components (IP)	*				Sony	Japan	DR			
		*				Siemens	Pondichery	DR			
	Integrators will be decided during detail Engineering.	*				Dv Tel	USA	DR			
		*				Honey Well	Gurgaon	DR			
		II				Bosch	Bangalore	A			With Bosch Software
		II				Axis	Sweeden	A			With Bosch Software
		*				Pelco	USA	DR			
		II				Axis	Sweden	A			With Milestone Software
82	Control Desk, Server / PC Rack for Unit control room and Auxillary control room	I				Pyrotech works Space	Udaipur	A			

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	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				Digital Instruments and Control System (Proface)	Bangalore	A			Proface Brand
		III				Schnieder Electric		A			
93	Hand Held Calibrator	III				Main Contractor Approved Sources		Noted			Compatible with the Transmitter to be Supplied & Subject to meeting BIFPCL specification requirement
94	Hart Management System	III				Yokogawa	India	A			
		III				Emerson Process Mgmt	USA / Singapore / India	A			
		III				P & F	Germany / Bangalore	A			
		III				MTL	Chennai	A			
95	Impact Head Type Flow Element	II				Detriech / Emerson	USA	A			
		II				Midwest	USA	A			
		II				Veris Inc	USA	A			
96	Isolator	III				Turck	Brand Name	Noted			Will be covered in DDCMIS QP
		III				Stahl	Brand Name	Noted			Will be covered in DDCMIS QP
		III				P & F	Brand Name	Noted			Will be covered in DDCMIS QP
		III				MTL	Brand Name	Noted			Will be covered in DDCMIS QP
		III				Wied Muler	Germany	Noted			Will be covered in DDCMIS QP
		*				Phoenix Contact	India	DR			
97	Master Slave Clock System	II				Hopf	Germany	A			
		I				Sertel	Chennai	A			
		II				Hathway	USA	A			
		II				Buerk Mobatime	Germany	DR			
		II				Moser Baer	Switzerland	DR			
		II				Mein Berg	Germany	A			
		I				Sands	Chennai	A			
		I				Masibus	Gandhinagar	A			

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	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
107	SWAS Analyser (Chloride)	III				ABB	UK	A			
		III				Orion	USA	A			Orion Brand
		*				DKK	Japan	DR			
		*				SWAN	Switzerland	DR			
108	SWAS Analyser (Conductivity)	III				Hach	Switzerland	A			Polymetron Brand
		III				Emerson Process Management	Navi Mumbai	A			
		III				Yokogawa	Japan	A			
		III				ABB	UK	A			
		*				Honeywell	USA	DR			
		*				DKK	Japan	DR			
		*				SWAN	Switzerland	DR			
		*				Orion	USA	DR			
109	SWAS Analyser (Dissolved Oxygen)	III				Orion	USA	A			Orion Brand
		III				Hach	Switzerland	A			Polymetron Brand
		III				Emerson Process Management	USA	A			
		III				ABB	UK	A			
		*				Honeywell	USA	DR			
		*				SWAN	Switzerland	DR			
		*				DKK	Japan	DR			
110	SWAS Analyser	III				Hach	Switzerland	A			Polymetron Brand
		III				Orion	USA	A			Orion Brand
		III				ABB	UK	A			
		*				DKK	Japan	DR			
		*				SWAN	Switzerland	DR			
		*				Rosemount Analytical Inc Irvine		DR			
111	SWAS Analyser (pH)	III				ABB	UK	A			
		III				Hach	Switzerland	A			Polymetron Brand
		III				Emerson Process Management	Navi Mumbai	A			
		III				Yokogawa	Japan	A			
		*				Honeywell	USA	DR			

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No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				SWAN	Switzerland	DR			
		*				DKK	Japan	DR			
		*				Orion		DR			
112	SWAS Analyser (Phosphate)	III				Hach	USA	A			
		III				Hach	Switzerland	A			Polymetron Brand
		III				ABB	UK	A			
		*				DKK	Japan	DR			
		*				Orion	USA	DR			
		*				SWAN	Switzerland	DR			
		*				Rosemount Analytical Inc Irvine		DR			
113	SWAS Analyser (Silica)	III				Hach	USA	A			
		III				Hach	Switzerland	A			Polymetron Brand
		III				ABB	UK	A			
		*				DKK	Japan	DR			
		*				Orion	USA	DR			
		*				SWAN	Switzerland	DR			
		*				Rosemount Analytical Inc Irvine		DR			
114	SWAS Analyser (Sodium)	III				Hach	Switzerland	A			Polymetron Brand
		III				Orion	USA	A			Orion Brand
		III				ABB	UK	A			
		*				SWAN	Switzerland	DR			
		*				DKK	Japan	DR			
115	SWAS Analyser (Turbidity)	III				ABB	UK	A			
		III				Emerson	USA	A			
		III				WTW	Germany	A			
		III				E & H	Germany	A			
		*				SWAN	Switzerland	DR			
		*				DKK	Japan	DR			
116	Synchronising Relay	III				Siemens	Mumbai	A			
		III				Areva	Chennai	A			
		III				ABB	Bangalore	A			
117	Synchroscope	III				Alsthom	Chennai	Noted			
		III				Reyrolle	UK	Noted			
		III				ABB	Germany	Noted			

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No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				AE	Mumbai	Noted			
118	Ultrasonic Type Flow Meter (for Stack)	III				Maihak	Germany	A			
		III				Durag	Germany	A			
		III				Teledyne	USA	A			
		*				GE Sensing	USA	DR			
119	UPS / ACDB	I				EMERSON (DB Power)	Pune	A			Approved up to 105 KVA,
		I				Merlin & Gerin	France	A			
		I				Gutur	Switzerland	A			
		I				AEG (Saft)	Germany	A			
		I				Hirel	Gandhinagar	A			Approved up to 120 KVA,
		I				Emerson (Tata Libert)	Mumbai	A			Approved up to 150 KVA,
		I				Fuji Electric	Japan	A			
		*				Keltron	Kerala	DR			
		*				APC	India	DR			
120	Vibration Monitoring System for BOP	II / I				Shinkawa	Japan	A			Refer Note - 1
		II / I				Bentley Niveda	USA	A			Refer Note - 1
		II / I				Vibrometer	Switzerland	A			Refer Note - 1
		II / I				Rockwell Automation	USA	A			Refer Note - 1
		II / I				SKF	USA	A			Refer Note - 1
		*				Emerson	Mumbai	DR			
		*				Burel and Kajer		DR			
		*				IRD Mechanalysis	Mumbai	DR			
123	Wireless Solution (Microwave Tower Communication)	III				D Link	Goa	A			
		III				Sheetal	Pune	A			
		III				Pyrotech	Udaipur	A			
		III				Arya Communications	New Delhi	A			
		*				Lotus Wireless	Vishakhapatna	DR			
		*				Avirion	Israel	DR			
		*				AMG Systems Ltd.	UK	DR			
124	Large Video Screen (LED Based)	I				Delta	Gurgaon	A			
		I				Barco	Noida	A			
		I				Christie	USA	A			

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		CONTRACTOR : BHEL - PEM, HYD, Trichy, PC, EDN					VENDOR AS APPROVED BY				DATE : 12/12/2015	
		CONTRACT NO :										
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark	
131	Static Excitation System for Generator Excitation including associated Thristors, Power devices and Electronic Modules	I				BHEL-EDN, Bangalore	Bangalore	A				
132	Panels for SEE	II				BHEL-EDN, Bangalore	Bangalore	A				
		II				Prammen	Bangalore	A				
133	Field Breaker	II				ABB	Switzerland	A				
		II				LENNOIR/ MERSEN	France	A				
134	Off-Load Isolators	II				ABB	SWEDEN	A				
		II				C&S	DELHI / NOIDA	A				
		II				ABB	Bangalore	A				
135	CONDUCTION MONITORING CKT	II				VAC	GERMANY	A				
		II				KALPA Electricals	BANGALORE	A				
		II				KAPPA	BANGALORE	A				
136	Filters	III				SCHAFFNER	GERMANY	A				
137	Field Discharge Resistor	I				AMP CONTROL	MUMBAI	A				
		I				OHMARK		A				
		I				M&I Materials,	MUMBAI	A				
138	Parallel Shunt Reactors	I				FIBRADITE		A				
						SREE VENKATESHA ELECTRICALS		DR				
139	Excitation Transformenr	I				BHEL	JHANSI	A				
140	Power Contractors	II				ABB	INDIA	A				
						SIEMENS	INDIA	A				
	LEGENDS :											

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY BIFPCL)

A - For those items proposed vendor is acceptable to BIFPCL. To be indicated with letter "A" in the list alognwith the condition of approval, if any.

DR - For those items "Detailed Required" for BIFPCL review. To be identified with letter "DR" in the list.

DR* - For those item "Detail Required by BIFPCL for record updation only

NOTED : For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED"

2.0 QP INSPECTION CATEGORY :

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		CONTRACTOR : BHEL - PEM, HYD, Trichy, PC, EDN					VENDOR AS APPROVED BY			DATE : 12/12/2015	
		CONTRACT NO :									
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark

CAT - I : For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection

CAT - II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL

CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units / works.

*** - Inspection category will be decided during vendor evaluation.**

NOTE - 1 : EMPTY CABINETS, COMPUTERS, SIGNAL ISOLATOR / MULTIPLIER, MCB, TB, POWER SUPPLY ETC. SHALL ALSO BE ACCEPTABLE FROM INDEGENEOUS SOURCES AGREED BY BIFPCL IN QP. IF THE TOTAL INTEGRATED PANEL

NOTE - 2 : Thrust bearing RTD vendor will be finalised after award during detail engineering.

NOTE - 3 : For the items not appearing in the preaward list, bidder and BIFPCL will mutually discussed in future.

NOTE - 4 : The items which are appearing under Schedule - I (To be supplied from overseas vendor), for those items, indegeneous approved vendors stands cancelled / Withdrawn.

Note 5: For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

Engg. Div/QA&I

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No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
						S K SYSTEMS, SONEPET		A			
						DUSTVEN, BANGALORE		A			
						ABB LIMITED		DR			
						MESINA, MUMBAI		DR			
						JAYPEE ENGINEERING WORKS, KOLKATA		DR			
						BATLIBOI LTD.,		DR			
						SPRAYING SYSTEMS INDIA PVT., LTD.,		DR			
						A.P.C. SYSTEMS & PRODUCTS PVT.LTD		DR			
						TRAC FUJICO AIR SYSTEMS LIMITED		DR			
						APC AIR SYSTEMS PVT LTD		DR			
						ROOTS COOLING SYSTEM PVT LTD		DR			
						GLOBAL ENVIRO AIR SYSTEM PVT LTD.,		DR			
						INDVENT FANS PRIVATE LTD.,		DR			
						GENTECH ENGINEERING SERVICES		DR			
						PACK PLAST INSDUSTRIES.		DR			
						DUSTECH ENGINEERS PVT LTD.,		DR			
						ADVANCE VENTILATION PVT LTD .,		DR			
14	HELICAL GEAR BOX	I				SHANTI GEARS, COIMBATORE		A			
						ELECON, VV NAGAR		A			
						SIEMENS (FLENDER), KHARAGPUR		A			
						PREMIUM TRANMISSION LTD, PUNE/FALTA		A			
						SIEMENS (FLENDER), GERMANY		A			
						SEW EURODRIVE GMBH & CO., GERMANY		A			
						NEW ALLENBURY WORKS, KOLKATA		A			
						R&D MULTIPLES (METAL CAST) PVT. LTD.		DR			
						ESSENTIAL POWER TRANSMISSION PVT.LTD		DR			
						KATEEL Engineering Industry Pltd		DR			
15	PLANETARY GEAR BOX	I				ELECON, VV NAGAR		A			
						SIEMENS (FLENDER), GERMANY		A			
						MOVENTAS, GERMANY		A			
						PREMIUM TRANMISSION LTD, PUNE/FALTA		DR			
						BREVINI, ITALY		A			
						SEW EURODRIVE GMBH & CO., GERMANY		A			
						SHANTI GEARS, COIMBATORE		DR			
						R&D MULTIPLES (METAL CAST) PVT. LTD.		DR			
						ESSENTIAL POWER TRANSMISSION PVT.LTD		DR			
						KATEEL Engineering Industry Pltd		DR			
16	FLUID COUPLING (TRACTION TYPE)	I				PREMIUM TRANMISSION LTD, aurangabad		A			
						ELECON , VV Nagar		A			
						FLUIDOMAT, indore		A			
						VOITH(INDIA), hyderabad		A			

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	CONTRACTOR : BHEL - ISG						VENDOR AS APPROVED BY				DATE : 12/12/2015
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No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
						VOITH , germany		A			
						ESCO COUPLINGS & TRANSMISSIONS PVT LTD, bangalore		DR			
17	FLUID COUPLING (SCOOP TYPE)	I				FLUIDOMAT, INDORE		A			
						VOITH, GERMANY		A			
						VOITH, India		A			
						PREMIUM TRANMISSION LTD, AURANGABAD		A			
						ELECON, VV NAGAR		A			
						ESCO COUPLINGS & TRANSMISSIONS PVT LTD, bangalore		DR			
18	HORIZONTAL CENTRIFUGAL PUMP	I				KSB, PUNE		A			
						BEST & CROMPTON, CHENNAI		A			
						SAM TURBO, COIMBATORE		A			
						KBL, IRLOSARWADI		A			
						M&P, PUNE		A			
						WPIL, GHAZIABAD		A			
						FLOWMORE, GHAZIABAD		A			
						KUBOTA CORPN., JAPAN		DR			
						BEACON WEIR LTD, CHENNAI		DR			
						Kishor Pumps Pvt. Ltd., Chennai		DR			
						METSO MINERALS (INDIA) PVT LTD.,INDIA		DR			
						WIER MINERALS (India) Pvt. Ltd, INDIA		DR			
						VARAT PUMP & MACHINERY PVT LTD, KOLATA		DR			
19	ELEVATOR	I				ALIKRAFT, VADODARA		A			
						UNIVERSAL CONSTRUCTION MACHINERY, PUNE		A			
						AVON CRANES, GURGAON		A			
						MEKASTER, HALOL		A			
20	EOT CRANES / HOISTS	I				REVA INDUSTRIES, FARIDABAD		A			
						EDDY CRANE, PUNE		A			
						CONSOLIDATED HOIST, SATARA/PUNE		A			
						ELECTROTHERAPHY, RISHRA		A			
						HERCULES HOIST, RAIGAD		A			
						TUBRO FERGUSSON, KOLKATA		A			
						PRAYAS ENGG (PBL), VV NAGAR		A			
						ALPHA SERVICES, ALWAR		A			
						CENTURY CRANE ENGINEERS PVT. LTD, PALWAL		A			
						ARMSEL, BANGALORE		A			
						TRACTEL TIRFOR, PALWAL		A			
						MILLARS INDIA, KARAMSAD		A			
						AVON CRANES, GURGAON		A			
						GRIP ENGINEERS, HYDERABAD		A			

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING			REF. NO :	
		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE			REVISION NO : 00	
		CONTRACTOR : BHEL - ISG					VENDOR AS APPROVED BY			DATE : 12/12/2015	
		CONTRACT NO :									
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
						GRIP ENGINEERS, FARIDABAD		A			
VENDORS FOR ALL OTHER ITEMS, OTHER THAN THOSE LISTED ABOVE, SHALL BE FROM BHEL APPOVED SOURCES.											
CUSTOMER APPROVAL SHALL BE REQUESTED, IN CASE ANY OTHEER VENDOR IS FOUND TECHNICALLY SUITABLE DURING DETAILED ENGINEERING,											
II	ASH HANDLING SYSTEM										
1	ASH HANDLING SYSTEM INCL	I				MACAWBER BEEKAY PVT.LTD,		A			
	ASH EXTRACTION VALVES					STOCK REDLER INDIA PRIVATE LIMITED,		DR			
	VACUUM BREAKER					THE INDURE PVT., LTD., NEW DELHI		A			
	CLINER GRINDER					MCNALLY BHARAT ENGINEERING COMPANY LTD		A			
	JET PUMP					UNITED CONVEYOR CORPN., (INDIA) PVT., LTD.		DR			
	ASH CONDITIONER					Meico India Pvt Ltd ,		DR			
	BAG FILTER					BHEL ISG, BANGALORE		A			
2	ASH SLURRY PUMP	I				SAM INDUSTRIAL PUMPS, COMBATORE		A			
						WEIR MINERALS (MANUFACTURING AT WEIR MINERALS BANGALORE)		A			
						Metso Minerals, ALWAR		DR			
3	HORIZONTAL WATER PUMPS	I				FLOWMORE, GHAZIABAD		A			
						WORTHINGTON, GHAZIABAD		A			
						MATHER & PLATT, PUNE		A			
						SAM TURBO INDUSTRY, COIMBATORE		A			
						KSB, PUNE		A			
						BEST AND CROMPTON, CHENNAI		A			
						KIRLOSKAR BROTHERS, KIRLOSR BADI		A			
						KUBOTA CORPN., JAPAN		DR			
						BEACON WEIR LTD, CHENNAI		DR			
						Kishor Pumps Pvt. Ltd., Chennai		DR			
						MCNALLY SAYAJI ENGINEERING LIMITED		DR			
						METSO MINERALS (INDIA) PVT LTD.,		DR			
						WIER MINERALS (India) Pvt. Ltd		DR			
						VARAT PUMP & MACHINERY PVT LTD		DR			
4	OIL FREE SCREW COMPRESSORS	I				INGERSOL RAND INDIA, AHEMEDABAD		A			
						KOBELCO, JAPAN		A			
						ATLAS COPCO, BELGIUM		A			
						ELGI ,COIMBATORE		A			
						AERZENER, GERMANY		A			
5	ROTARY TWIN LOBE BLOWERS FLUIDISING	I				KULKARNI POWER TOOLS, SHIROL		A			
						EVEREST TRANSMISSION, DELHI/BAHADURGARH		A			
						KAY INTERNATIONAL, SONEPAT		A			
						ACME AIR EQUIPMENT CO, AHEMEDABAD		DR			
						SWAM PNEUMATICS, NOIDA		A			

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - ISG	VENDOR AS APPROVED BY	DATE : 12/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
6	VOID										
7	KNIFE GATE VALVE (SLURRY DUTY)	I				BRAY CONTROL INDIA (VAAS INDUSTRIES), CHENNAI		A			
						ORBINOX, COIMBATORE		A			
						SISTAG,SWITZERLAND		A			
						WEIR MINERALS, BANGALORE		A			
						FOURESS ENGG., BANGALORE		A			
8	PLUG VALVE (SLURRY DUTY ABOVE 10 KG/CM2)	I				Flowserve, MARAIMALAINAGAR		A			
						WEIR BDK, HUBLI		DR			
9	PLUG VALVE WATER DUTY	I				FISHER XOMOX,CHENNAI		A			
						WEIR BDK,HUBLI		A			
						Flowserve,MARAIMALAINAGAR		A			
10	KNIFE GATE VALVE (FLY ASH DUTY)	I				ORBINOX, CHENNAI		A			
						BRAY CONTROL INDIA (VAAS INDUSTRIES), CHENAI		A			
						SISTAG,SWITZERLAND		A			
						FOURESS,BANGALORE		A			
						JASH SHUTTE, INDORE		A			
11	BALL VALVES (UPTO 350 NB 150 CLASS, 50 NB 800 CLASS)	I				FLOWCHEM,AHEMEDABAD		A			
						BDK,HUBLI		A			
						L&T,COIMBATORE		A			
						MICROFINISH,HUBLI		A			
						PRECISION ENGG.,MUMBAI		A			
						AKAY,HUBLI		A			
12	BUTTER FLY VALVE (500 NB, PN 10/PN 16; 900 NB PN 10)	I				Flowserve,MARAIMALAINAGAR		A			
						PENTAIR VALVES & CONTROLS,HALOL		A			
						BDK		A			
						INTERVALVE POONAWALA, PUNE		A			
						FOURESS ENGG, BANGALORE		A			
						CRANE PROCESS,SATARA		A			
						L&T Valves.ANCHIPURAM		A			
13	CI /SGI GATE/GLOBE/CHECK VALVES (UPTO 600 NB, PN 16)	I				KIRLOSKAR BROTHERS, KONDAPURI		A			
						H SARKAR, HOWRAH		A			
						LEADER,JULLANDHAR		A			
						A V VALVES,AGRA		A			
						BANKIM,HOWRAH		A			
	SAFETY RELIEF VALVE	III				SPIRAX MARSHALL, PUNE		Noted			
						FISCHER SANMAR, CHENNAI		Noted			
						LEADER,JALANDAR		Noted			
	CS VALVES (UPTO 600 NB 150 CLASS)	II				WEIR BDK, HUBLI		A			
						KSB, COIMBATORE		A			
						STEEL STRONG.MUMBAI		A			

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING			REF. NO :	
		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE			REVISION NO : 00	
		CONTRACTOR : BHEL - ISG					VENDOR AS APPROVED BY			DATE : 12/12/2015	
		CONTRACT NO :									
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
						L&T,COIMBATORE		A			
						LEADER VALVES,ALANDHAR		A			
						FOURESS, MUMBAI/AURAGABAD		A			
16	MS ERW PIPE AS PER IS 1239 (UPTO 150 NB)	I				Jindal,GHAZIABAD		A			
		I				Jindal,HISSAR		A			
		I				Surya Roshni,BHADURGAH		A			
		II				SAIL		A			
		I				TISCO,AMSHEDPUR		A			
		I				Indus Tubes, GB NAGAR		A			
		I				DADU PIPES,SIANDARAAD		A			
		I				Welspun,ANJAR		A			
		I				API Apollo Tubes Ltd,SIANDARABAD		A			
		I				Lloyds Line Pipes Ltd, THANE		A			
17	M.S. Pipes as per IS 3589 (upto 900 NB) (CAT-II FOR SAIL)	I				Jindal, GHAZIABAD		A			
		I				JINDAL, HISSAR		A			
		I				Surya Roshni,BAHADURGAH		A			
		I				DADU PIPES,SIANDARAAD		A			
		II				SAIL		A			
		I				Indus Tubes, GB NAGAR		A			
		I				Welspun,ANJAR		A			
						Maharastra Seamless,RAIGAD		A			
						Ratnamani,KUTCH		A			
						JCO GAS PIPES,CHINDWARA		A			
						Ratnamani,KTCH/AHEMEDABAD		A			
						Mukat Tanks & Vessels,TARAPUR		A			
						Mukat Pipes,RAJPURA		A			
						PSL Holdings,CHENNAI/DAMAN/UTCH/ VIZAG		A			
						Mann Industries, INDORE		A			
						Welspun,BARUCH		A			
						SAMSHI PIPES,BARODA		A			
						ASIAN MILLS PRIVATE LIMITED		DR			
						JNB Steel Industries Pvt. Ltd.,		DR			
						APL Apollo Tubes Ltd.		DR			
						Jotindra Steel & Tubes Ltd.		DR			
						Amardeep Steel Centre		DR			
						Tubes India		DR			
						M.J. Patel (India) Limited		DR			
						ADS PRO - SHIELD		DR			
18	CI SPUN PIPES-	I				KAPILANSH DHATU UDYOG(P) LTD, NAGPUR		A			
						HITECH METAL CASTING,HYDERABAD		DR			
						Kesoram Spun Pipe,HOOGLY		A			

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		CONTRACTOR : BHEL - ISG					VENDOR AS APPROVED BY			DATE : 12/12/2015	
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						Kushlava, VIAYAWADA		A			
						IISCO		A			
						ELECTROSTEEL CASTINGS LIMITED, CHENNAI		A			
19	GEAR BOX	I				Refer CHP List					
20	FLUID COUPLING (SCOOP TYPE & TRACTION TYPE)	I				Refer CHP List					
21	EOT CRANE [UPTO 20 TON] /ELECTRIC HOIST [UPTO 20 TON]	I				REFER CHP LIST					
22	PNEUMATIC / HYDRAULIC ACTUATOR (CYLINDER)	I				SCHRADER DUNCAN, PUNE		A			
						ROTEX, MUMBAI		A			
						VAAS INDUSTRIES, CHENNAI		A			
						NUCON, HYDERABAD		A			
						DUNCAL, MUMBAI		A			
23	CAST BASALT LINED PIPES & FITTINGS (If applicable)	I				Enviro Bulk Handling Systems Pvt Ltd., PUNE		A			
						TURBO ENGINEERS (CBE), COIMBATORE		A			
						Vidyut Green Bank, MUMBAI		A			
						Deccan Mechanical and Chemical Industries Pvt. Ltd., Pune		A			
24	CASTABLE REFRACTORY	II				CALDERYS INDIA (ACE), KATNI		A			
						MAHAKOSHAL REFRACTORIES, KATNI		A			
						TATA REFRACTORIES, BELPHAR		A			
						BHASKAR REFRACTORIES, FARIDABAD		A			
25	METALLIC EXPANSION BELLOWS	I				MB METALLIC BELLOWS, CHENNAI		A			
						SUR INDUSTRIES,KOLKATA		A			
						LONE STAR, CHENNAI		A			
26	AIR DRYING UNIT (BHR TYPE) UPTO 900 M3/HR	I				INDCON, DELHI		A			
						MELCON, NOIDA		A			
						SUMMIT,COIMBATORE		A			
						ATLAS COPCO, BELGIUM		A			
						DELAIR,GURGAON		A			
						SHALCOT,NOIDA		DR			
27	INSULATION	III				LLOYDS INSULATION CHENNAI WORKS AT ROCKWOOL BHILAI		A			
						ROCKWOOL INDIA,MEDAK		A			
						MINWOOL,RAJNANDGAON		A			
						LAPINUS ROCKWOOL LTD,GWALIOR		A			
28	MS PLATES (SEE NOTE 2)	III				SAIL		A			
						JSPL		A			
						TISCO		A			
						LLOYD STEEL INDS. LTD		A			
						JSW		A			
						ESSAR STEEL		A			
						IISCO		A			
						ISPAT INDUSTRIES		A			

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING				REF. NO :
		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE				REVISION NO : 00
		CONTRACTOR : BHEL - ISG					VENDOR AS APPROVED BY				DATE : 12/12/2015
		CONTRACT NO :									
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
						RINL		A			
29	REFRIGERANT TYPE AIR DRYER	I				SUMMITS, COIMBATORE		A			
						ATLAS COPCO, BELGIUM		A			
						MELCON, GREATER NOIDA		A			
						DELAIR, GURGAON		A			
						TRIDENT,COIMBATORE		A			
						SHALCOT, NOIDA		DR			
30	VENT FILTER	II				ORIENT FANS (ACCO), KOLKATA		A			
						THERMAX, PUNE		A			
						Howden Solyvent (FLAKT) , KOLKATA		A			
						RICCO, PUNE		A			
31	QT ACTUATORS	III				ROTEX, MUMBAI		A			
						ELOMATIC, PUNE		A			
32	STRAINERS	III				GUJARAT OTOFILT,AHEMEDABAD		A			
						OTOKLIN FILTERS,MUMBAI		A			
						MULTITEX,NOIDA		A			
						GREAVES COTTON,MUMBAI		A			
						JAYPEE,DELHI		A			
33	AFTER COOLER	I				PARKAIRE,DELHI		A			
						ABACUS HEAT TRANSFER,FARIDABAD		A			
						INDCON,DELHI		A			
						SUMMITS HYGRONICS,COIMBATORE		A			
						MELLCON,DELHI		A			
VENDORS FOR ALL OTHER ITEMS, OTHER THAN THOSE LISTED ABOVE, SHALL BE FROM BHEL APPOVED SOURCES. CUSTOMER APPROVAL SHALL BE REQUESTED, IN CASE ANY VENDOR IS FOUND TECHNICALLY SUITABLE DURING DETAILED ENGINEERING.											
III	HCSD SYSTEM										
1	Agitator	I				SUDARSHAN CHEMICALS IND. LTD. (FORMERLY Rathi Vessels), PUNE		A			
		I				Remi, VV Nagar		DR			
		II				Hoesch (with Sew -Finland make Gearbox & Weg-Brazil make Motor), Germany		A			
2	Hose Pump	I				Pennwalt, Mumbai		DR			
		I				Watson Marlow (Bredel), Netherland		A			
		II				Verder, UK		A			
3	HCSD Pump with suction vessel, pulsation dampener and Pump controller	I				Weir Minerals, Netherlands		A			
						ABEL, Germany		A			
						FELUWA,Germany		A			
						WIRTH, Germany		DR			
	Plug cock in HCSD line	II				Flowserve, MARAIMALAINAGAR		A			
	Flange Pump (Booster Pump)	I				Weir Minerals,Bangalore		A			
						Sam Turbo,Coimbatore		A			

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING			REF. NO :	
		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE			REVISION NO : 00	
		CONTRACTOR : BHEL - ISG					VENDOR AS APPROVED BY			DATE : 12/12/2015	
		CONTRACT NO :									
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
						Metso Minerals,Alwar		DR			
6	Strainer in HCSD Pump Suction - as applicable	III				HCSD Vendor					
VENDORS FOR ALL OTHER ITEMS, OTHER THAN THOSE LISTED ABOVE, SHALL BE FROM BHEL APPOVED SOURCES.											
CUSTOMER APPROVAL SHALL BE REQUESTED, IN CASE ANY VENDOR IS FOUND TECHNICALLY SUITABLE DURING											
IV	DRY BOTTM ASH HANDLING SYSTEM										
1	DRY BOTTM ASH SYSTEM (IMPORTED EQUIPMENTS)	I				MAGALDI POWER		A			
		I				CLYDE BERGEMANN		DR			
		I				LONKING		DR			
2	INDIAN PORTION					FROM ABOVE LIST / BHEL APPROVED SOURCES FROM AHP					
CUSTOMER APPROVAL SHALL BE REQUESTED, IN CASE ANY VENDOR IS FOUND TECHNICALLY SUITABLE DURING DETAILED ENGINEERING,											
V	ELECTRICAL										
1	DRY TYPE TRANSFORMERS	II				BHEL					
2	LT BUS DUCT	I				BHEL					
3	LT SWITCHGEAR	I				BHEL					
4	HT MOTOR	II				BHEL					
5	ONAN TRANSFORMERS	I				Refer PEM List					
6	HT CABLE					Refer PEM List					
7	LT POWER & CONTROL CABLE					Refer PEM List					
8	INSTRUMENT/SIGNAL/ SCREENED/TELEPHONE SPECIAL CABLES					Refer PEM List					
9	BATTERIES					Refer PEM and EDN List					
10	BATTERY CHARGER					Refer PEM and EDN List					
11	LIGHT FITTINGS	III				BAJAJ ELECTRICALS LIMITED		Noted			
						CROMPTON GREAVES LTD.		Noted			
						PHILIPS INDIA LIMITED		Noted			
						HAVELL'S INDIA LTD., NEW DELHI		Noted			
						Vintus systems		DR			
12	DG SETS	I				POWERICA LIMITED		A			
						SUDHIR GENSETS LTD, DELHI (CUMMINS)		DR			
						TIL LTD, (CATERPILLAR)		A			
						MODI MIRRLESS BLACK STONE, NEW		DR			

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - ISG	VENDOR AS APPROVED BY	DATE : 12/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
						Apollo Power Systems Ltd.		Noted			

VENDORS FOR ALL OTHER ITEMS, OTHER THAN THOSE LISTED ABOVE, SHALL BE FROM BHEL APPOVED SOURCES.
CUSTOMER APPROVAL SHALL BE REQUESTED, IN CASE ANY VENDOR IS FOUND TECHNICALLY SUITABLE DURING DETAILED ENGINEERING,

L OTHER
13/12/15

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY BIFPCL)

A - For those items proposed vendor is acceptable to BIFPCL. To be indicated with letter "A" in the list alognwith the condition of approval, if any.
DR - For those items "Detailed Required" for BIFPCL review. To be identified with letter "DR" in the list.
DR* - For those item "Detail Required by BIFPCL for record updation only
NOTED : For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED" (N)

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection witness by BIFPCL
CAT - II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis of review of
CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main supplier.

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units / works.
*** - Inspection category will be decided during vendor evaluation.**

NOTE - 1 : For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

13/12/15

NOTE - 2 : For the items not appearing in the preaward list, bidder and BIFPCL will mutually discussed in future.

Rated A

INTERNATIONAL OPERATIONS DIVISION

PROJECT : MAITREE (2 X 660MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL PACKAGE	REF. NO.: -	
PACKAGE : EPC		REV. NO.: 00	
CONTRACTOR : BHEL, Bhopal	SUB-SYSTEM: BHEL BHOPAL		
CONTRACT NO. :		DATE: 14.12.2015	

SL. NO.	ITEM	QP/ INSP CAT.	Q P. N O.	QP. SUBMISSIO N SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
1	HT MOTOR	I				BHEL	BHOPAL	A			ID FAN, BFP MOTOR & OTHER HT MOTORS-SUB QR ITEM
2	BEARING ASSEMBLY	I				OMEGA INDUSTRIES	BHOPAL	A			UP TO 250 MM
		I				MALIK ELECTROMECHANICAL	MUMBAI	A			UPTO 250×160×560 MM
		I				UNITOOL	MUMBAI	A			UP TO 250 (D) ×200 (L)
		I				RENK	GERMANY	A			UP TO 400 MM DIA
		I				OMEGA RENK	BHOPAL	A			UP TO 280 MM DIA
		I				DUMDUM	KOLKATA	A			UP TO 250 (D) ×200 (L)
		I				PRECIMAX	SOLAPUR	DR			
		I				ZOLLERN GmbH	GERMANY	DR			
		I				ZOLLERN TRANSMISSION	BRAZIL	DR			
3	ANTIFRICTION BEARING	***				NTN	JAPAN	A			
		***				SKF	GERMANY	A			

PROJECT : MAITREE (2 X 660MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL	REF. NO.:-
PACKAGE : EPC	PACKAGE	REV. NO.: 00
CONTRACTOR : BHEL, Bhopal	SUB-SYSTEM: BHEL BHOPAL	
CONTRACT NO. :		DATE: 14.12.2015

SL. NO.	ITEM	QP/ INSP CAT.	Q P. N O.	QP. SUBMISSIO N SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
		***				FAG	GERMANY	A			
		***				STERYS	AUSTRIA	A			
		***				NSK	JAPAN/SINGAPORE	A			
		***				SKF	INDIA	DR			
		***				FAG	INDIA	DR			
		***				NSK	INDIA	DR			
4	COOLER (CACW/CACA)	I/***				KARNATAKA ENGG	BHOPAL	A			
		I/***				LAXMI ENGG INDUSTRIES	BHOPAL	A			
		I/***				GEI HAMMON	BHOPAL	A			
		I/***				FITWELL	BHOPAL	A			
		I/***				C DOCTOR	AHMEDABAD	A			
		I/***				MEHTA INDUSTRIES	BHOPAL	A			FOR CACA ONLY
		I/***				SHRAO ENGG	BHOPAL	DR			
5	ROTOR BARS (Copper)	***				SIEMENS	GERMANY	A			
		***				CHANDRA METAL	ALLAHABAD	A			

PROJECT : MAITREE (2 X 660MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL PACKAGE	REF. NO.: -
PACKAGE : EPC		REV. NO.: 00
CONTRACTOR : BHEL, Bhopal	SUB-SYSTEM: BHEL BHOPAL	
CONTRACT NO. :		DATE: 14.12.2015

SL. NO.	ITEM	QP/ INSP CAT.	Q P. N O.	QP. SUBMISSIO N SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
		***				JYOTI	VADODARA	A			
		***				SILKANS ELECTRIC	MUMBAI	A			
		***				PRAYOG	PUNE	A			
		***				PRAGATI ELECTRIC	MUMBAI	A			
		***				ETC	BHOPAL	DR			
		***				PARAS	BANGALORE	A			
18	SPEED SWITCHES	***				AG SYSTEM	MUMBAI	A			
		***				JAYSHREE ELECTRIC	PUNE	A			
		***				PROTO CONTROL	PUNE	A			
		***				JOSNA ELECTRONIC	NEW DELHI	DR			
19	RTD, BTD	***				DETRIV	MUMBAI	A			
		***				TECHNO INSTRUMENTS	AHMEDABAD	A			
		***				GENERAL INSTRUMENTS	GOA	A			
		***				PYRO ELECTRIC	GOA	A			
		***				JINDAL ELECTRONIC	ROORKEE	A			
		***				PROCESS CONTROL	ROORKEE	A			

ENGINEERING DIV/ QAI

PROJECT : MAITREE (2 X 660MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL PACKAGE	REF. NO.: -
PACKAGE : EPC		REV. NO.: 00
CONTRACTOR : BHEL, Bhopal	SUB-SYSTEM: BHEL BHOPAL	
CONTRACT NO. :		DATE: 14.12.2015

SL. NO.	ITEM	QP/ INSP CAT.	Q P. N O.	QP. SUBMISSIO N SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
		***				R J INDUSTRIAL CORPORATION	ROORKEE	DR			
20	DIAL TYPE THERMOMETER	***				PTCI	KOLKATA	A			
		***				NSRT	KOLKATA	A			
		***				H GURU	RISHRA/MUZZA FARPUR	A			
21	WATER FLOW INDICATOR	***				LEVCON	KOLKATA	A			
		***				SUKRUT	PUNE	A			

NOTE 1: * INSPECTION & TESTING REQUIREMENT SHALL BE COVERED IN THE RESPECTIVE EQUIPMENTS**
NOTE 2 : BHEL BHOPAL TO ENSURE PROCUREMENT OF ALL INSULATING MATERIAL FOR VPI PROCESS AS PER SIEMENS GERMANY APPROVED SOURCE & AGREED VENDOR AS PER LOA .
NOTE 3 : BHEL SHALL COMPLY WITH VENDOR APPROVAL CONDITION.
NOTE – 4 : For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

PROJECT: MAITREE STPP (2 x 660 MW) PACAKGE : EPC Sub Package : HT Switchgear CONTRACTOR : M/S BHEL CONT. NO.;	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE 13.12.2015

Sl. No.	ITEM	QP / INS CAT.	QP No:-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER BIFPCL	SC APPL SCHEDULE	SC DETAIL SUB SCH	REMARKS
2.	Numerical Relay Network system Integration	I	Q-03			SEL	USA / Bangalore,India	A@			@- Subject to Sub-QR clearance from BIFPCL Engg
						Honeywell	Pune	A@			
						ABB	Bangalore / Baroda	A@			
						Schneider	Noida	A@			
						Alstom	Chennai	DR@			
						Siemens	Gurgaon	DR@			
						L&T	Mumbai	DR@			
						GE	BANGALORE	DR@			For F650 series
3.	IEC 61850 Complaint Numerical Relays	(part of Swgr MQP	Q-04			Please refer LT Switchgear & LT Busduct sub package list					
7	FQP for HT switchgear	I	G-01								

Note 1 : Approval conditions attached to sub- vendors shall be adhered to.

Note 4 : Abbreviations

A – For these items proposed vendor is acceptable to BIFPCL. To be indicated with letter "A" in the list along with the condition of approval, if any.
DR – For these items "Detailed required" for BIFPCL review. To be identified with letter "DR" in the list.
NOTED – For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED."

	PROJECT: MAITREE STPP (2 x 660 MW) PACAKGE : EPC Sub Package : HT Switchgear CONTRACTOR : M/S BHEL CONT. NO.;	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE 13.12.2015

Sl. No.	ITEM	QP / INS CAT.	QP No:-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER BIFPCL	SC APPL SCHEDULE	SC DETAIL SUB SCH	REMARKS

1. QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by BIFPCL and the final acceptance will be on physical inspection witness by BIFPCL.

CAT-II : For these items the Quality Plans approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis review of documents as per approved QP.

CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by BIFPCL shall be on the basis certificate of conformance by the main supplier.

General Notes:

1-Vendor list & category of the mandatory spares shall be as mentioned above.

2-For item not appearing in the above list, main contractor to approach BIFPCL for acceptable vendors & inspection categorization of the same.

3- BIFPCL approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.

4- For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

Project : MAITREE STPP (2 x 660 MW)
Package : EPC Pkg (440/220kV Switchyard Package, GT, ST,UT, Auxiliary Transformer, IPBD and SPBD)
Supplier : BHEL
Contract No.:

Annexure - VI
LIST OF ITEMS REQUIRING QUALITY PLAN
AND SUB-SUPPLIER APPROVAL

DOC.NO. :
REV.NO. : 0

DATE : 13.12.2015
PAGE :

S.N.	Item Description	QP/ Insp. Cat		QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Sub-supplier approval status / cat	Sub-supplier Details submission schedule	Remark
13	ALUMINIUM TUBE	III	130			HINDALCO	RENUKUT	A		
						INDALCO	ALUPURAM	A		
						JINDAL ALUMINUM TUBE	BANGALORE	A		
						ALOM EXTRUSIONS	KOLKATA	A		
						BALCO	KORBA	A		
						SUDAL	NASIK	A		
15	CABLE TRAY, BENDS, COUPLER PLATES	III	*							Refer Cabling List
16	ACSR CONDUCTOR	III	140			HINDUSTAN VIDYUT PRODUCTS	FARIDABAD	A		
						GUPTA POWER	BHUWANESHWAR	DR		
						DIAMOND POWER	VADODARA	A		
						HIREN ALUMINIUM	SILVASSA	A		
						JSK INDUSTRIES	SILVASSA	A		
						HIRA CABLES	HIRAKUD	A		
						SHARAVATHY CONDUCTORS	BANGALORE	A		
17	GS EARTHWIRE / LIGHTING WIRE	III	*			MAIN CONTRACTOR APPROVED SOURCES				
18	CABLE GLANDS	III	*							Refer Cabling List
19	1.1KV GRADE POWER AND CONTROL CABLES (SUBJECT TO PROVENNESS REQUIREMENETS)	III	150							Refer Cabling List
20	CABLE LUGS	III	*							Refer Cabling List
21	LIGHTING FIXTURES & LUMINARIES	III	*							Refer Station Lighting list
22	LIGHTING POLE	III	*			BIS approved Vendors as per IS-2713*				*Vendor should have valid BIS licence.
23	INDUSTRIAL RECEPTACLES	III								Refer Cabling List
24	LEAKAGE CURRENT ANALYSER	III	*			ISA	ITALY	NOTED		
						PGK ELECTRONICS	CHENNAI	NOTED		
						DOBLE	USA	NOTED		
						TRANSINOR	NORWAY	NOTED		
						SCOPE T&M	PUNE	NOTED		

Project : MAITREE STPP (2 x 660 MW)
Package : EPC Pkg (440/220kV Switchyard Package, GT, ST,UT, Auxiliary Transformer, IPBD and SPBD)
Supplier : BHEL
Contract No.:

Annexure - VI
LIST OF ITEMS REQUIRING QUALITY PLAN
AND SUB-SUPPLIER APPROVAL

DOC.NO. :
REV.NO. : 0
7 OF 7
DATE : 13.12.2015
PAGE :

S.N.	Item Description	QP/ Insp. Cat		QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Sub-supplier approval status / cat	Sub-supplier Details submission schedule	Remark
37	STATION TRANSFORMER / UNIT TRANSFORMER L1 Level Vendor (Refer Note 4)	I	220			ALSTOM ABB SIEMENS BHEL CGL EMCO	ALLAHABAD VADODARA NAVI MUMBAI BHOPAL KANJUR MARG THANE	A A A A A A		
38	AUX TRANSFORMER L1 Level Vendor (Refer Note 4)	I	230			ALSTOM ABB BHEL SCHNEIDER SIEMENS EMCO	ALLAHABAD VADODARA BHOPAL/ JHANSI VADODARA NAVI MUMBAI THANE/ JALGAON	A A A A A A		
39	IPBD L1 Level Vendor (Refer Note 4	I	240			BHEL	RUDRAPUR	A		
40	SPBD L1 Level Vendor (Refer Note 4)		250			BHEL	RUDRAPUR	A		

1. SYSTEM SUPPLIERS/SUB-SUPPLIERS APPROVAL STATUS CATEGORY(SHALL BE FILLED BY BIFPCL)
A-For this items proposed vendor is acceptable to BIFPCL. To be indicated with letter "A" in the list along with condition of approval,if any.
DR-For these items "Detailed required" for BIFPCL review.To be identified with letter "DR" in the list.
NOTED- For these items vendors are approved by Main Supplier & accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED".

2. QP / INSPN CATEGORY
CAT-I :For these items the Quality Plans approved by BIFPCL & final acceptance will be on physical inspection witness by BIFPCL
CAT-II :For these items the Quality Plans approved by BIFPCL.However no physical inspection shall be done by BIFPCL.The final acceptance by BIFPCL shall be on basis of docoments as per approved QP
CAT-III :For these items Main supplier approves the Quality Plans.The final acceptance by BIFPCL shall be on basis of certificate of conformance by the main supplier.
* :Control measure of item covered in quality plan of main item.

3. UNITS/WORKS : Place of manufacturing/ Place of Main Supplier of multi units/works.

4. Comprehensive L-2 list of sub-vendors shall be finalized with the finally selected L-1 vendor in line with MOM PROVISIONS but prior to order finalization on L-1 vendor by the Bidder.

5 : For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

PROJECT : MAITREE STPP (2 x 660 MW) PACKAGE : EPC-STG CONTRACTOR : BHEL BHOPAL CONT NO. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: RE JOINTS, BFV, TANKS	Ref No. Revision No. 00 Date : 14/12/2015

SR NO.	ITEM	QP/INS-PN.CAT*	QP NO.	QP SUB-MISSION SCHEDU-LE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS/CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS
4	PLATES(MS) FOR PRESSURE PARTS	***				DILLINGER HUTTENWERKE	GERMANY	A			
		***				BRITISH STEEL	UK	A			
		***				CORUS CONSTRUCTION & INDUSTRIAL	UK	A			
		***				WUYANG	CHINA	A			
		***				M/S AZOVSTAL	UKRAINE	A			UP TO 135MM THK
		***				M/S ARCELOR MITTAL	ROMANIA	A			UP TO 95MM THK
		***				SAIL	INDIA	A			
		***				OTTO WOLFF HANDERCESEHEL	GERMANY	A			
		***				MOBAR ENGG GMBH	GERMANY	A			
		***				SUMITOMO	JAPAN	A			
		***				RAUTARUUKKI STEEL	FINLAND	A			
		***				DAVAL	FRANCE	A			
		***				MARUBENI ITOCHU STEEL IND	JAPAN	A			
		***				JINDAL	RAIGARH	A			
		***				TISCO	JAMSHEDPUR	A			
		***				JINDAL	ANGUL	A			

PROJECT : MAITREE STPP (2 x 660 MW) PACKAGE : EPC-STG CONTRACTOR : BHEL BHOPAL CONT NO. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: RE JOINTS, BFV, TANKS	Ref No. Revision No. 00 Date : 14/12/2015

SR NO.	ITEM	QP/INS-PN.CAT*	QP NO.	QP SUB-MISSION SCHEDU-LE	QP APPL SCHEDU LE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS/CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS
5.	RE JOINTS FABRICATION	II				MODERN ALLIED	BHOPAL	A			
		II				BORA BROTHERS	BHOPAL	A			
		II				BHOPAL ENGG	BHOPAL	A			
		II				MEHTA INDUSTRIES	BHOPAL	A			
		II				SHRI KUSHAL FABRICATORS	BHOPAL	A			
		II				SIGMA HEAVY ENGG INDUSTRIES	BHOPAL	A			
		II				DUNHILL PRODUCT	BHOPAL	A			
		II				TUNGABHADRA STEEL PRODUCT	KARNATKA	A			
6.	RE JOINTS	I				BHEL	BHOPAL	A			
7.	WATER LEVEL GAUGES (TUBULAR TYPE)		REFER C&I LIST ENCLOSED TO THE LOA/NOA								

PROJECT : MAITREE STPP (2 x 660 MW) PACKAGE : EPC-STG CONTRACTOR : BHEL BHOPAL CONT NO. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: RE JOINTS, BFV, TANKS	Ref No. Revision No. 00 Date : 14/12/2015

SR NO.	ITEM	QP/INS - PN.CAT*	QP NO.	QP SUB-MISSION SCHEDU-LE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS/CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS
8.	DISHED END	II				METAL ENGINEER	HYDERABAD	A			
		***				ANUP	AHEMDABAD	A			
						DIAMOND FAB	PUNE	A			
		***				SHRI SATYA FABRICATORS	HYDERABAD	A			
		***				MAHINDRA DISH ENDS	MUMBAI	A			
		***				CEREC METALFORM	VADODARA	A			
		***				SHRI VISHWAKARMA FABRICATORS	BHOPAL	A			
		***				DYNAMIC DISH	HYDERABAD	DR			
		***				DISH (I) PVT. LTD	N. DELHI	A			
9	MISC TANKS FABRICATION	II				B.K. ENTERPRISE	BHOPAL	A			
		II				BORA BROTHERS	BHOPAL	A			
		II				SIGMA HEAVY ENGG INDUSTRIES	BHOPAL	A			
		***				SHRI KUSHAL FABRICATORS	BHOPAL	A			
		***				MODERN ALLIED	BHOPAL	A			
		***				MEHTA INDUSTRIES	BHOPAL	A			
		***				DUNHILL PRODUCT	BHOPAL	A			
		II				ELECTRO AUTO INDUSTRIES	BHOPAL	A			

PROJECT : MAITREE STPP (2 x 660 MW) PACKAGE : EPC-STG CONTRACTOR : BHEL BHOPAL CONT NO. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: RE JOINTS, BFV, TANKS	Ref No.	
		Revision No. 00	
		Date : 14/12/2015	

SR NO.	ITEM	QP/INS-PN.CAT*	QP NO.	QP SUB-MISSION SCHEDU-LE	QP APPL SCHEDU LE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS/CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS
		***				STEEL INNOVATION	BHOPAL	DR			
		***				INDO-ASIATI C ENGRS	DELHI	DR			
10.	MICS. TANKS	II				BHEL	BHOPAL	A			
11.	FLASH TANKS FABRICATION	II				ELECTRO AUTO INDUSTRIES	BHOPAL	A			
		II				MODERN ALLIED	BHOPAL	A			
		***				SHRI KUSHAL FABRICATORS	BHOPAL	A			
		***				MEHTA INDUSTRIES	BHOPAL	A			
		***				BORA BROTHERS	BHOPAL	A			
		***				B.K. ENTERPRISE	BHOPAL	A			
		***				STEEL INNOVATION	BHOPAL	DR			
		***				INDO-ASIATI C ENGRS	DELHI	DR			
12.	FLASH TANKS	***				BHEL	BHOPAL	A			
13.	ACTUATORS FOR BFV	REFER C&I LIST ENCLOSED TO THE LOA/NOA									
14.	CASTINGS FOR BF VALVE	II				UP STEEL	MUZAFFAR NAGAR	A			
		II				L&T	KANSBAHL	A			
		II				BHEL	BHOPAL	A			
		II				SIMPLEX	BHILAI	A			
		II				VAISHNAV STEEL	MUZ. NAGAR	DR			
		II				SAURABH METALS	MANDIDEEP	A			
		II				STAR WIRE (I) PVT. LTD.	BALLABHGARH	A			

PROJECT : MAITREE STPP (2 x 660 MW) PACKAGE : EPC-STG CONTRACTOR : BHEL BHOPAL CONT NO. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: RE JOINTS, BFV, TANKS	Ref No. Revision No. 00 Date : 14/12/2015

SR NO.	ITEM	QP/INS-PN.CAT*	QP NO.	QP SUB-MISSION SCHEDU-LE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS/ CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS
		II				BOLLINENI CASTINGS	HYDERABAD	DR			
		II				STEELCAST	BHAVNAGAR	A			
15.	BF VALVE BODY & DOOR FABRICATION	***				SIGMA HEAVY ENGG INDUSTRIES	BHOPAL	A			
		***				SHRI KUSHAL FABRICATORS	BHOPAL	A			
		***				MODERN ALLIED	BHOPAL	A			
		***				MEHTA INDUSTRIES	BHOPAL	A			
		***				DUNHILL PRODUCT	BHOPAL	A			
		***				BHOPAL ENGG	BHOPAL	A			
16.	BUTTER FLY VALVES	I				BHEL	BHOPAL	A			
17.	TEMPERATURE GAUGES	III	REFER C&I LIST ENCLOSED TO THE LOA/NOA								

	PROJECT : MAITREE STPP (2 x 660 MW) PACKAGE : EPC-STG CONTRACTOR : BHEL BHOPAL CONT NO. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: RE JOINTS, BFV, TANKS	Ref No. Revision No. 00 Date : 14/12/2015

SR NO.	ITEM	QP/INS-PN.CAT*	QP NO.	QP SUB-MISSION SCHEDU-LE	QP APPL SCHEDU LE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS/CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDUL E	REMARKS
18.	PRESSURE GAUGES		REFER C&I LIST ENCLOSED TO THE LOA/NOA								
19.	WATER LEVEL SWITCHES		REFER C&I LIST ENCLOSED TO THE LOA/NOA								
20	RUBBER SEALS	II				BOMBAY OIL SEALS	MUMBAI	N			
		II				INTERNATIONAL RUBBER INDUSTRIES	INDORE	N			
		II				INDIAN RUBBER PRODUCT	HARDWAR	N			
		***				VAKO SEAL	MUMBAI	N			
		***				JAMES WALKER	UK	N			
		II				MANISHA RUBBER	MUMBAI	N			
		II				SHAKTI RUBBER	AHMEDABAD	N			

BIFPCL (Ad) Authorised

Bangladesh-India Friendship Power Company (P.) Ltd. BIFPCL

INTERNATIONAL OPERATIONS DIVISION New Delhi-3 (India) BHEL

7 OF 8

PROJECT : MAITREE STPP (2 x 660 MW)
PACKAGE : EPC-STG
CONTRACTOR : BHEL BHOPAL
CONT NO. :

LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL

SUB SYSTEM: RE JOINTS, BFV, TANKS

Ref No.
Revision No. 00
Date : 14/12/2015

SR NO.	ITEM	QP/INS - PN.CAT*	QP NO.	QP SUB-MISSION SCHEDU-LE	QP APPL SCHEDU LE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS/CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS
21	FORGINGS AND BARS	II				KISAAN STEEL	GHAZIABAD	A			
		II				FORGE MONCHIERI	ITALY	A			
		***				CFFP	HARDWAR	A			
		***				STAR WIRE	BALLABHGARH	A			
		***				GHAZIABAD FORGINGS	GHAZIABAD	A			
		***				GHAZIABAD ISPAT	GHAZIABAD	A			
		***				HINDON FORGE	GHAZIABAD	A			
		***				BAY FORGE	CHENNAI	A			
		***				YOUNG CHANG METAL CO. LTD	KOREA	A			
		***				MYSCO CO. LTD.	KOREA	A			
		***				PSM	KOREA	A			
		***				VIKRANT STEEL	KOLKATTA	A			
		***				SAIL-ASP	DURGAPUR	A			
		***				GOLDEN IRON & STEEL WORKS	N. DELHI	DR			
		***				TAE WOONG CO. LTD.	KOREA	A			
22	STANLESS STEEL PLATES FOR PRESSURE PARTS	II				USINOR INDU STEEL	FRANCE	A			
		***				JINDAL STRIPS	HISSAR	A			
		***				NISSHOIWAI COPR	JAPAN	A			
		***				SAIL	SALEM	A			
		***				BOEHLER	AUSTRLA	A			

*** Inspection and testing requirements are covered under respective main equipments doc.

Note 1 For Items not listed above, BHEL approved vendors shall be applicable.

"N" Vendor is noted for this project

PROJECT: MAITREE, 2X660 MW PACKAGE: TG PACKAGE CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEM SREQUIRING QUALITY PLAN AND SUB CONTRACTOR APPROVAL SUB SYSTEM: C & I	REFNO.:00 REV NO.:00 Date:14.12.2015

Sl No.	Item	LIST OFIT EMS		Vendor/Manufacturer Name	Place	SC_APP L_S	Remarks
1.	RTDs	II		Detriv Instrumentation & Electronics	Mumbai	A	
1.	RTDs	II		Thermal Instruments (GIC Group)	Savant wadi	A	
1.	RTDs	II		Jindal Electronics	Roorkee	A	
1.	RTDs	*		Process Control	Roorkee	DR	
1.	RTDs	II		Techno Instruments	Ahemdabed	A	
1.	RTDs	*		Eleind Engineering.	Noida	DR	
1.	RTDs	*		Baumer Technologies	Vapi	DR	
1.	RTDs	II		Tempsens Instruments	Udaipur	A	
1.	RTDs	III		Emerson Process Management	Pawane	A	Make M/s Emerson Germany
2.	Thermocouples	II		Techno Instruments	Ahmedabed	A	For metal temperatures inside HP IP LP turbine and Valve casings, only, Thermo-sensor Germany, Emerson Pawane and ABB utility Germany to be considered
2.	Thermocouples	II		Detriv Instrumentation & Electronics	Mumbai	A	
2.	Thermocouples	III		Emerson Process Management	Pawane	A	
2.	Thermocouples	*		Baumer Technologies	Vapi	DR	
2.	Thermocouples	II		Jindal Electronics	Roorkee	A	
2.	Thermocouples	III		ABB Utility Automation	Germany	A	
2.	Thermocouples	*		Eleind Engineering.	Noida	DR	
2.	Thermocouples	III		Thermo Sensor	Germany	A	
2.	Thermocouples	II		Tempsens Instruments	Udaipur	A	

1

PROJECT: MAITREE, 2X660 MW PACKAGE: TG PACKAGE CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEM SREQUIRING QUALITY PLAN AND SUB CONTRACTOR APPROVAL SUB SYSTEM: C & I	REFNO.:00 REV NO.:00 Date:14.12.2015

Sl No.	Item	LIST OFITEMS		Vendor/Manufacturer Name	Place	SC_APP_LS	Remarks
2.	Thermocouples	*		SiemensLimited	Gurgaon	DR	
3.	Fibre optic Gen End Winding VibrationMonitoring System	II		Vibro System INC	Canada	A	Refer Note 1
3.	Fibre optic Gen End Winding VibrationMonitoring System	II		MC-Monitoring SA	Switzerland	A	Refer Note 2
3.	Fibre optic Gen End Winding VibrationMonitoring System	*		SiemensLimited	Gurgaon	DR	
4.	Level Switch (Float/Displacer Type)	III		Chemtrols Samil	Mumbai	A	
4.	Level Switch (Float/Displacer Type)	III		Pune Techtrols	Pune	A	
4.	Level Switch (Float/Displacer Type)	III		Levcon Instruments	Kolkata	A	
4.	Level Switch (Float/Displacer Type)	III		SBEM	Pune	A	
4.	Level Switch (Float/Displacer Type)	III		SiemensLimited	Gurgaon	A	
4.	Level Switch (Float/Displacer Type)	III		DKInstruments	Kolkata	A	
4.	Level Switch (Float/Displacer Type)	III		V Automat&Instruments	NewDelhi	A	
4.	Level Switch (Float/Displacer Type)	III		Magnetrol Instruments	Belgium	A	
4.	Level Switch (Float/Displacer Type)	III		Endress& Hauser Instruments	Switzerland / Aurangabad	A	
4.	Level Switch (Float/Displacer Type)	*		Pratolina Instruments	Mumbai	DR	
5.	Pressure/Differential Pressure Gauge	III		Manometer India	Mumbai	A	
5.	Pressure/Differential Pressure Gauge	III		H Guru Instruments(South India)	Bangalore	A	

PROJECT: MAITREE, 2X660 MW PACKAGE: TG PACKAGE CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEM SREQUIRING QUALITY PLAN AND SUB CONTRACTOR APPROVAL SUB SYSTEM: C & I	REFNO.:00 REV NO.:00 Date:14.12.2015

Sl No.	Item	LIST OFITEMS		Vendor/Manufacturer Name	Place	SC_APP L_S	Remarks
5.	Pressure/Differential Pressure Gauge	III		H Guru Instruments	Muzaffarpur Risra	A	
5.	Pressure/Differential Pressure Gauge	III		FISCHER MESS & REGELTECHNIK	Germany	A	
5.	Pressure/Differential Pressure Gauge	III		Baumer Technologies	Vapi	A	
5.	Pressure/Differential Pressure Gauge	III		GluckIndia	Mumbai	A	
5.	Pressure/Differential Pressure Gauge	III		A N Instruments	Narendrapur	A	
5.	Pressure/Differential Pressure Gauge	III		Ashcroft	Gandhinagar	A	
5.	Pressure/Differential Pressure Gauge	III		Wika Instruments	Pune	A	
5.	Pressure/Differential Pressure Gauge	III		NSRT	Kolkata	A	
5.	Pressure/Differential Pressure Gauge	III		PTCI	Kolkata	A	
5.	Pressure/Differential Pressure Gauge	*		Siemens Limited	Gurgaon	DR	
5.	Pressure/Differential Pressure Gauge	III		Walchand nagar Industries	Attikolla, Dharwad	A	
5.	Pressure/Differential Pressure	*		New Scientific Repairs & Tradi	KOLKATA	DR	

INTERNATIONAL OPERATIONS DIVISION

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	PROJECT: MAITREE, 2X660 MW PACKAGE: TG PACKAGE CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEM SREQUIRING QUALITY PLAN AND SUB CONTRACTOR APPROVAL SUB SYSTEM: C & I	REFNO.:00 REV NO.:00 Date:14.12.2015

Sl No.	Item	LIST OFITEMS		Vendor/Manufacturer Name	Place	SC_APP L_S	Remarks
5.	Pressure/Differential Pressure Gauge	*		Forbes Marshall (Hyd) Pvt Ltd	IDA Nacharam, Medak	DR	
6.	Pressure/DP/Flow Transmitters	II		ABB Limited	Bangalore	A	2600 T series
6.	Pressure/DP/Flow Transmitters	II		Emerson Process Management	Pawane	A	
6.	Pressure/DP/Flow Transmitters	III		Fuji Electric System	Japan /China	A	
6.	Pressure / D P / Flow Transmitters	II		Laxsons Automation	Daman	A	M/s Smar Brazil Make
6.	Pressure/DP/Flow Transmitters	III		ABB Utility Automation	Germany	A	2600 T series
6.	Pressure/DP/Flow Transmitters	III		Yokogawa India	Bangalore	A	Make M/s Yokogawa, Japan
6.	Pressure/DP/Flow Transmitters	III		Siemens Limited	Thane	A	
6.	Pressure/DP/Flow Transmitters	*		Chino corporation India	Ghaziabad	DR	
7.	Instrumentation Cables	II		Paramount Communication	Khuskhera	A	For PVC, FRLS
7.	Instrumentation Cables	II		KEI industries	Bhiwadi	A	For PVC, FRLS
7.	Instrumentation Cables	II		Delton Cables	Faridabad	A	For PVC, FRLS
7.	Instrumentation Cables	II		Cords Cables	Bhiwadi	A	For PVC, FRLS
7.	Instrumentation Cables	II		Elkay Telelinks	New Delhi	A	For PVC, FRLS
7.	Instrumentation Cables	II		Universal Cables	Satna	A	For PVC, FRLS

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PROJECT: MAITREE, 2X660 MW PACKAGE: TG PACKAGE CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEM SREQUIRING QUALITY PLAN AND SUB CONTRACTOR APPROVAL SUB SYSTEM: C & I	REFNO.:00 REV NO.:00 Date:14.12.2015

Sl No.	Item	LIST OFIT EMS		Vendor/Manufacturer Name	Place	SC_A PP L_S	Remarks
7.	Instrumentation Cables	II		NICCO Corporation	Kolkata	A	For PVC, FRLS
7.	Instrumentation Cables	II		Thermo Cables Ltd.	Hyderabad	A	For PVC, FRLS
7.	Instrumentation Cables	*		Advance Cable Technologies	Bangalore	DR	
7.	Instrumentation Cables	*		Manoj Cables Limited	Delhi	DR	
7.	Instrumentation Cables	*		Pagoda Cables Pvt. Ltd.	Delhi	DR	
8.	Gas Analyser Cabinet	I		ABB Limited	Bangalore	A	H2 Analyser imported from ABB, Germany
8.	Gas Analyser Cabinet	I		Adage Automation	Mumbai	A	Hydrogen Gas Analyser (Calomat 6) will be Imported from Siemens Germany
8.	Gas Analyser Cabinet	I		Yokogawa India	Bangalore	A	Analyser will be imported from M/S Yokogawa Electric Corporation (YEC), Japan (Micro Processor based, Working on Gas Density Principle).
8.	Gas Analyser Cabinet	I		SiemensLimited	India	A	H2 Analyser imported from Siemens, Germany
9.	Conductivity Analyser (Conduction Measuring Equipment)	*		ForbesMarshall	Pune	DR	
9.	Conductivity Analyser (Conduction Measuring Equipment)	III		ABB India Limited	Bangalore/ Dehradun	A	Make:ABB,USA/UK

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	PROJECT: MAITREE, 2X660 MW PACKAGE: TG PACKAGE CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEM SREQUIRING QUALITY PLAN AND SUB CONTRACTOR APPROVAL SUB SYSTEM: C & I	REFNO.:00 REV NO.:00 Date:14.12.2015

Sl No.	Item	LIST OFITEMS		Vendor/Manufacturer Name	Place	SC_APP L_S	Remarks
9.	Conductivity Analyser (Conduction Measuring Equipment)	III		Yokogawa India	Bangalore	A	Make M/S Yokogawa, Japan.
9.	Conductivity Analyser (Conduction Measuring Equipment)	III		HACH Company	USA	A	
10.	Flow Nozzles for Performance Calibration	II		TM Technomatic	Italy	A	Actual Calibration (Wet) Certification to be Furnished
10.	Flow Nozzles for Performance Calibration	II		Seiko Flow Control	Austria	A	Actual Calibration (Wet) Certification to be Furnished
10.	Flow Nozzles for Performance Calibration	II		Primary Flow Signal INC.	USA	A	Actual Calibration (Wet) Certification to be Furnished
11.	Pressure / DP Switch	II		Switzer Process Instruments	Chennai	A	Up to 40 Kg/cm2 & 200 °C, not for compound switch application. Except 900 Series Switches.
11.	Pressure / DP Switch	*		Baumer Technologies	Vapi	DR	
11.	Pressure / DP Switch	*		Vasu Tech	New Delhi	DR	
11.	Pressure / DP Switch	II		Ashcroft India	Gandhinagar	A	
11.	Pressure / DP Switch	II		Switzer process instrument (Indfos Industries)	Ghaziabad	A	Up to 40 Kg/cm2 & 200 °C, not for compound switch application
11.	Pressure / DP Switch			Siemens Limited	Gurgaon	DR	

PROJECT: MAITREE, 2X660 MW PACKAGE: TG PACKAGE CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEM SREQUIRING QUALITY PLAN AND SUB CONTRACTOR APPROVAL SUB SYSTEM: C & I	REFNO.:00 REV NO.:00 Date:14.12.2015

Sl No.	Item	LIST OFITEMS		Vendor/Manufacturer Name	Place	SC_APP L_S	Remarks
11.	Pressure / DP Switch	*		BOLL & KIRCH	Germany	DR	
11.	Pressure / DP Switch	*		IMI Norgren Herion	India	DR	
11.	Pressure / DP Switch	*		Trafag Controls India Private	Gurgaon	DR	
12.	Capacitance type Level Transmitters/Switches	III		Magnetrol Instruments	Belgium	A	Application Capacitance Level Switches–Generator & Turbine Capacitance type Level Transmitters–Generator (Primary Water Tank)
12.	Capacitance type Level Transmitters/Switches	III		Endress+Hauser Instruments	Switzerland / Aurangabad	A	
12.	Capacitance type Level Transmitters/Switches	II		NIVO Controls	Indore	A	
12.	Capacitance type Level Transmitters/Switches	II		SBEM Pvt. Ltd.,	Pune	A	
12.	Capacitance type Level Transmitters/Switches	*		DK Instruments	Kolkata	DR	
13.	Guided Wave Radar Level Transmitters	III		Magnetrol Instruments	Belgium	A	Application-Main Oil Tank & Control Fluid Tank
13.	Guided Wave Radar Level Transmitters	III		Endress+Hauser Instruments	Switzerland / Aurangabad	A	Application- Main Oil Tank & Control Fluid Tank
14.	Position Transmitters	III		Siemens Limited	Gurgaon	A	Make-M/s Siemens, Germany
14.	Position Transmitters	III		ABB Limited	Bangalore/ Dehradun	A	Make-M/s ABB Germany
14.	Position Transmitters	III		Electronics Corporation	Hyderabad	DR	
14.	Position Transmitters	III		BI Enterprises	Mumbai	DR	

	PROJECT: MAITREE, 2X660 MW PACKAGE: TG PACKAGE CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEM SREQUIRING QUALITY PLAN AND SUB CONTRACTOR APPROVAL SUB SYSTEM: C & I	REFNO.:00 REV NO.:00 Date:14.12.2015

Sl No.	Item	LIST OF ITEMS		Vendor/Manufacturer Name	Place	SC_A PP L_S	Remarks
14.	Position Transmitters	*		Curtiss Wright Corporation	USA	DR	

LEGENDS :

DR–Detailed Required.

CAT- I:For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection witness by BIFPCL.

CAT- II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis of review of documents.

CAT- III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main supplier.

*- Inspection category will be decided during vendor evaluation.

Note 1: Wired Panel along with standard bought out items like Blank panel / enclosure, accessories like Ethernet switch, Power Supply, Terminal, MCB are accepted from indigenous suppliers acceptable to BIFPCL and tied up in QP.

Note 2:For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

(BHEL-Hwr)

Project : Maitree STPP Package : 2 x 660 MW EPC –TG & AUX Contractor : BHEL, Hyderabad Contract No.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: **BFP, Drive Turbine, Heaters (HP, LP) Drain Cooler and Deaerator**	Ref No.: Revision No.: 00 Date: **12-12-2015**	

SN	ITEM	QP/ INS-PN CAT *	QP No.	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
						LIMITED.,					
		II				M/s ASIAN INDUSTRIAL VALVES	INDIA	A			
		II				M/s BHARAT HEAVY ELECTRICALS LTD.,	INDIA	A			
		II				M/s DRESSER INDUSTRIES INC.,	USA	A			
		II				M/s ANDERSON, GREENWOOD & CO.,	USA	A			
58	LP HEATER	I				BHEL	HYDERBAD	A			SUB-QR ITEM
59	HP HEATER	I				BHEL	HYDERBAD	DR			SUB-QR ITEM
						SPX	USA	A			SUB-QR ITEM
						BHI	SOUTH KOREA	A			SUB-QR ITEM
						TEI	USA	A			SUB-QR ITEM
						SHANGHAI	CHINA	DR			SUB-QR ITEM
						HOLTEC	USA	A			SUB-QR ITEM
60	DRAIN COOLER	I				BHEL	HYDERBAD	A			
61	VALVES GATE, GLOBE, CHECK ½ TO 10" (UPTO 2500 CL)	II				TOA VALVES	JAPAN	A			
		II				DEUTSCHE BABCOCK	GERMANY	A			
		II				DRESSER	USA	A			
		II				BHEL	TRICHY	A			
62	VALVES (GATE, GLOBE, NRV) ½ TO 10"	II				AUDCO	CHENNAI	A			
		II				BHEL	TRICHY	A			

Project : Maitree STPP Package : 2 x 660 MW EPC –TG & AUX Contractor : BHEL, Hyderabad Contract No.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: **BFP, Drive Turbine, Heaters (HP, LP) Drain Cooler and Deaerator**	Ref No.: Revision No.: 00 Date: **12-12-2015**

SN	ITEM	QP/ INS-PN CAT *	QP No.	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
						FOURESS	AURANGABAD	A			Up to 2"x800# Upto 10x600#
63	CCS GLOBE VALVES UPTO 300 NB AND 150 CLASS	II				KBL	KONDAPURI	A			
		II				FOURESS ENGG	AURANGABAD	A			
		II				BDK	HUBLI	A			
		II				KSB	COIMBATORE	A			
		II				LEADER ENGG	JALLANDHAR	A			
		I				SKILT	MUMBAI	DR			
		II				BHEL	TRICHY	A			
64	DEARATOR	I	QVM-Q-308			BHEL	HYDERABAD	A			SUB-QR ITEM
65	DEARATOR SPRAY VALVES	III				COCHRANE ENVIRONMENTAL SYSTEM (CRANE)	USA	A			
		III				STERLING	USA	A			
		III				KCD	USA	DR			
66	DEARATOR TRAY ASSEMBLY	III	QVM-Q-308			COCHRANE ENVIRONMENTAL SYSTEM (CRANE)	USA	A			
		III				STERLING	USA	A			
		III				KCD	USA	DR			
		I				VRK INDUSTRIES	HYDERABAD	DR			
67	LT MOTORS UPTO 200 KW (REFER NOTE-1)	II				BHARAT BIJLEE	MUMBAI	A			UPTO 160KW
		II				KEC	BANGALORE/ HUBLI*	A			* UPTO 90 KW
		II				MARATHON	KOLKATA	A			
		II				CGL	AHMEDNAGAR	A			-
		II				ABB	FARIDABAD*/ BANGALORE	A			* UPTO 55 KW
68	LOW FIN TUBE-	II				M/s A-1	INDIA	A			

Project : Maitree STPP Package : 2 x 660 MW EPC –TG & AUX Contractor : BHEL, Hyderabad Contract No.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: **BFP, Drive Turbine, Heaters (HP, LP) Drain Cooler and Deaerator**	Ref No.: Revision No.: 00 Date: 12-12-2015

SN	ITEM	QP/ INS-PN CAT *	QP No.	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
	THRUST CUM JOURNAL BRG OF CWP	II				OSBORNE ENGINEERS LTD		DR			
		II				DAIDO METAL CO LTD		DR			
		II				OSAKA ASAHI METAL MFG CO LTD		DR			
		II				MICHELL BEARINGS		DR			

N & A- Proposed vendor is acceptable to BIFPCL, DR – "Details required" for BIFPCL review.

2 QP/INSPECTION CATEGORY :

CAT – I : For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection witness by BIFPCL.

CAT – II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis of review of documents as per QP.

CAT-III : For those items main supplier approves Quality Plan. The final acceptance by BIFPCL shall on the basis of Certificate of Conformance by main supplier.

NOTE 1: a) Less than 30 KW

Acceptance of Motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows:
It is hereby confirmed that the above mentioned motor / motors was / were manufactured taking care of BIFPCL specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing / data sheets.

b) 30 KW and above
Acceptance of Motor rating between 30 KW & 50 KW is based on BIFPCL review of Routine Test inspection report as per IS 325 by main contractor along with COC of the manufacturer & the contractor confirming as follows:
« It is hereby confirmed that the above mentioned motor / motors was / were manufactured taking care of BIFPCL specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate, space heater and tested in accordance with approved drawing / data sheets.
FOR HT MOTORS REFER SEPARATE VENDOR LIST FINALIZED FOR BHEL BHOPAL.

	Project : Maitree STPP Package : 2 x 660 MW EPC –TG & AUX Contractor : BHEL, Hyderabad Contract No.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: **BFP, Drive Turbine, Heaters (HP, LP) Drain Cooler and Deaerator**	Ref No.: Revision No.: 00 Date: **12-12-2015**

SN	ITEM	QP/ INS-PN CAT *	QP No.	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS

NOTE 2 : IF BOOSTER PUMPS SHAFT AND CEP SHAFT ARE MADE FROM ROLLED BARS THEN VENDORS SHALL BE AS PER BHEL APPROVED VENDOR LIST.

NOTE 3 : FOR VALVES OF SIZE ½ INCH AND BELOW SHALL BE PROCURED FROM BHEL APPROVED SOURCES.

NOTE 4: * - BHEL INFORMED THAT THESE ARE THE REGULAR SUPPLIERS OF MHI, JAPAN FOR THE PUMPS AND THE SCOPE OF SUPPLY. BASED ON THEIR EXPERIENCE THESE VENDORS ARE NOTED FOR THIS PROJECT.

NOTE 5: VENDORS IDENTIFIED WITH# - BHEL to furnish experience details of the party for the required model / rating, size & height.

NOTE 6: * MHI APPD VENDORS ARE ALSO ACCEPTABLE.**

Note 7: For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

Bangladesh-India Friendship Power Company (Pvt.) Ltd. BIFPCL

BIFPCL

भारत हेवी इलेक्ट्रिकल्स लि. / BHEL
INTERNATIONAL OPERATIONS DIVISION
New Delhi-3 (India)

भारत हेवी इलेक्ट्रिकल्स लि. / BHEL
INTERNATIONAL OPERATIONS DIVISION
New Delhi-3 (India)

ENGINEERING DIV / QA&I - BIFPCL, Dhaka	Page 20 of 20	BHEL

	PROJECT : Maitree STPP (2 x 660 MW)						LIST OF ITEMS REQUIRING QP			REF. NO :	
	PACKAGE : EPC PACKAGE						APPROVAL & ACCEPTABLE			REVISION NO : 00	
	CONTRACTOR : BHEL - PEM						VENDOR AS APPROVED BY BIFPCL			DATE : 12/12/2015	
	CONTRACT NO :										
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
1	FIRE PROTECTION & DETECTION SYSTEM	I				BHEL-HYDERABAD	HYDERABAD	A			

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY BIFPCL)

A - For those items proposed vendor is acceptable to BIFPCL. To be indicated with letter "A" in the list alognwith the condition of approval, if any.

DR - For those items "Detailed Required" for BIFPCL review. To be identified with letter "DR" in the list.

DR* - For those item "Detail Required by BIFPCL for record updation only

NOTED : For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED" (N)

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection witness by BIFPCL

CAT - II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis of review of documents.

CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main supplier.

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units / works.

*** - Inspection category will be decided during vendor evaluation.**

NOTE - 1 : For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

Note 2 : The above vendor list is broadly discussed and finalised however BHEL has to get reveted the vendor list from BIFPCL before ordering.

NOTE - 3 : For the items not appearing in the preaward list, bidder and BIFPCL will mutually discussed in future.

(ANIL JOSHI)
(GM/MECH & IPDS)

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING QP			REF. NO :	
		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE			REVISION NO : 00	
		CONTRACTOR : BHEL - PEM					VENDOR AS APPROVED BY BIFPCL			DATE : 12/12/2015	
		CONTRACT NO :									
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
	OIL FILLED SERVICE TRANSFORMER					DANISH PRIVATE LIMITED	INDIA	DR			
	OIL FILLED SERVICE TRANSFORMER					SHNEIDER	BARODA	A			
	OIL FILLED SERVICE TRANSFORMER					VIJAI ELECTRICALS LTD	Medak	DR			
	OIL FILLED SERVICE TRANSFORMER					DANISH PRIVATE LIMITED	INDIA	DR			
	OIL FILLED SERVICE TRANSFORMER					ESENNAR TRANSFORMERS (P) LTD.	INDIA	DR			
2	CABLE TRAYS & ACC.	II				PREMIER POWER PRODUCTS (CAL) PVT. LTD.	HOWRAH	A			GALVANIZING AT NEHA GALVANIZER
	CABLE TRAYS & ACC.					M/S M J ENGG	OKHLA/BHIWADI	A			
	CABLE TRAYS & ACC.					M/S JAMNA METAL	DELHI/KUNDLI	A			
	CABLE TRAYS & ACC.					M/S AMTECH	PUNE	A			GALVANINZING AT B.G. SHIRKE PUNE
	CABLE TRAYS & ACC.					M/S INAR PROFILES	VIZAG	A			
	CABLE TRAYS & ACC.					RABI ENGINEERING WORKS PVT. LTD.	INDIA	DR			
	CABLE TRAYS & ACC.					PATNY SYSTEMS (P) LTD	HYDERABAD	A			GALVANINZING AT GURPREET GALVANIZER
	CABLE TRAYS & ACC.					UNITECH FABRICATORS and ENGINEERS PVT LTD	HOWRAH/HOOGLY	A			
	CABLE TRAYS & ACC.					PENTAX FERRO INCORPORATE	INDIA	DR			

15-12-15

PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
CONTRACTOR : BHEL - PEM	VENDOR AS APPROVED BY BIFPCL	DATE : 12/12/2015
CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
	CABLE TRAYS & ACC.					INDIANA GRATINGS PVT. LTD.	MUMBAI/PUNE	A			GALVANIZING AT KARAMTARA GALVANIZER POONA GALVANIZER
	CABLE TRAYS & ACC.					M/S TRG	CHENNAI	A			
	CABLE TRAYS & ACC.					RUKMANI ELECTRICAL & COMPONENTS PVT LTD	RAIPUR	A			GALVANIZING AT M/S SIGMA
	CABLE TRAYS & ACC.					RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	Kolkata	A			GALVANIZING AT B.P PRODUCTS
	CABLE TRAYS & ACC.					INDUSTRIAL PERFORATION (I) PVT.LTD.	Kolkata	A			GALVANIZING AT UNISTAR GALVANIZER
	CABLE TRAYS & ACC.					PASSIVE INFRA PROJECTS PVT. LTD.	ROHTAK	A			
	CABLE TRAYS & ACC.					KANNADE ANAND UDG	MUMBAI	DR			
	CABLE TRAYS & ACC.					Vatco	Mumbai	A			
	CABLE TRAYS & ACC.					VINFAB ENGINEERS INDIA PVT. LTD.	INDIA	DR			
	CABLE TRAYS & ACC.					INDMARK FORMTECH PVT LTD	INDIA	DR			
	CABLE TRAYS & ACC.					PARMAR METALS PVT. LTD	INDIA	DR			
	CABLE TRAYS & ACC.					MAHESWARI ELECTRICAL MFRS. PVT. LTD.	INDIA	DR			
	CABLE TRAYS & ACC.					INDIA ELECTRICALS SYNDICATE	INDIA	DR			
	CABLE TRAYS & ACC.					EROS METAL WORKS (P) LTD.	INDIA	DR			
	CABLE TRAYS & ACC.					SARAL INDUSTRIES	INDIA	DR			
	CABLE TRAYS & ACC.					NAMDHARIINDUSTRIAL TRADERS PVT. LTD	INDIA	DR			
	CABLE TRAYS & ACC.					STEELITE ENGINEERING LTD.	Mumbai	A			

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - PEM	VENDOR AS APPROVED BY BIFPCL	DATE : 12/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
3	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	III				STEELITE ENGINEERING LTD.	MUMBAI	A			GALVANIZING AT SIGMA GALVANIZER
	CABLE TRAY SUPPORT SYSTEM - BOLTABLE					INDUSTRIAL PERFORATION (I) PVT.LTD.	Kolkata	A			GALVANIZING AT UNISTAR GALVANIZER
	CABLE TRAY SUPPORT SYSTEM - BOLTABLE					PREMIER POWER PRODUCTS (CAL) PVT. LTD.	HOWRAH	A			GALVANIZING AT NEHA GALVANIZER
	CABLE TRAY SUPPORT SYSTEM - BOLTABLE					INDMARK FORMTECH PVT LTD	INDIA	DR			
	CABLE TRAY SUPPORT SYSTEM - BOLTABLE					M/S AMTECH	PUNE	A			GALVANINZING AT B.G. SHIRKE PUNE
	CABLE TRAY SUPPORT SYSTEM - BOLTABLE					RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	INDIA	DR			
	CABLE TRAY SUPPORT SYSTEM - BOLTABLE					M/S INAR PROFILES	VIZAG	A			
	CABLE TRAY SUPPORT SYSTEM - BOLTABLE					M/S INDIANA GRATINGS	PUNE	A			GALVANIZING AT KARAMTARA GALVANIZER POONA GALVANIZER

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	CABLE TRAY SUPPORT SYSTEM - BOLTABLE					M/S VATCO	MUMBAI	A			GALVANIZING AT SIGMA GALVANIZER
4	HT XPLE CABLES					NICCO CORPORATION LTD.	Kolkata	A			UPTO 11KV ONLY
	HT XPLE CABLES					TORRENT CABLES LTD.	Nadiad	A			
	HT XPLE CABLES					Finolex	Pune	A			
	HT XPLE CABLES					HAVELLS INDIA LIMITED	ALWAR	A			
	HT XPLE CABLES					Uniflex	Valsad	A			
	HT XPLE CABLES					CRYSTAL CABLE INDUSTRIES LTD.	INDIA	DR			
	HT XPLE CABLES					UNIVERSAL CABLES LTD.	SATNA	A			
	HT XPLE CABLES					PARAMOUNT COMMUNICATIONS LTD.	INDIA	DR			
	HT XPLE CABLES					DIAMOND POWER INFRASTRUCTURE LTD	INDIA	DR			
	HT XPLE CABLES					GEMSCAB INDUSTRIES LTD.	INDIA	DR			
	HT XPLE CABLES					KEC INTERNATIONAL LTD.	INDIA	DR			
	HT XPLE CABLES					Incab	Pune	A			UPTO 11KV ONLY
	HT XPLE CABLES					SRIRAM CABLES PVT. LTD.	BHIWADI	A			UPTO 11KV ONLY
	HT XPLE CABLES					KEI INDUSTRIES LTD.	BHIWADI	A			
	HT XPLE CABLES					CABLE CORPORATION OF INDIA LTD.	INDIA	DR			
	HT XPLE CABLES					APAR INDUSTRIES LIMITED,	INDIA	DR			
	HT XPLE CABLES					POLYCAB WIRES PVT. LTD.	DAMAN	A			
	HT XPLE CABLES					RAVIN CABLES LIMITED	INDIA	DR			
	HT XPLE CABLES					STERLITE TECHNOLOGIES LTD.	INDIA	DR			
	HT XPLE CABLES					TIRUPATI PLASTOMATICS PVT. LTD.	INDIA	DR			
5	LT XLPE POWER CABLE					THERMO CABLES LTD.	HYDERABAD	A			
	LT XLPE POWER CABLE					KEC INTERNATIONAL LTD.	MUMBAI	DR			
	LT XLPE POWER CABLE					CRYSTAL CABLE INDUSTRIES LTD.	INDIA	DR			
	LT XLPE POWER CABLE					INCOM CABLES (P) LTD.	INDIA	DR			
	LT XLPE POWER CABLE					SUYOG ELECTRICALS LTD.	BARODA	A			
	LT XLPE POWER CABLE					CORDS CABLE INDUSTRIES LTD.	BHIWADI	A			
	LT XLPE POWER CABLE					GEMSCAB INDUSTRIES LTD.	BHIWADI	A			

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	LT XLPE POWER CABLE					NICCO CORPORATION LTD.	Kolkata	A			
	LT XLPE POWER CABLE					Incab	Pune	A			
	LT XLPE POWER CABLE					UNIVERSAL CABLES LTD.	SATNA	A			
	LT XLPE POWER CABLE					Hindustan Vidyut PRODUCTS LTD.	Faridabad	A			
	LT XLPE POWER CABLE					SRIRAM CABLES PVT. LTD.	BHIWADI	A			
	LT XLPE POWER CABLE					APAR INDUSTRIES LIMITED,	INDIA	DR			
	LT XLPE POWER CABLE					KEC INTERNATIONAL LTD.	CHENNAI	DR			
	LT XLPE POWER CABLE					ASSOCIATED CABLES PVT. LTD	Mumbai	DR			
	LT XLPE POWER CABLE					ASSOCIATED CABLES TECHNOLOGIES PVT. LTD	Bangalore	DR			
	LT XLPE POWER CABLE					GLOSTER CABLES LIMITED	SECUNDRABAD	DR			
	LT XLPE POWER CABLE					STEP INDUSTRIES PVT. LTD	DELHI	DR			
	LT XLPE POWER CABLE					IMT CABLES PVT LTD.	DELHI	DR			
	LT XLPE POWER CABLE					EPSILLON CABLES PVT LTD	NAGPUR	DR			
	LT XLPE POWER CABLE					KRISHNA ELECTRICAL INDUSTRES LTD.	GWALIOR	DR			
	LT XLPE POWER CABLE					GOYOLENE FIBRE(I) PVT.	Mumbai	DR			
	LT XLPE POWER CABLE					MANSFIELD CABLES COMPANY LTD.	INDIA	DR			
	LT XLPE POWER CABLE					DIAMOND POWER INFRASTRUCTURE LTD	INDIA	DR			
	LT XLPE POWER CABLE					CRYSTAL CABLE INDUSTRIES LTD.	INDIA	DR			
	LT XLPE POWER CABLE					GUPTA POWER INFRASTRUCTURE LIMITED,	INDIA	DR			
	LT XLPE POWER CABLE					SPECIAL CABLES PVT. LTD	NEW DELHI	DR			
	LT XLPE POWER CABLE					GOVIND CABLE INDUSTRIES	Kolkata	DR			
	LT XLPE POWER CABLE					TIRUPATI PLASTOMATICS PVT. LTD.	INDIA	DR			
	LT XLPE POWER CABLE					SCOT INNOVATION WIRES AND CABLES PVT. LTD.	INDIA	DR			
	LT XLPE POWER CABLE					HAVELLS INDIA LTD.	ALWAR	A			
	LT XLPE POWER CABLE					PARAMOUNT COMMUNICATIONS LTD.	INDIA	A			
	LT XLPE POWER CABLE					APAR INDUSTRIES LIMITED,	Bangalore	A			
	LT XLPE POWER CABLE					PARAMOUNT CABLE	KHUSHKHERA	A			
	LT XLPE POWER CABLE					T C COMMUNICATION PVT LTD.	GHAZIABAD	DR			
	LT XLPE POWER CABLE					Spee Cables	Bangalore	A			

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	LT XLPE POWER CABLE					GUPTA POWER CABLES	BHUBHANESHWAR	A			
	LT XLPE POWER CABLE					SIECHEM	PONDICHERRY	DR			
	LT XLPE POWER CABLE					DELTON CABLES LTD.	Faridabad	A			A) unarmored cable all sizes B) ARMOURED CABLES UPTO 3.5X240 SQ MM WITH GI STRIP ARMOUR AND ICX70 SQ MM WITH AL STRIP ARMOUR
	LT XLPE POWER CABLE					KEI INDUSTRIES LTD.	BHIWADI	A			
	LT XLPE POWER CABLE					POLYCAB WIRES PVT. LTD.	DAMAN	A			
	LT XLPE POWER CABLE					TORRENT CABLES LTD.	Nadiad	A			
	LT XLPE POWER CABLE					RAVIN CABLES LIMITED	Pune	A			
	LT XLPE POWER CABLE					Finolex	Pune	A			
6	LT PVC CONTROL CABLE	II				NICCO CORPORATION LTD.	Kolkata	A			
	LT PVC CONTROL CABLE					Incab	Pune	A			
	LT PVC CONTROL CABLE					TORRENT CABLES LTD.	Nadiad	A			
	LT PVC CONTROL CABLE					Hindustan Vidyut PRODUCTS LTD.	Faridabad	A			
	LT PVC CONTROL CABLE					DELTON CABLES LTD.	Faridabad	A			unarmored cable all sizes
	LT PVC CONTROL CABLE					R R Kabel	Silvasa	A			
	LT PVC CONTROL CABLE					DIAMOND POWER INFRASTRUCTURE LTD	INDIA	DR			
	LT PVC CONTROL CABLE					UNIVERSAL CABLES LTD.	SATNA	A			
	LT PVC CONTROL CABLE					PARAMOUNT COMMUNICATIONS LTD.	KHUSHKHERA	A			
	LT PVC CONTROL CABLE					THERMO CABLES LTD.	HYDERABAD	A			
	LT PVC CONTROL CABLE					SPM CABLES	HYDERABAD	A			
	LT PVC CONTROL CABLE					SPM POWER & TELECOM PVT. LTD,	HYDERABAD	A			

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	LT PVC CONTROL CABLE					GUPTA POWER INFRASTRUCTURE LIMITED,	BHUBHANESHWAR	A				
	LT PVC CONTROL CABLE					GUPTA POWER CABLES	BHUBHANESHWAR	A				
	LT PVC CONTROL CABLE					SUYOG ELECTRICALS LTD.	VADODARA	A				
	LT PVC CONTROL CABLE					SUYOG CABLES	Bangalore	A				
	LT PVC CONTROL CABLE					Sbee Cables	Bangalore	A				
	LT PVC CONTROL CABLE					GEMSCAB INDUSTRIES LTD.	BHIWADI	A				
	LT PVC CONTROL CABLE					POLYCAB WIRES PVT. LTD.	DAMAN	A				
	LT PVC CONTROL CABLE					PARAMOUNT CABLE	KHUSHKHERA	A				
	LT PVC CONTROL CABLE					INCAB	PUNE	A				
	LT PVC CONTROL CABLE					HINDUSTAN VIDYUT PRODUCTS LTD.	Faridabad	A				
	LT PVC CONTROL CABLE					SAM CABLES & CONDUCTORS (P) LTD.	UTTARAKHAND	A				
	LT PVC CONTROL CABLE					DELTON CABLES LTD.	Faridabad	A				
	LT PVC CONTROL CABLE					SBEE CABLES	Bangalore	A				
	LT PVC CONTROL CABLE					FINOLEX	PUNE	A				
	LT PVC CONTROL CABLE					KEC INTERNATIONAL LTD.	MUMBAI	DR				
	LT PVC CONTROL CABLE					KEC INTERNATIONAL LTD.	CHENNAI	DR				
	LT PVC CONTROL CABLE					SIECHEM	PONDICHERRY	DR				
	LT PVC CONTROL CABLE					INCOM CABLES (P) LTD.	Bulandshahar	DR				
	LT PVC CONTROL CABLE					CRYSTAL CABLE INDUSTRIES LTD.	Howrah	DR				
	LT PVC CONTROL CABLE					SRIRAM CABLES PVT. LTD.	BHIWADI	DR				
	LT PVC CONTROL CABLE					GOYOLENE FIBRE(I) PVT LTD.	MUMBAI	DR				
	LT PVC CONTROL CABLE					KRISHNA ELECTRICAL INDUSTRIES	GWALIOR	DR				
	LT PVC CONTROL CABLE					ASSOCIATED CABLES PVT LTD.	MUMBAI	A				
	LT PVC CONTROL CABLE					SPECIAL CABLES PVT. LTD	NEW DELHI	DR				
	LT PVC CONTROL CABLE					GLOSTER CABLES LIMITED	SECUNDRABAD	A				
	LT PVC CONTROL CABLE					ADVANCE CABLE TECHNOLOGIES (P) LTD	Bangalore	DR				
	LT PVC CONTROL CABLE					STEP INDUSTRIES PRIVATE LIMITED	DELHI	DR				
	LT PVC CONTROL CABLE					CMT CABLES PVT LTD.	DELHI	DR				

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	LT PVC CONTROL CABLE					EPSILLON CABLES PVT. LTD	NAGPUR	DR			
	LT PVC CONTROL CABLE					T C COMMUNICATION PVT. LTD.	GAZIABAD	DR			
	LT PVC CONTROL CABLE					UNIVERSAL CABLES LTD.	INDIA	A			
	LT PVC CONTROL CABLE					TORRENT CABLES LTD.	INDIA	A			
	LT PVC CONTROL CABLE					R.R. Kabel	INDIA	A			
	LT PVC CONTROL CABLE					C m l ltd	Faridabad	DR			
	LT PVC CONTROL CABLE					ELKAY TELELINKS LTD.	Faridabad	A			
	LT PVC CONTROL CABLE					KEI INDUSTRIES LTD.	BHIWADI	A			
	LT PVC CONTROL CABLE					HAVELLS INDIA LTD.	ALWAR	A			
	LT PVC CONTROL CABLE					MANSFIELD CABLES COMPANY LTD.	INDIA	DR			
	LT PVC CONTROL CABLE					SAM CABLES AND CONDUCTORS (P) LTD.	INDIA	DR			
	LT PVC CONTROL CABLE					CORDS CABLE INDUSTRIES LTD.	BHIWADI	A			
	LT PVC CONTROL CABLE					Finolex	Pune	A			
	LT PVC CONTROL CABLE					RAVIN CABLES LIMITED	PUNE	A			
	LT PVC CONTROL CABLE					APAR INDUSTRIES LIMITED,	Bangalore	DR			
	LT PVC CONTROL CABLE					ADVANCE CABLE TECHNOLOGIES (P) LTD	INDIA	DR			
	LT PVC CONTROL CABLE					GOVIND CABLE INDUSTRIES	KOLKATA	DR			
	LT PVC CONTROL CABLE					SCOT INNOVATION WIRES AND CABLES PVT. LTD.	INDIA	DR			
	LT PVC CONTROL CABLE					CMI LTD.	Faridabad	DR			
	LT PVC CONTROL CABLE					TIRUPATI PLASTOMATICS PVT. LTD.	INDIA	DR			
7	SCREENED CONTROL CABLES	II				CORDS CABLE INDUSTRIES LTD.	BHIWADI	A			FOR PVC, FRLS
	SCREENED CONTROL CABLES					PARAMOUNT COMMUNICATIONS LTD.	KHUSHKHERA	A			FOR PVC, FRLS
	SCREENED CONTROL CABLES					KEI INDUSTRIES LTD.	BHIWADI	A			FOR PVC, FRLS
	SCREENED CONTROL CABLES					POLYCAB WIRES PVT. LTD.	DAMAN	A			
	SCREENED CONTROL CABLES					Tew & C	USA	A			
	SCREENED CONTROL CABLES					DELTON CABLES LTD.	Faridabad	A			FOR PVC, FRLS
	SCREENED CONTROL CABLES					Habia Cables	Sweden	A			
	SCREENED CONTROL CABLES					Kerpen	Germany	A			
	SCREENED CONTROL CABLES					Lapp Cables	Germany	A			

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	SCREENED CONTROL CABLES					ELKAY TELELINKS LTD.	Faridabad	A			FOR PVC, FRLS
	SCREENED CONTROL CABLES					Gupta Cables	ORISSA	DR			
	SCREENED CONTROL CABLES					UNIVERSAL	SATNA	A			FOR PVC, FRLS
	SCREENED CONTROL CABLES					NICCO	KOLKATA	A			FOR PVC, FRLS
	SCREENED CONTROL CABLES					INCAB	PUNE	DR			
	SCREENED CONTROL CABLES					RELIANCE ENGRS LTD	BANGALORE	DR			
	SCREENED CONTROL CABLES					ELKEY TELELINKS	Faridabad	A			
	SCREENED CONTROL CABLES					CORDS CABLE INDUSTRIES LTD.	KAHARANI	A			
	SCREENED CONTROL CABLES					UNIVERSAL CABLE	SATNA	A			PVC, FRLS TYPE
	SCREENED CONTROL CABLES					MANSFIELD CABLES COMPANY LTD.	INDIA	DR			
	SCREENED CONTROL CABLES					GEMSCAB INDUSTRIES LTD.	INDIA	DR			
	SCREENED CONTROL CABLES					POLYCAB WIRES PVT. LTD.	INDIA	DR			
	SCREENED CONTROL CABLES					DELTON CABLES LTD.	INDIA	DR			
	SCREENED CONTROL CABLES					SPECIAL CABLES PVT. LTD	INDIA	DR			
	SCREENED CONTROL CABLES					SUYOG ELECTRICALS LTD.	INDIA	DR			
	SCREENED CONTROL CABLES					THERMO CABLES LTD.	HYDERABAD	A			
	SCREENED CONTROL CABLES					T C COMMUNICATION PVT LTD.	PUNE	DR			
	SCREENED CONTROL CABLES					FINOLEX	PUNE	DR			
	SCREENED CONTROL CABLES					THERMO CABLES LTD.	INDIA	A			
	SCREENED CONTROL CABLES					Lapp Cables	INDIA	DR			BHEL WILL FORWARD ONLY TWO PROPOSAL AFTER DETAILS
	SCREENED CONTROL CABLES					LIONI CABLE	Pune	DR			
	SCREENED CONTROL CABLES					GUPTA CABLES	ORISSA	DR			
	SCREENED CONTROL CABLES					CMI	Faridabad	DR			
	SCREENED CONTROL CABLES					LIONI CABLE	Pune	DR			
	SCREENED CONTROL CABLES					Thermo Electra	Netherland	A			
8	DC BATTERY CHARGER	I				HBL POWER SYSTEMS LTD	HYDERABAD	A			
	DC BATTERY CHARGER					DUBAS ENGG PVT LTD	BANGALORE	A			
	DC BATTERY CHARGER					AMARA RAJA POWER SYSTEMS LIMITED	TIRUPATI	A			
	DC BATTERY CHARGER					MASS-TECH CONTROLS PVT.LTD.	INDIA	DR			
	DC BATTERY CHARGER					CHHABI ELECTRICALS PVT.LTD.	JALGAON	A			

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	DC BATTERY CHARGER					CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED	KOLKATTA	A			
	DC BATTERY CHARGER					STATCON POWER CONTROLS LTD	HAPUR	DR			
	DC BATTERY CHARGER					JEMA ENERGY	SPAIN	DR			
9	ELECTRIC LAB EQUIPMENT	III				APPLIED TECHNO PRODUCTS PVT. LTD.	INDIA	N			
	ELECTRIC LAB EQUIPMENT					TECHNOLOGY PRODUCTS	INDIA	N			
	ELECTRIC LAB EQUIPMENT					TTL TECHNOLOGIES PVT. LTD.	INDIA	N			
	ELECTRIC LAB EQUIPMENT					PCI LIMITED	INDIA	N			
	ELECTRIC LAB EQUIPMENT					SCIENTIFIC MES TECHNIK PVT.LTD.	INDIA	N			
	ELECTRIC LAB EQUIPMENT					THE MOTWANE MANUFACTURING	INDIA	N			
	ELECTRIC LAB EQUIPMENT					JOST's ENGG. CO. LTD.	INDIA	N			
	ELECTRIC LAB EQUIPMENT					HIOKI E.E. CORPORATION	JAPAN	N			
10	STATION LIGHTING SYSTEM	III				TECHNO ELECTRIC and ENGG. CO. LTD.	INDIA	N			
	STATION LIGHTING SYSTEM					AVAIDS TECHNOVATORS PVT. LTD.	INDIA	N			
	STATION LIGHTING SYSTEM					BAJAJ ELECTRICALS LTD.	INDIA	N			
	STATION LIGHTING SYSTEM					MIKA ENGINEERS,	INDIA	N			
	STATION LIGHTING SYSTEM					PHILIPS ELECTRONICS INDIA LTD.	INDIA	N			
11	CATHODIC PROTECTION	III				RAYCHEM RPG LTD	INDIA	N			
	CATHODIC PROTECTION					MITCORR CATHODICPROTECTION PVT. LTD	INDIA	N			
12	GENERATOR CIRCUIT BREAKER	I				ALSTOM GRID SAS	FRANCE	N			
	GENERATOR CIRCUIT BREAKER					ABB SWITZERLAND LTD.,	SWITZERLAND	N			
13	PA SYSTEM	III				Hi-Tech audio Systems Pvt. Ltd	INDIA	DR			
	PA SYSTEM					INDUSTRONIC INDUSTRIE-ELECTRONIC GMBH & CO. KG	GERMANY	DR			
	PA SYSTEM					LARAON ENGINEERS AND CONSULTANTS PVT. LTD.	INDIA	DR			Neumann System
	PA SYSTEM					CHASHMITA ENGINEERS PVT. LTD.	INDIA	A			Bosch
	PA SYSTEM					AISHAN TECHNOLOGIES INDIA PVT. LTD.	INDIA	DR			
	PA SYSTEM					Haritasha	Bangalore	A			Bosch
	PA SYSTEM					Karthik	Chennai	A			Bosch
	PA SYSTEM					BYTE COMMUNICATIONS PVT.LTD.	INDIA	A			
	PA SYSTEM					Commend	Austriya	DR			IP Based
	PA SYSTEM					Stentofone Zenitel	Norway	DR			IP Based
	PA SYSTEM					Siemens	GURGAON	DR			Bosch

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	PA SYSTEM					NEUMAN	Germany	A			THROUGH M/S LARAON, GURGOAN AS SYSTEM INTEGRATO
	PA SYSTEM					BNA TECHNOLOGY	Bangalore	A			
	PA SYSTEM					BOSCH	Bangalore	A			
	PA SYSTEM					POWER SYSTEMS	INDIA	DR			
14	DC Lead Acid Batteries	II				HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	DR			
	DC Lead Acid Batteries					HBL POWER SYSTEMS LTD	INDIA	DR			
	DC Lead Acid Batteries					EXIDE INDUSTRIES LTD	INDIA	A			
15	DC Ni-Cd Batteries	II				HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	DR			
	DC Ni-Cd Batteries					Saft	France / Sweeden	A			
	DC Ni-Cd Batteries					HBL POWER SYSTEMS LTD	HYDERABAD	A			
	DC Ni-Cd Batteries					AMCO SAFT INDIA LTD	BANGALORE	A			

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY BIFPCL)

A - For those items proposed vendor is acceptable to BIFPCL. To be indicated with letter "A" in the list alognwith the condition of approval, if any.

DR - For those items "Detailed Required" for BIFPCL review. To be identified with letter "DR" in the list.

DR* - For those item "Detail Required by BIFPCL for record updation only

NOTED : For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED" (N)

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection witness by BIFPCL

CAT - II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis of review of

CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main supplier.

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units / works.

*** - Inspection category will be decided during vendor evaluation.**

NOTE - 1 : For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

Note 2 : The above vendor list is broadly discussed and finalised however BHEL has to get reveted the vendor list from BIFPCL before ordering.

NOTE - 3 : For the items not appearing in the preaward list, bidder and BIFPCL will mutually discussed in future.

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PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00	
CONTRACTOR : BHEL - PEM	VENDOR AS APPROVED BY BIFPCL	DATE : 12/12/2015	
CONTRACT NO :			

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
1	CW TREATMENT PLANT	I				ION EXCHANGE (INDIA) LTD	MUMBAI	A			
	CW TREATMENT PLANT					THERMAX LTD.	PUNE	A			
	CW TREATMENT PLANT					CHEMBOND SOLENIS WATER TECHNOLOGIES LTD	INDIA	DR			
	CW TREATMENT PLANT					DRIPLEX WATER ENGG PVT. LTD	DELHI	A			
2	PRETREATMENT PLANT					DRIPLEX WATER ENGG PVT. LTD	NEW DELHI	A			
	PRETREATMENT PLANT					SHRIRAM EPC LTD.	CHENNAI	DR			
	PRETREATMENT PLANT					THERMAX LTD.	PUNE	DR			
	PRETREATMENT PLANT					ION EXCHANGE (INDIA) LTD	MUMBAI	A			
	PRETREATMENT PLANT					TRIVENI ENGIEERING & INDUSTRIES LTD.,	NOIDA	A			
	PRETREATMENT PLANT					GEO MILLER	NEW DELHI	A			
	PRETREATMENT PLANT					VA TECH WABAG	PUNE	A			
	PRETREATMENT PLANT					BHEL	RANIPET	DR			
3	EFFLUENT TREATMENT PLANT	I				TRIVENI ENGIEERING & INDUSTRIES LTD.,	NOIDA	A			
	EFFLUENT TREATMENT PLANT					PARAMOUNT LIMITED	BARODA	DR			
	EFFLUENT TREATMENT PLANT					Aqua Design India Pvt. Ltd.	INDIA	DR			
	EFFLUENT TREATMENT PLANT					SHRIRAM EPC LTD.	CHENNAI	DR			
	EFFLUENT TREATMENT PLANT					ION EXCHANGE (INDIA) LTD	Mumbai	A			
	EFFLUENT TREATMENT PLANT					Geo Miller	New Delhi	A			
	EFFLUENT TREATMENT PLANT					TECHNOFAB ENGG. LTD.	DELHI	DR			
	EFFLUENT TREATMENT PLANT					DRIPLEX WATER ENGG PVT. LTD	New Delhi	A			
	EFFLUENT TREATMENT PLANT					EUREKA FORBES LTD.	New Delhi	DR			
	EFFLUENT TREATMENT PLANT					THERMAX LTD.	PUNE	DR			
	EFFLUENT TREATMENT PLANT					VA TECH WABAG LTD	PUNE	DR			
4	FUEL OIL HANDLING AND STORAGE SYSTEM	I				GMW PRIVATE LIMITED	BARODA	A			
	FUEL OIL HANDLING AND STORAGE SYSTEM					THERMOSYSTEMS PVT. LTD.	HYDERABAD	DR			
	FUEL OIL HANDLING AND STORAGE SYSTEM					UNITECH MACHINES LTD.	Gurgaon	A			
	FUEL OIL HANDLING AND STORAGE SYSTEM					TECHNO ELECTRIC and ENGG. CO. LTD.	KOLKATA	A			

	PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING QP				REF. NO :
	PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE				REVISION NO : 00
	CONTRACTOR : BHEL - PEM					VENDOR AS APPROVED BY BIFPCL				DATE : 12/12/2015
	CONTRACT NO :									
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
	FUEL OIL HANDLING AND STORAGE SYSTEM					TECHNOFAB ENGG. LTD.	DELHI	A			
	FUEL OIL HANDLING AND STORAGE SYSTEM					SHALCOT MECHANIQUE PVT. LTD.	INDIA	DR			
	FUEL OIL HANDLING AND STORAGE SYSTEM					RAUNAQ INTERNATIONAL LTD.	FARIDABAD	A			
	FUEL OIL HANDLING AND STORAGE SYSTEM					NEW FIRE ENGINEERS PVT LTD	MUMBAI	DR			
	FUEL OIL HANDLING AND STORAGE SYSTEM					XICON INTERNATIONAL LIMITED	INDIA	DR			
5	GAS CHLORINATION PLANT	I				IEC FABCHEM LTD.	CHENNAI	A			
	GAS CHLORINATION PLANT	I				Capital Control	Mumbai	A			
	GAS CHLORINATION PLANT					Perfect Chloro System	CHENNAI	A			UPTO 120 KG/HR
	GAS CHLORINATION PLANT					PENNWALT INDIA LTD.	Mumbai	DR			
6	FIRE TENDERS	III				VIJAY FIRE VEHICLES AND PUMPS LTD	INDIA	N			
	FIRE TENDERS					BRIJBASI HI-TECH UDYOG LTD	INDIA	N			
	FIRE TENDERS					WADIA BODY BUILDERS	INDIA	N			
7	FORK LIFT TRUCK	III				VOLTAS MATERIAL HANDLING PVT. LTD.	INDIA	N			
	FORK LIFT TRUCK					ACTION CONSTRUCTION EQUIPMENT LTD	INDIA	N			
8	WORKSHOP EQUIPMENTS	III				KHALSA ENGINEERING WORKS	INDIA	N			
	WORKSHOP EQUIPMENTS					SAGAR HEAVY ENGINEERINGS PVT. LTD.	INDIA	N			
	WORKSHOP EQUIPMENTS					BATLIBOI LTD.	INDIA	N			
	WORKSHOP EQUIPMENTS					HMT Machine Tools Ltd (100% subsidiary of M/s HMT Ltd.)	INDIA	N			
	WORKSHOP EQUIPMENTS					ABRO TECHNOLOGIES PVT. LTD	INDIA	N			
9	Sewage Treatment Plant					Aqua Design India Pvt. Ltd.	CHENNAI	DR			
	Sewage Treatment Plant					THERMAX LTD.	PUNE	A			
	Sewage Treatment Plant					TRIVENI ENGIEERING & INDUSTRIES LTD.,	NOIDA	A			
	Sewage Treatment Plant					SHRIRAM EPC LTD.	CHENNAI	DR			

15-12-15

PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
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CONTRACTOR : BHEL - PEM	VENDOR AS APPROVED BY BIFPCL	DATE : 12/12/2015
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No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
	Sewage Treatment Plant					VA TECH WABAG LTD	PUNE	A			
	~~Sewage Treatment Plant~~					~~TECHNOFAB ENGG. LTD.~~	~~NEW DELHI~~	~~DR~~			
	~~Sewage Treatment Plant~~					~~GEO MILLER~~	~~NEW DELHI~~	~~A~~			
	~~Sewage Treatment Plant~~					~~PARAMOUNT LIMITED~~	~~Vadodara~~	~~DR~~			
	~~Sewage Treatment Plant~~					~~DRIPLEX WATER ENGG PVT. LTD~~	~~NEW DELHI~~	~~A~~			
	Sewage Treatment Plant					ION EXCHANGE (INDIA) LTD	Mumbai	A			
10	WEIGH BRIDGE	III				TECHNO SCALE INDUSTRIES,	INDIA	N			
	WEIGH BRIDGE					IPA Private Ltd.,	INDIA	N			
	WEIGH BRIDGE					STATWEIGH INDIA (P) LTD.	INDIA	N			
11	OXYGEN DOSING SYSTEM					POWER PIPING COMPANY	INDIA	DR			
	OXYGEN DOSING SYSTEM					V.K PUMP INDUSTRIES PVT LTD	Thane	DR			
	OXYGEN DOSING SYSTEM					PSI ENGINEERING SYSTEMS (P) LTD.	INDIA	DR			
	OXYGEN DOSING SYSTEM					SWELORE ENGG. PVT. LTD	AHMEDABAD	DR			
	OXYGEN DOSING SYSTEM					ENPRO INDUSTRIES PVT.LTD.	INDIA	DR			
	OXYGEN DOSING SYSTEM					POSITIVE METERING PUMPS (I) PVT. LTD.	INDIA	DR			
	OXYGEN DOSING SYSTEM					MR SYSTEMS	INDIA	DR			
12	CHEMICAL DOSING SYSTEM	I				PSI ENGINEERING SYSTEMS (P) LTD.	CHENNAI	A			
	CHEMICAL DOSING SYSTEM					POWER PIPING COMPANY	INDIA	DR			
	CHEMICAL DOSING SYSTEM					MR SYSTEMS	INDIA	A			
	CHEMICAL DOSING SYSTEM					ENPRO INDUSTRIES PVT.LTD.	INDIA	DR			
	CHEMICAL DOSING SYSTEM					POSITIVE METERING PUMPS (I) PVT. LTD.	INDIA	DR			
	CHEMICAL DOSING SYSTEM					V.K PUMP INDUSTRIES PVT LTD	NASIK	A			
	CHEMICAL DOSING SYSTEM					TECHNO CONSULTANTS	MUMBAI	A			
	CHEMICAL DOSING SYSTEM					V K Pumps	Thane	A			
	CHEMICAL DOSING SYSTEM					Milton Roy	Chennai	DR			
	CHEMICAL DOSING SYSTEM					ROCKWIN FLOWMWTER INDIA PVT LTD	INDIA	DR			
	CHEMICAL DOSING SYSTEM					SWELORE ENGG. PVT. LTD	INDIA	A			
	CHEMICAL DOSING SYSTEM					TECHNO STRENGTH	HYDERABAD	DR			
	CHEMICAL DOSING SYSTEM					HEIDELBERG PROMINENT FLUID CONTROL INDIA PRIVATE LTD.	INDIA	DR			
13	CONDENSATE POLISHING UNIT	I				DRIPLEX WATER ENGINEERING INTERNATIONAL PRIVATE LIMITED	NEW DELHI	A			
	CONDENSATE POLISHING UNIT					ION EXCHANGE (INDIA) LTD	MUMBAI	A			

15-12-15

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING QP				REF. NO :	
		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE				REVISION NO : 00	
		CONTRACTOR : BHEL - PEM					VENDOR AS APPROVED BY BIFPCL				DATE : 12/12/2015	
		CONTRACT NO :										
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark	
	SINGLE GIRDER EOT / HOT MISC. CRANES					SAFEX ENERGY PVT. LTD.	INDIA	DR				
	SINGLE GIRDER EOT / HOT MISC. CRANES					MEEKA MACHINERY PVT LTD	INDIA	DR				
	SINGLE GIRDER EOT / HOT MISC. CRANES					Henan Weihua Heavy Machinery Co. Ltd. ,	CHINA	DR				
	SINGLE GIRDER EOT / HOT MISC. CRANES					TECHNO INDUSTRIES	INDIA	DR				
	SINGLE GIRDER EOT / HOT MISC. CRANES					Grip Engineers Pvt. Ltd.,	INDIA	DR				
20	CHAIN PULLEY BLOCK	III				HERCULES HOISTS LTD.	Raigarh	A				
	CHAIN PULLEY BLOCK					TRACTEL TIRFOR INDIA PVT. LTD.	PALVAL	A				
	CHAIN PULLEY BLOCK					TUOBRO FURGUSON (INDIA) PVT LTD	INDIA	DR				
	CHAIN PULLEY BLOCK					CENTURY CRANE ENGINEERS PVT LTD	INDIA	DR				
	CHAIN PULLEY BLOCK					TECHNO INDUSTRIES	INDIA	DR				
	CHAIN PULLEY BLOCK					LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	A			UPTP 12 TONS	
	CHAIN PULLEY BLOCK					Armsell	Bangalore	DR			UPTO 5 TONS	
	CHAIN PULLEY BLOCK					BRADY & MORRIS ENGINEERING CO. LTD.	INDIA	DR				
21	ELECTRIC HOIST	II				CONSOLIDATED HOISTS PVT LTD	PUNE	A			UPTO 35 TONS AT SATARA & UPTO 15 TONS	
	ELECTRIC HOIST					TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	A			UPTO 5 TONS	
	ELECTRIC HOIST					GRIP ENGINEERS PVT. LTD.	HYDERABAD	A			UPTO 40 TONS	
	ELECTRIC HOIST					REVA INDUSTRIES LTD.	FARIDABAD	A			UPTO 25TONS	
	ELECTRIC HOIST					EDDY CRANES PVT. LTD.	PUNE	A			UPTO 14 TONS	
	ELECTRIC HOIST					BRADY & MORRIS ENGINEERING CO.	INDIA	DR				
	ELECTRIC HOIST					ALPHA SERVICES	ALWAR,	A			UPTO 15 TONS	
	ELECTRIC HOIST					CENTURY CRANE ENGINEERS PVT. LTD.	PALVAL	A			UPTO 25TONS	
	ELECTRIC HOIST					Avon Cranes	Gurgaon	A			UPTO 20 TONS	
	ELECTRIC HOIST					HERCULES HOISTS LTD.	Raigarh	A			UPTO 15TONS	

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - PEM	VENDOR AS APPROVED BY BIFPCL	DATE : 12/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
	ELECTRIC HOIST					Armsell	Bangalore	A			UPTO 15 TONS
	ELECTRIC HOIST					Mangla Hoists Pvt Ltd	INDIA	DR			
	ELECTRIC HOIST					GLOBAL TECHNOLOGIES	INDIA	DR			
	ELECTRIC HOIST					ROCKWELL HOISTO CRANES PVT. LTD.	INDIA	DR			
	ELECTRIC HOIST					TECHNO INDUSTRIES	INDIA	DR			
	ELECTRIC HOIST					MEEKA MACHINERY PVT LTD	INDIA	DR			
	ELECTRIC HOIST					AVON CRANES	GURGAON	A			
	ELECTRIC HOIST					CONSOLIDATED HOISTS PVT LTD	PUNE	A			UPTO 35 TONS AT SATARA & UPTO 15
	ELECTRIC HOIST					HERCULES HOISTS LTD.	RAIGARH	A			
	ELECTRIC HOIST					ARMSELL	Bangalore	A			
	ELECTRIC HOIST					SAFEX ENERGY PVT. LTD.	INDIA	DR			
22	ELEVATORS	I				CITY LIFTS (INDIA) LTD.	INDIA	DR			
	ELEVATORS					KONE ELEVATOR INDIA LTD.	CHENNAI	A			
	ELEVATORS					OTIS	MUMBAI	A			
	ELEVATORS					SAMIL ELTEC	KOREA	A			
	ELEVATORS					ECE	GHAZIABAD	A			
	ELEVATORS					TECHNO	AHMEDABAD	A			
	ELEVATORS					OMEGA	AHMEDABAD	A			
	ELEVATORS					TECHNO INDUSTRIES LTD.	INDIA	DR			
23	AIR CONDITIONING SYSTEM	I				BLUE STAR LTD.	MUMBAI	A			
	AIR CONDITIONING SYSTEM					VOLTAS LTD.	MUMBAI	A			
	AIR CONDITIONING SYSTEM					STERLING AND WILSON LIMITED	KOLKATA	A			
	AIR CONDITIONING SYSTEM					DRAFT-AIR (INDIA) PVT. LTD.	AHMEDABAD	DR			
	AIR CONDITIONING SYSTEM					ADVANCE VENTILATION PVT.LTD.	DELHI	DR			

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING QP				REF. NO :	
		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE				REVISION NO : 00	
		CONTRACTOR : BHEL - PEM					VENDOR AS APPROVED BY BIFPCL				DATE : 12/12/2015	
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No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark	
28	LUBE OIL TRANSFER PUMPS	II				TUSHACO PUMPS PVT.LTD.	INDIA	A				
	LUBE OIL TRANSFER PUMPS	II				UT PUMPS	INDIA	DR				
	LUBE OIL TRANSFER PUMPS					MATZ PUMPS PVT. LTD.	INDIA	A				
	LUBE OIL TRANSFER PUMPS					DELTA P D PUMPS PVT. LTD.	INDIA	DR				
29	D/G EOT CRANE ABOVE 150T-200T	I				UNIQUE INDUSTRIAL HANDLERS PVT LTD.	NASIK	A				
	D/G EOT CRANE ABOVE 150T-200T					DEMAG CRANES & COMPONENTS (I) PVT. LTD.	PUNE	DR				
	D/G EOT CRANE ABOVE 150T-200T					ANUPAM INDUSTRIES LTD.	VU NAGAR	A				
	D/G EOT CRANE ABOVE 150T-200T					HEAVY ENGG. CORPORATION LTD.	INDIA	A				
	D/G EOT CRANE ABOVE 150T-200T					WMI KONECRANES INDIA LTD.	MUMBAI	A				
	D/G EOT CRANE ABOVE 150T-200T					FURNACE & FONDRY EQUIPMENT CO.	INDIA	A				
	D/G EOT CRANE ABOVE 150T-200T					MUKAND LIMITED	THANE	A				
	D/G EOT CRANE ABOVE 150T-200T					HEC	Ranchi	A				
	D/G EOT CRANE ABOVE 150T-200T					ELECTROMECH MATERIAL HANDLING SYSTEMS (INDIA) PVT. LTD.	INDIA	DR				
	D/G EOT CRANE ABOVE 150T-200T					THE TATA IRON & STEEL LTD.	INDIA	DR				

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY BIFPCL)

A - For those items proposed vendor is acceptable to BIFPCL. To be indicated with letter "A" in the list alognwith the condition of approval, if any.

DR - For those items "Detailed Required" for BIFPCL review. To be identified with letter "DR" in the list.

DR* - For those item "Detail Required by BIFPCL for record updation only

NOTED : For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED" (N)

(ANIL JOSHI)
GM/MECH DEPTT

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING QP				REF. NO :	
		PACKAGE : EPC PACKAGE					APPROVAL & ACCEPTABLE				REVISION NO : 00	
		CONTRACTOR : BHEL - PEM					VENDOR AS APPROVED BY BIFPCL				DATE : 12/12/2015	
		CONTRACT NO :										
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark	

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection witness by BIFPCL

CAT - II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis of review

CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main supplier.

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units / works.

*** - Inspection category will be decided during vendor evaluation.**

NOTE - 1 : For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

Note 2 : The above vendor list is broadly discussed and finalised however BHEL has to get reveted the vendor list from BIFPCL before ordering.

NOTE - 3 : For the items not appearing in the preaward list, bidder and BIFPCL will mutually discussed in future.

(ANIL JOSHI)
CGM/MECH&IPD

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - PEM	VENDOR AS APPROVED BY BIFPCL	DATE : 12/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
1	CONTROL VALVE	I				KOSO INDIA PRIVATE LIMITED	PALAKKAD / Nasik	DR			
	CONTROL VALVE					SPX CORPORATION, USA	USA	DR			
	CONTROL VALVE					DRESSER VALVE INDIA PVT. LTD	COIBATORE	A			
	CONTROL VALVE					CCI	USA / Austria / Korea	A			
	CONTROL VALVE					EMERSON (FISHER)	USA/FRANCE/JAPAN	A			
	CONTROL VALVE					DRESSOR MASONEILAN	FRANCE	A			
	CONTROL VALVE					HORA	GERMANY	A			
	CONTROL VALVE					SEMPELL	GERMANY	DR			
	CONTROL VALVE					KOSO	JAPAN	DR			
	CONTROL VALVE					DAUME REGELARMATUREN GmbH,	GERMANY	DR			
	CONTROL VALVE					INSTRUMENTATION LTD.	PALGHAT	A			
	CONTROL VALVE					VALVITALIA S.P.A.,	ITALY	DR			
	CONTROL VALVE					METSO SINGAPORE PTE. LTD.,	SOUTH KOREA	DR			
	CONTROL VALVE					MIL CONTROLS LTD.	ALWAYE	A			
	CONTROL VALVE					EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	CHENNAI	A			
	CONTROL VALVE					HOLTER REGELARMATUREN GmbH & Co.KG	GERMANY	DR			
	CONTROL VALVE					PARCOL S.p.A	ITALY	DR			
	CONTROL VALVE					TYCO SAMPELL	GERMANY	A			
	CONTROL VALVE					LESLIE	USA	A			
	CONTROL VALVE					FLOW SERVE	BANGALORE	A			
	CONTROL VALVE					INSTRUMENTATION LTD.	PALGHAT	A			
	CONTROL VALVE					FORBES ARCA	PUNE	A			APPROVED UPTO 4 INCH & 300 POUND FOR HIGHER RATING & SIZE DR
	CONTROL VALVE					CCI	INDIA	DR			APPROVED FOR 840 SERIES 8 INCH, 600 CLASS
	CONTROL VALVE					WEIR VALVES AND CONTROLS	UK	DR			
	CONTROL VALVE					WALDEMAR PRUSS ARMATURENFABRIK GME	GERMANY	DR			

(ANIL JOSHI)

15-12-15

		PROJECT : Maitree STPP (2 x 660 MW)					LIST OF ITEMS REQUIRING QP				REF. NO :	
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No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark	
2	FLOW ELEMENT - NOZZLE	I				MICRO PRECISION PRODUCTS PVT. LTD.	FARIDABAD	A			DR FOR P-91 MATERIAL	
	FLOW ELEMENT - NOZZLE					INSTRUMENTATION LTD.	PALGHAT	A				
	FLOW ELEMENT - NOZZLE					HYDROPNEUMATICS PVT. LTD.	INDIA	DR				
	FLOW ELEMENT - NOZZLE					STAR-MECH CONTROLS (I) PVT.LTD.	PUNE	A			DR FOR P-91 MATERIAL	
	FLOW ELEMENT - NOZZLE					SEIKO	AUSTRIA	A				
	FLOW ELEMENT - NOZZLE					WISE CONTROL	KOREA	A				
	FLOW ELEMENT - NOZZLE					SAMIL	KOREA	DR				
	FLOW ELEMENT - NOZZLE					TECHNO METIC	ITALY	A				
	FLOW ELEMENT - NOZZLE					SEIKO FLOW CONTROL GMBH	AUSTRIA	DR				
	FLOW ELEMENT - NOZZLE					MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	GOA	DR				

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2.0 QP INSPECTION CATEGORY :

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(ANIL JOSHI)
(GM/MECH & IPP)

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - PEM	VENDOR AS APPROVED BY	DATE : 15/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub. SCH	SS Approval SCH	Remark
1	MISC.PUMPS (VERTICAL)	I				JYOTI LTD.	VADODARA	A			
	MISC.PUMPS (VERTICAL)					WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	A			
	MISC.PUMPS (VERTICAL)					SULZER PUMPS INDIA LTD.	BOMBAY	DR			
	MISC.PUMPS (VERTICAL)					BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	DR			
	MISC.PUMPS (VERTICAL)					WPIL LIMITED	KOLKATTA/GAZIABAD	A			
	MISC.PUMPS (VERTICAL)					Mather & Platt	Pune	A			
	MISC.PUMPS (VERTICAL)					KBL	Kirloskarwadi	A			
	MISC.PUMPS (VERTICAL)					FLOWMORE LTD.	GAZIABAD	A			
	MISC.PUMPS (VERTICAL)					FLOWSERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	DR			
2	COOLING TOWERS	I				HAMON SHRIRAM COTTRELL PVT. LTD.,	CHENNAI	DR			
	COOLING TOWERS					Hamon Thermal Europe, S.A.	INDIA	DR			
	COOLING TOWERS					NATIONAL BUILDINGS CONSTRUCTION CORPORATION LTD.	NEWDELHI	A			
	COOLING TOWERS					GEA COOLING TOWER	CHENNAI	A			
	COOLING TOWERS					PAHARPUR COOLING TOWERS LTD.	NEWDELHI	A			
	COOLING TOWERS					GAMMON INDIA LTD.	INDIA	DR			
	COOLING TOWERS					BDT	INDIA	DR			
	COOLING TOWERS					LARSEN and TOUBRO LTD.	CHENNAI	A			
3	TRAVELLING WATER SCREENS	II				MACMET INDIA LTD	INDIA	DR			
	TRAVELLING WATER SCREENS					GMW PRIVATE LIMITED	VADODARA	A			
4	MISC.PUMPS (HORIZONTAL)	I				KIRLOSKAR BROTHERS LTD.	Kirloskarwadi	A			
	MISC.PUMPS (HORIZONTAL)					WPIL LIMITED	gaziabad	A			
	MISC.PUMPS (HORIZONTAL)					FLOWMORE LTD.	gaziabad	A			
	MISC.PUMPS (HORIZONTAL)					WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	A			
	MISC.PUMPS (HORIZONTAL)					BEST and CROMPTON ENGG LTD.	chennai	A			
	MISC.PUMPS (HORIZONTAL)					BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	DR			
	MISC.PUMPS (HORIZONTAL)					V-Flo Pumps & Systems Co. Ltd.,	CHINA	DR			
	MISC.PUMPS (HORIZONTAL)					FLOWSERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	DR			
	MISC.PUMPS (HORIZONTAL)					Mather & Platt	PUNE	A			
	MISC.PUMPS (HORIZONTAL)					JYOTI LTD.	INDIA	DR			

[ANIL JOSHI]

	PROJECT : Maitree STPP (2 x 660 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL - PEM	VENDOR AS APPROVED BY	DATE : 15/12/2015
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub. SCH	SS Approval SCH	Remark
	HEAT EXCHANGERS (PLATE TYPE)					Sondex Heat Exchangers India Pvt. Ltd.	INDIA	DR			
9	DEBRIS FILTER	I				TAPROGGE GmBH	GERMANY	A			
	DEBRIS FILTER					GEA BGR ENERGY SYSTEM INDIA LTD.	CHENNAI	A			
	DEBRIS FILTER					QINGDAO HUATAI ELECTRIC EQUIPMENT CO. Ltd.	CHINA	DR			
	DEBRIS FILTER					Northern Heavy Industries Group Co. Ltd.,	CHINA	DR			

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY BIFPCL)

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DR - For those items "Detailed Required" for BIFPCL review. To be identified with letter "DR" in the list.

DR* - For those item "Detail Required by BIFPCL for record updation only

NOTED : For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED" (N)

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection witness by BIFPCL

CAT - II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis of

CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main supplier.

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units / works.

*** - Inspection category will be decided during vendor evaluation.**

NOTE - 1 : For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

Note 2 : The above vendor list is broadly discussed and finalised however BHEL has to get reveted the vendor list from BIFPCL before ordering.

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(ANIL JOSHI)

	PROJECT : Maitree STPP (2 x 660 MW)						LIST OF ITEMS REQUIRING QP				REF. NO :	
	PACKAGE : EPC PACKAGE						APPROVAL & ACCEPTABLE				REVISION NO : 00	
	CONTRACT NO :						VENDOR AS APPROVED BY				DATE : 15/12/2015	
No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark	
1	M.E. BELLOWS	I				FLEXATHERM EXPANLLOW PVT. LTD.	INDIA	DR			SUBJECT TO CARRYING OUT TYPE TEST	
	M.E. BELLOWS					Qinhuangdao North Metal Hose Co. Ltd.,	CHINA	DR			SUBJECT TO CARRYING OUT TYPE TEST	
	M.E. BELLOWS					Teddington Engineered Solutions	UK	DR				
	M.E. BELLOWS					LONESTAR INDUSTRIES	CHENNAI	A			SUBJECT TO CARRYING OUT TYPE TEST	
	M.E. BELLOWS					MB METALLIC BELLOWS PVT. LTD.	CHENNAI	A			SUBJECT TO CARRYING OUT TYPE TEST	
	M.E. BELLOWS					FLEXICAN BELLOWS AND HOSES PVT. LTD.	VADODARA	A			SUBJECT TO CARRYING OUT TYPE TEST	
	M.E. BELLOWS					METALLIC BELOWS INDIA PVT. LTD.	CHENNAI	A			SUBJECT TO CARRYING OUT TYPE TEST	
	M.E. BELLOWS					B. D. Engineers	FARIDABAD	DR			SUBJECT TO CARRYING OUT TYPE TEST	
2	BALL VALVES					BELGAUM AQUA VALVES PVT. LTD.	BELGAUM	DR				
	BALL VALVES					A.V. VALVES LTD	AGRA	DR				
	BALL VALVES					MICROFINISH VALVES PVT LTD.	HUBLI	A				
	BALL VALVES					ATAM VALVES PVT. LTD.	INDIA	DR				
	BALL VALVES					WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	INDIA	DR				
	BALL VALVES					AUDCO(L & T)	COIMBOTORE	A				

(ANIL JOSHI)

	BALL VALVES					BDK	HUBLI	A			upto 400 NBX 150#
	BALL VALVES					PEC	MUMBAI	A			upto 400 NBX 150#
	BALL VALVES					FLOWCHEM	AHMEDABAD	A			upto 350 NBX 150#
	BALL VALVES					AKAY INDUSTRIES	MUMBAI	A			upto 50 NBX 150#
	BALL VALVES					VALTECH INDUSTRIES	MUMBAI	DR			
	BALL VALVES					GM ENGINEERING PVT. LTD.	RAJKOT	DR			
	BALL VALVES					LEADER VALVES LTD.	JALLANDHAR	A			upto 50 Nb
	BALL VALVES					INTERVALVE POONAWALLA LTD.	INDIA	DR			
	BALL VALVES					UNIFLOW	INDIA	DR			
	BALL VALVES					DEMBLA VALVES LTD.	INDIA	DR			
	BALL VALVES					Hawa Valves (India) Pvt. Ltd.	INDIA	DR			
	BALL VALVES					NILON VALVES PRIVATE LIMITED	INDIA	DR			
	BALL VALVES					VAAS AUTOMATION PVT. LTD.	INDIA	DR			
3	AIR RELEASE VALVES	III				A.V. VALVES LTD	AGRA	A			
	AIR RELEASE VALVES					G.M. DALUI AND SONS PVT.LTD.	HAWRA	A			
	AIR RELEASE VALVES					LEADER VALVES LTD.	JALANDER	A			
	AIR RELEASE VALVES					R and D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	A			
	AIR RELEASE VALVES					UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATTA	A			
4	BUTTERFLY VALVES (STEAM SERVICE)	I				INSTRUMENTATION LTD.	PALGHAT	A			
	BUTTERFLY VALVES (STEAM SERVICE)					FOURESS ENGG. INDIA LTD.	BANGALORE	A			
	BUTTERFLY VALVES (STEAM SERVICE)					AUTALEM, S.L.	SPAIN	DR			
	BUTTERFLY VALVES (STEAM SERVICE)					SHENJIANG VALVES CO. LTD.	CHINA	DR			
	BUTTERFLY VALVES (STEAM SERVICE)					NENGFA WEIYE TIELING VALVE JOINT STOCK CO. LTD.	CHINA	DR			
5	THERMAL INSULATION - R-MATTRESSES/P-SECN	II				LLOYD INSULATIONS (INDIA) LTD.	DAMAN, DURGAPUR, JAMSHEDPUR	A			
	THERMAL INSULATION - R-MATTRESSES/P-SECN					GOENKA ROCKWOOL (INDIA) PVT.LTD.	RAIPUR	A			
	THERMAL INSULATION - R-MATTRESSES/P-SECN					ROCKWOOL (INDIA) PVT. LTD.	MEDAK	A			
	THERMAL INSULATION - R-MATTRESSES/P-SECN					Polybond Insulation Private Limited,	INDIA	DR			

	THERMAL INSULATION - R-MATTRESSES/P-SECN				MINWOOL ROCK FIBRES LTD.	RAJNANDGAON	A			
	THERMAL INSULATION - R-MATTRESSES/P-SECN				THERMOCARE ROCKWOOL INDIA PRIVATE LTD.	INDIA	DR			
	THERMAL INSULATION - R-MATTRESSES/P-SECN				LAPININUS ROCKWOOL	MALANPUR(MP)	A			
	THERMAL INSULATION - R-MATTRESSES/P-SECN				SHREERAM EQUITECH PRIVATE LIMITED	INDIA	DR			
6	THERMAL INSULATION - ANCILLARY MATERIAL	III			ENERGY SAVING AND ALLIED PRODUCTS,	INDIA	N			
	THERMAL INSULATION - ANCILLARY MATERIAL				SURESH FASTENERS	INDIA	N			
	THERMAL INSULATION - ANCILLARY MATERIAL				ALLIED INSULATIONS (INDIA)	INDIA	N			
	THERMAL INSULATION - ANCILLARY MATERIAL				LLOYD INSULATIONS (INDIA) LIMITED	BHILAI	N			
	THERMAL INSULATION - ANCILLARY MATERIAL				U.P. TWIGA	BULENDSHAHAR	DR			
	THERMAL INSULATION - ANCILLARY MATERIAL				SUDHIR TRADING COMPANY,	INDIA	N			

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UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units / works.

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	PROJECT : Maitree STPP (2 x 660 MW) PACAKGE : EPC Sub Package: Desalination & FGDWWTP CONTRACTOR : M/S BHEL CONT. NO.	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE : 13th December 2015

S.NO.	Item	QAP/ INSP. CAT	QAP No.	Proposed Supplier	Place of Manufacturing	Approval Status	Remarks
	UF SYSTEM (SUB MERGED)	II		ION EXCHANGE (I) LTD.,	MUMBAI	A	
		II		THERMAX LIMITED,	CHENNAI	A	
		II		VA TECH WABAGH LTD		A	
		II		GE INDIA INDUSTRIAL PRIVATE LIMITED	BENGALURU	A	
		II		TORAY ASIA PVT. LTD	SINGAPORE 238164	A	
2	BWRO SKID	II		ION EXCHANGE (I) LTD.,	MUMBAI	A	
		II		THERMAX LIMITED,	CHENNAI	A	
		II		GE INDIA INDUSTRIAL PRIVATE LIMITED	BENGALURU	A	
		II		PENTAIR WATER INDIA PVT LTD	CHENNAI	A	
		II		PANDA WATER-TECH PVT. LTD.	AHMEDABAD	A	
		II		HYDROCHEM (S) PTE LTD (SUBSIDIARY OF HYFLUX LTD)	SINGAPORE	A	
		II		HYFLUX ENGINEERING INDIA PVT LTD,	CHENNAI	A	
3	RO MEMBRANE	II		DOW CHEMICALS INTERNATIONAL PVT LTD	VIKHROLI-WEST MUMBAI	A	
		II		HYDRANAUTICS - A NITTO DENKO COMPANY	MUMBAI	A	
		II		TORAY ASIA PVT. LTD	SINGAPORE 238164	A	
		II		TORAY INDUSTRIES INC	CHIBA 279 8555 JAPAN	A	

PROJECT : Maitree STPP (2 x 660 MW) PACAKGE : EPC Sub Package: Desalination & FGDWWTP CONTRACTOR : M/S BHEL CONT. NO.	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE : 13th December 2015

		II		MITSUI & CO PLANT SYSTEMS LTD	JAPAN	A	
		II		GE INDIA INDUSTRIAL PRIVATE LIMITED	BENGALURU	A	
4	ENERGY RECOVERY UNIT	II		ENERGY RECOVERY INC	CALIFORNIA	A	
5	DM SYSTEM	II		ION EXCHANGE (I) LTD.,	MUMBAI	A	
		II		PARAMOUNT LIMITED	VADODARA	A	
		II		THERMAX LIMITED,	CHENNAI	A	
		II		VA TECH WABAGH LTD		A	
		II		ADUATECH SYSTEMS (ASIA) PVT. LTD.,	PUNE	A	
		II		DRIPLEX WATER ENGINEERING LIMITED	NEW DELHI	A	
		II		DOSHION VEOLIA WATER SOLUTIONS PVT LTD	CHENNAI	A	
6	HP PUMP WITH MOTOR &ACC (STAILESS STEEL	II		FLOWSERVE INDIA CONTROLS (P) .LTD	COIMBATORE	A	
		II		KIRLOSKAR BROTHERS LIMITED	CHENNAI	A	
		II		MATHER AND PLATT PUMPS LTD.,	CHENNAI	A	
		II		SULZER PUMPS INDIA LIMITED	CHENNAI	A	
		II		KSB PUMPS LTD.,	CHENNAI	A	
		II		BEST & CROMTON ENGG LIMITED	CHENNAI	A	
		II		GRUNDFOS PUMPS INDIA PVT LTD	CHENNAI	DR	
		II		ITT CORPORATION INDIA PVT. LTD	MUMBAI	DR	

	PROJECT : Maitree STPP (2 x 660 MW) PACAKGE : EPC Sub Package: Desalination & FGDWWTP CONTRACTOR : M/S BHEL CONT. NO.		LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL		REF NO : REVISION NO. 00 DATE : 13th December 2015		
		II		CLYDE UNION LTD	GLASGOW - G44 4EX	A	
	RUBBER EXPANSION BELLOWS	II		BACHMANN INDUS(I) LTD	CHENNAI	N	
		II		KELD ELLENTOFT INDIA PVT. LTD.	CHENNAI	N	
		II		CORI ENGINEERS PVT LTD.	CHENNAI	N	
		II		EAGLE BURGMANN KE PVT.LTD	CHENNAI	N	
		II		HAT RUBBERS	CHENNAI	N	
		II		HITECH JOINTS & LININGS P LTD	CHENNAI	N	
		II		HITECH ENGINEERING	CHENNAI	N	
		II		SHREE RUBBER WORKS,	NAVI MUMBAI	N	
		II		STEAMLINE INDUSTRIES LIMITED	MUMBAI	N	
8	GRP PIPES & PIPE FITTINGS	II		MODERN ENGINEERING PLASTICS PV	SALEM	N	
		II		SHRIRAM SEPL COMPOSITES P LTD	MARSHALL'S ROAD,EGMORE,C	N	
		II		BALAJI FIBER REINFORCE PVT LTD	VADODARA	N	
		II		EPP COMPOSITES PRIVATE LIMITED	RAJKOT	N	
		II		REINHOLD POLY GLASS	HOSUR	N	
		II		CHEMICAL PROCESS PIPING PVT LIMITED	MUMBAI	N	
9	HP PIPING (SS PIPING AND ROD)			STANDARD METAL TRADING CO.,	CHENNAI	N	
				TUBE PRODUCTS INCORPORATE	BARODA	N	
				PADMINI STEELS	MUMBAI	N	

	PROJECT : Maitree STPP (2 x 660 MW) PACAKGE : EPC Sub Package: Desalination & FGDWWTP CONTRACTOR : M/S BHEL CONT. NO.			LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL		REF NO : REVISION NO. 00 DATE : 13th December 2015	
		II		CHOKSI TUBE,	MUMBAI	N	
		II		D.K.CORPORATION,	MUMBAI	N	
		II		BALWANT STEEL	CHENNAI	N	
		II		ROSHAN IND CORPORATION	MUMBAI	N	
10	STEEL TANK	II		TECHNOFAB ENGINEERING LIMITED		N	
		II		UNITECH MACHINES LTD(INFRASTRUCTURE DIVISION)	GURGAON	N	
		II		SAKTHI HI-TECH CONSTRUCTIONS PVT LTD	KANCHEEPURAM DISTRICT	N	
		II		GMW PRIVATE LIMITED	VADODARA	N	
		II		THERMO PADS (P) LTD	HYDERADAD	N	
		II		THERMOSYSTEMS PVT. LIMITED.,	HYDERADAD	N	
		II		TECHNO ELECTRIC & ENGINEERING CO LTD.,	KOLKATA	N	
		II		BRIDGE AND ROOF CO.(INDIA) LTD.,	CHENNAI	N	
		II		DIAMOND FABRICATIONS (I) PVT. LTD.,	PUNE	N	
11	FGD WASTE WATER TREATMENT PLANT	II		ION EXCHANGE (I) LTD.,	MUMBAI	N	
		II		ION EXCHANGE (INDIA) LIMITED,	CHENNAI	N	
		II		GEO MILLER & COMPANY LIMITED	NEW DELHI	N	
		II		PARAMOUNT LTD	VADODARA	N	
		II		THERMAX LIMITED,	PUNE	N	
		II		VA TECH WABAGH LTD		N	
		II		DRIPLEX WATER ENGINEERING LIMITED	NEW DELHI	N	

PROJECT : Maitree STPP (2 x 660 MW) PACAKGE : EPC Sub Package: Desalination & FGDWWTP CONTRACTOR : M/S BHEL CONT. NO.	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE : 13th December 2015

II		DOSHION VEOLIA WATER SOLUTIONS PVT LTD	CHENNAI	N	
II		DOSHION VEOLIA WATER SOLUTIONS PVT.LTD	AHMEDABAD	N	
II		TECHNOFAB ENGINEERING LIMITED		N	
II		TRIVENI ENGINEERING & INDUSTRIES LTD.,	NOIDA	N	
II		SRIRAM EPC LTD	CHENNAI	N	
II		AQUA DESIGNS INDIA PRIVATE LTD	CHENNAI	N	
II		AQUA ENGINEERS AND CONSULTANTS INDIA PVT LTD	CHENNAI	N	
II		ARUN ELECTROCHEMICAL SYSTEMS PVT LTD	CHENNAI	N	
II		CLEAR WATER LIMITED	NEW DELHI	N	
II		MECON LTD	RANCHI	N	
II		DAYSTAR ENVIRO TECHNOLOGIES PVT LTD	VADODARA	N	
II		ENVIAN ENGINEERS PVT LTD	CHENNAI	N	

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NOTED : For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED"

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CAT - II : For those items the Quality Plans are approved by BIFPCL. However no physical inspection shall be done by BIFPCL. The final acceptance by BIFPCL shall be on the basis of review of documents.

CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main supplier.

BIFPCL 5 of 6 ENGINEERING DIV / QAI CONTRACTOR 12/13/2015

BIFPCL	PROJECT : Maitree STPP (2 x 660 MW) PACAKGE : EPC Sub Package: Desalination & FGDWWTP CONTRACTOR : M/S BHEL CONT. NO.	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE : 13th December 2015

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NOTE - 1 : For the items not appearing in the preaward list, BHEL's approved Vendor list will be used.

NOTE – 2 : For items covered in Annexure-I to B0, Part-B, Section-V, Amendment No 5 of technical specification, BHEL has to furnish the details to establish qualifying / provenness requirement to BIFPCL for review at the time of detailed engineering irrespective of the approval category "A" or "DR" mentioned in the vendor list.

BIFPCL

6 of 6

ENGINEERING DIV / QAI

CONTRACTOR

12/13/2015

CONTRACTOR:
CONT_NO:
Package:

MAITREE (2×660 M
BHEL –RANIPET
EPC PACKAGE

LIST OF ITEMS REQUIRING QUAL' 'PLAN AND SUBCONTRACTOR APPRO VAL
SUB SYSTEM: Electrical,C&I

Ref No:
Date: 13.12.2015

8	OPACITY MONITOR	III			SICK	GERMANY	A
		III			DURAG	GERMANY	A
		III			CODEL	UK	A
		III			LAND COMBUSTION	UK	A
	HEATER (PANEL TYPE HOPPER HEATERS)	II			HTD HEAT TRACE INDIA	HYDERABAD	A
		II			HOT FOIL EHS INC	USA	A
		II			HTD HEAT TRACE	USA	A
		II			THERMON	USA	A
		II			THERMOPADS	HYDERABAD	A
		II			THERMON	PUNE	A
10	ELEVATOR	II			ECE	GHAZIABAD	A
		II			TECHNO	AHMEDABAD	A
		II			OTIS	MUMBAI	A
		II			KONE	CHENNAI	A
		II			OMEGA	AHMEDABAD	A
		II			SAMIL ELTEC	KOREA	A
11	LT MOTORS (REFER NOTE 1)	II			KEC	BANGALORE/HUBLI	A
		II			SIEMENS	MUMBAI	A
		II			CGL	AHMEDNAGAR	A
		II			MARATHON	KOLKATA	A
		II			BBL	MUMBAI	A
					ABB	FARIDABAD/ BANGALORE	A
					JYOTI	VADODARA	A

PROJECT: MAITREE (2×660 M
CONTRACTOR: BHEL –RANIPET
CONT_NO: EPC PACKAGE
Package:

LIST OF ITEMS REQUIRING QUAL' PLAN AND SUBCONTRACTOR APPROVAL
SUB SYSTEM: Electrical,C&I

Ref No:
Date: 13.12.2015

		II			LHP	SOLAPUR	A
					NGEF	HUBLI	A
12	XLPE/PVC INSULATED LT POWER CABLES				REFER SEPARATE LIST		
13	PVC INSULATED LT CONTROL CABLES				REFER SEPARATE LIST		
14	SCREENED (INSTRUMENT) CABLES	II			POLYCAB	DAMAN	A
		II			ELKAY TELELINKS	FARIDABAD	A
		II			ADVANCE CABLES	BANGALOR E	A
		II			PARAMOUNT	KHUSKHERA	A
		II			UNIVERSAL	SATNA	A
		II			NICCO	KOLKATA	A
		II			DELTON	FARIDABAD	A
		II			INCAB	PUNE	A
		II			THERMO CABLES	HYDERABAD	A
		II			KEI	BHIWADI	A
		II			CORDS	BHIWADI	A
		II			GUPTA POWER INFRASTRUCTURE LTD.	KHURDA	A
		II			CMI	BHIWADI	A
		II			SPECIAL CABLES	RUDRAPUR	A
		II			LAPP CABLES	BANGALORE	A
		II			KEC	MYSORE	A
		II			GENERAL CABLES	BADDI	A
15	AUXILIARY CONTROL PANEL/ LTMSB				REFER SEPARATE LIST		

13/12/2015

CONTRACTOR:
CONT_NO:
Package:

MAITREE (2×660 M
BHEL –RANIPET
EPC PACKAGE

LIST OF ITEMS REQUIRING QUAL PLAN AND SUBCONTRACTOR APPROVAL
SUB SYSTEM: Electrical,C&I

Ref No:
Date: 13.12.2015

16	ELECTRICAL ACTUATOR (WITH GEAR BOX ALSO)	II				DREHMO	GERMANY	A	
		II				AUMA	GERMANY	A	
		II				ROTORK	CHENNAI/ BANGALORE	A	
		II				ROTORK	UK	A	
		II				LIMITORQUE	FARIDABAD	A	
		II				AUMA INDIA	BANGALORE	A	
17	GEARED MOTOR	III				SHANTI GEARS LTD	COIMBATORE	A	
		III				NEW ALLENBERY WORKS	KOLKATA	A	
		III				LAXMI HYDRAULIC PVT. LTD.	SHOLAPUR	A	
		III				POWERBUILD	VV NAGAR	A	
18	DISCONNECTING SWITCH FOR ESP	III				BHEL APPROVED VENDORS			INSULATOR MAKE SHALL BE BHEL/ WSI/ JSI/ UCE/ ADITYA BIRLA
19	HEATING ELEMENT (TUBULAR) FOR ESP	III				BHEL APPROVED VENDORS			
20	INTERLOCKS FOR ESP	III				BHEL APPROVED VENDORS			
21	PERSONNEL COMPUTER FOR ESP	III				BHEL APPROVED VENDORS			
22	PRINTER FOR ESP	III				BHEL APPROVED VENDORS			
23	THERMOSTAT FOR ESP	III				BHEL APPROVED VENDORS			
24	LIMIT SWITCH WITH LEVER FOR GATES & DAMPERS	III				BHEL APPROVED VENDORS			
25	JUNCTION BOXES FOR GATES & AMPERS	III				BHEL APPROVED			

PROJECT: CONTRACTOR: CONT_NO: Package:	MAITREE (2×660 M BHEL –RANIPET EPC PACKAGE	LIST OF ITEMS REQUIRING QUAL PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: Electrical,C&I	Ref No: Date: 13.12.2015

					VENDORS			
26	OTHER ITEMS LIKE PC TERMINATION BOX, PC ADD ON CARD SIMULATOR FOR ARECA, COMCON INTERFACE MODULE, PC	III			BHEL APPROVED VENDORS			
27	FQP FOR ELECTRICAL ITEMS	I			BHEL	RANIPET		

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13/12/2015

	PROJECT : Maitree STPP (2 x 660 MW) PACAKGE : EPC Sub Package: FGD CONTRACTOR : M/S BHEL CONT. NO.	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE : 13th December 2015

S.NO.	Item	QAP/ INSP. CAT	QAP No.	Proposed Supplier	Place of Manufacturing	Approval Status	Remarks
1	FGD absorber recirculation pumps	II		Dutching Pumpen	Germany	A	
				Xiangyang WuErWu pump Industry Co. Ltd	China	A DR	
				Andritz	India	A	
				Metso	India	A	
				Weir Minerals	India	A	
2	Oxidation blower	I		ITO blowers	Japan	A	
				Aerzen Machines (India) Pvt. Ltd	India	A	
				General Energy Management system (P) Ltd	India	A	
3	MV motors for oxidation blower, FGD pumps	II		BHEL	India	A	
4	Limestone mills	II		Cemtec	India	A	
				Fismidth	India	A	
				Metso Mineal Industries	India	A	
				ThyssenKrupp Fordertechnik	Germany	A	
				Christian Pfeiffer Maschinenfabrik GmbH	Austria	A	
5	Gypsum dewatering	II		Fismidth	India	A	
				Shangai XuHe Environmental Technology Co. Ltd	China	A	
				Tenova Delkor	India	A	

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BIFPCL	PROJECT : Maitree STPP (2 x 660 MW) PACAKGE : EPC Sub Package: FGD CONTRACTOR : M/S BHEL CONT. NO.	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE : 13th December 2015

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BHEL INTERNATIONAL OPERATIONS DIVISION

BHEL INTERNATIONAL OPERATIONS DIVISION

13/12/2015

BIFPCL 2 of 2 ENGINEERING DIV / QAI CONTRACTOR 12/13/2015

BIFPCL	PROJECT : MAITREE (2X660 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL	REF. NO.:
	PACKAGE : EPC	PACKAGE	REV. NO.: 00
	CONTRACTOR : BHEL	SUB-SYSTEM: BHEL TRICHY, EDN	
	CONTRACT NO. :		DATE: 12TH DECEMBER 2015

SL. NO.	ITEM	QP/ INSP. CAT.	QP. NO.	QP. SUBMISSION SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
1	LT MOTORS (REFER NOTE 1)	I				KEC	BANGALORE/ HUBLI	A			HUBLI UPTO 90 KW, RQP
		I				SIEMENS	MUMBAI	A			RQP
		I				CGL	AHMEDNAGAR	A			RQP
		I				MARATHON	KOLKATA	A			RQP
		I				BBL	MUMBAI	A			RQP
		I				ABB	FARIDABAD/ BANGALORE	A			FARIDABAD UPTO 55 KW, BANGALORE ABOVE 55 KW, RQP
		I				JYOTI	VADODARA	A			
		I				LHP	SOLAPUR	A			
		I				NGEF	HUBLI	A			UPTO 15 KW
2	LT MCC / ACDB/ DCDB/ MLDB/ LP					REFER SEPARATE LIST					
3	CONTROL PANEL (NON PLC/ NON MOSAIC TYPE)					REFER SEPARATE LIST					
4	XLPE INSULATED LT POWER CABLES					REFER SEPARATE LIST					

ENGINEERING DIV/ QAI

BIFPCL	PROJECT : MAITREE (2X660 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL	REF. NO.:
	PACKAGE : EPC	PACKAGE	REV. NO.: 00
	CONTRACTOR : BHEL	SUB-SYSTEM: BHEL TRICHY, EDN	
	CONTRACT NO. :		DATE: 12TH DECEMBER 2015

SL. NO.	ITEM	QP/ INSP. CAT.	QP. NO.	QP. SUBMISSION SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
5	PVC INSULATED LT POWER CABLES					REFER SEPARATE LIST					
6	PVC INSULATED LT CONTROL CABLES					REFER SEPARATE LIST					
7	ELEVATORS	I				ECE	GHAZIABAD	A			
		I				TECHNO INDUSTRIES	AHMEDABAD	A			
		I				OTIS	MUMBAI	A			
		I				OMEGA	AHMEDABAD	A			
		I				SAMIL ELTEC	KOREA	A			
		I				KONE	CHENNAI	A			
		I				JOHNSON	CHENNAI	DR			
		I				SCHINDLER	MUMBAI	DR			
		I				THYSSEN KRUPP	GERMANY / INDIA	DR			
8	FLAME PROOF ENCLOSURE	III				BALIGA	CHENNAI	A			
		III				FLEXPRO	NAVSARI	A			
		III				AJMERA	MUMBAI	A			

ENGINEERING DIV/ QAI

BIFPCL	PROJECT : MAITREE (2X660 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL PACKAGE	REF. NO.:
	PACKAGE : EPC	SUB-SYSTEM: BHEL TRICHY, EDN	REV. NO.: 00
	CONTRACTOR : BHEL		
	CONTRACT NO. :		DATE: 12TH DECEMBER 2015

SL. NO.	ITEM	QP/ INSP. CAT.	QP. NO.	QP. SUBMISSION SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
9	DC MOTOR (REFER NOTE 1)	I				KEC	BANGALORE/ HUBLI	A			
		I				CGL	AHMEDNAGAR	A			
10	FRACTIONAL HP MOTORS (REFER NOTE 2)					BHELAPPROVED SOURCES					

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BIFPCL	PROJECT : MAITREE (2X660 MW)	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL PACKAGE	REF. NO.:
	PACKAGE : EPC	SUB-SYSTEM: BHEL TRICHY, EDN	REV. NO.: 00
	CONTRACTOR : BHEL		
	CONTRACT NO. :		DATE: 12TH DECEMBER 2015

SL. NO.	ITEM	QP/ INSP. CAT.	QP. NO.	QP. SUBMISSION SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS

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BIFPCL	PROJECT: Maitree (2x660MW) Package: EPC CONTRACTOR: BHEL CONT NO:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: Steam Generator/RAW MATERIAL S	Ref No: Revision No: 00 Date: 13.12.15

SR NO	ITEM	QP /INS-PN CAT *	QP NO. 9560-102-2	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
1	SEAMLESS TUBES	S				TUBOS REUNIDOS	SPAIN	A			CS, T-11, T-22, T-23, T-91
		S				Vallorec & Mannesmann	Germany	A			T-92, T-91, T-23, T-22, T-11, CS
		S				Vallorec & Mannesmann	France	A			T-92, T-91, T-23, T-22, T-11, CS
		S				TENNARIS GLOBAL (NKK TUBES)	JAPAN	A			T-91, T-22, T-11, CS
		S				HENGYANG VALIN STEEL TUBE CO	CHINA	A			CS, T-11, T-22 (Note-5 WITH TPI)
		S				TENNARIS GLOBAL (DALMIN ITALY)	ITALY	A			T-22, T-11, CS
		S				JIANGSU CHENGDE STEEL TUBE SHARE	CHINA	A			CS & AS UPTO T-22 (Note-5 WITH TPI)
		S				JFE (KAWASAKI)	JAPAN	A			T-92, T-91, T-22, T-11, CS
		S				TENNARIS GLOBAL (SILCO, ROMANIA)	ROMANIA	A			CS, T-11, T-22, T-23, T-91
		S				CHANGZHOU CHANGBAO PRECISION	CHINA	A			CS
		S				PRODUCTUS TUBLARES	SPAIN	A			T-91, T-22, T-11, CS
		S				SUMITOMO METALS	JAPAN	A			T-92, T-91, T-23, T-22, T-11, CS
		S				BENTLER	Germany	A			T-92, T-91, T-22, T-11, CS, SS
		S				IBF	ITALY	A			T-91, T-22, T-11, CS

SR NO	ITEM	QP /INS--PN CAT *	QP NO. 9560-102-2	QP SUB-MISSION SCHEDU-LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHED ULE	SC APPL SCHED ULE	REMARKS
1	SEAMLESS TUBES	$				WAYMAN GORDAN	USA	A			T-91, T-22, T-11, CS
		$				BHEL SSTP	TRICHY	A			T22, T11, CS
		$				JINDAL SAW LTD	NASHIK	A*			CS, T-11, T-22 Sub to Conditions
		$				REMI	INDIA	A*			CS, T-11, T-22 Sub to Conditions
		$				ISMT	Ahmednagar/ Baranuti	A*			CS, T-11, T-22 Sub to Conditions
		$				MSL	RAIGAD	A*			CS Sub to Conditions
		$				BAOSHAN IRON & STEEL CO LTD	CHINA	A*			CS, T-11, T-22 (Note-5 WITH TPI)
		$				HMT	GUJRAT	DR			CS
		$				CHANGZHOU CHANGBAO PRECISION	CHINA	DR			ALLOY UPTOT-22
2	SEAMLESS TUBES (RIFLED)	$				SALZGITTER MANESSAMANN PRECISION	FRANCE	A			CS
		$				CHANGZHOU CHANGBAO PRECISION	CHINA	DR			
		$				BAOSHAN STEEL	CHINA	DR			
		$				TENNARIS GLOBAL (DALMINE)	ITALY	DR			
		$				SUMITOMO	JAPAN	DR			
		$				TUBOS REUNIDOS	SPAIN	DR			
3	SEAMLESS TUBES (SS)	$				KOBE	JAPAN	A			SS 304, SS 347H
		$				POSCO SPL STEEL CO	KOREA	A			SS 304, 347H, SUPER 304
		$				TUBACEX	SPAIN	A			

SR NO	ITEM	QP /INS-PN CAT *	QP NO. 9560-102-2	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
3	SEAMLESS TUBES (SS)	$				SMST	ITALY	A			SS 304, 347H, SUPER 304
	SEAMLESS TUBES (SS) UPTO DIA < 76.1 MM	$				SUMITOMO METAL IND LTD	JAPAN	A			SS 304, SS 347H, SUPER 304
	SEAMLESS TUBES (SS) UPTO OD 159.0MM & WT - 12.5MM	$				HUADI STEEL GROUP	CHINA	A			SS 304, 304H, 347H (Note-5 WITH TPI)
		$				ZHEJIANG JIULI HI TECH	CHINA	A			SS 304, 304H, 347H (Note-5 WITH TPI)
4	SEAMLESS PIPES	$				TUBACEX	SPAIN	A			SS PIPES
		$				SUMITOMO METALS	JAPAN	A			P-92, P-91, P-22, P-11, CS
		$				Vallorec & Mannesmann	France	A			P-92, P-91, P-22, P-11, CS
		$				HENGYANG VALIN STEEL TUBE CO	CHINA	A			CS
		$				BHEL SSTP	TRICHY	A			CS
		$				Yangzhou Chengde Steel Pipe Co Ltd	CHINA	A			CS
		$				TUBOS REUNIDOS	SPAIN	A			P-91, P-22, P-11, CS
		$				VALCONVY TRUB CHOMUTOV	CZECH REP	A			CS, P11, P22
		$				ARCELOR MITTAL	ROMANIA	A			CS
		$				WAYMAN GORDAN	USA	A			P-91, P-22, P-11, CS
		$				TENNARIS GLOBAL (NKK TUBES)	JAPAN	A			P-91, P-22, P-11, CS
		$				IBF SPA	ITALY	A			P-92, P-91, P-22, P-11, CS
		$				JFE (KAWASAKI)	JAPAN	A			P-92, P-91, P-22, P-11, CS

SR NO	ITEM	QP /INS-PN CAT*	QP NO. 9560-102-2	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
4	SEAMLESS PIPES	$				PRODUCTUS TUBLARES	SPAIN	A			P-91, P-22, P-11, CS
		$				Vallorec & Mannesmann	Germany	A			P-92, P-91, P-22, P-11, CS
		$				TENNARIS GLOBAL (Dalmine)	Italy	A			P-91, P-22, P-11, CS
		$				JINDAL SAW LTD	NASHIK	A*			CS, P-11, P-22, Sub to Conditions
		$				ISMT	Ahmednagar/ Baramati	A*			CS, P-11, P-22, Sub to Conditions
		$				Yangzhou Chengde Steel Pipe Co Ltd	CHINA	A*			P-11, P-22 (Sub to Conditions)
		$				MSL	RAIGAD	A*			CS Sub to Conditions
		$				REMI	BHARUCH	A*			CS, P-11, P-22, Sub to Conditions
		$				RATNAMANI	MUMBAI	DR			CS
		$				ZIZIANG GROSS	CHINA	DR			CS
	SEAMLESS PIPES (DIA UPTO 159 MM)	$				TENNARIS GLOBAL (SILCO TUBES)	ROMANIA	A			P-91, P-22, P-11, CS
	SEAMLESS PIPES (UPTO 160 MM)	$				BENTLER	Germany	A			P-92, P-91, P-22, P-11, CS
	SEAMLESS PIPES (UPTO 219.O MM)	$				JIANGSU CHENGDE STEEL TUBE SHARE	CHINA	A			CS & AS UPTO P-22 (Note-5 WITH TPI)
	SEAMLESS PIPES (UPTO 88.9 MM)	$				BAOSHAN IRON & STEEL CO LTD	CHINA	A*			CS
	SEAMLESS PIPES (UPTO OD 914 X WT 102 MM)	$				RINGMIL	ITALY	A			FORGED CS PIPE
5	PLATES & ROLLED SECTION (UPTO GRADE 91)	$				INDUS STEEL BELGIUM	BELGIUM	A			CS, SA515, AS UPTO Gr-91

SR. NO	ITEM	QP /INS--PN CAT*	QP NO. 9560-102-2	QP SUB-MISSION SCHEDU-LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHED ULE	SC APPL SCHED ULE	REMARKS
7	PLATES & ROLLED SECTION (CS)	$				ARCELOR MITTAL GALATI	ROMANIA	A			CS PLATES UPTO 80 MM
		$				JSW STEEL LTD	INDIA	A			STRUCTURAL STEEL
		$				RINL	INDIA	A			STRUCTURAL STEEL
		$				PSSAR STEEL LTD	INDIA	A			STRUCTURAL STEEL
		$				TISCO	INDIA	A			STRUCTURAL STEEL
		$				LIYODS STEEL INDS LTD (UTTAM VALUE STEEL)	INDIA	A			STRUCTURAL STEEL
		$				JSPAT INDUSTRIES LTD	INDIA	A			STRUCTURAL STEEL
		$				JSPL	INDIA	A			STRUCTURAL STEEL
		$				SAIL	INDIA	A			STRUCTURAL STEEL
		$				AZOVSTAL	UKARAINE	DR			
8	PLATES (SS)	$				OUTOKUMPU	SWEDEN	A			SS PLATES UPTO 20 MM THK
		$				INDUSTEEL BELGIUM	BELGIUM	A			GR-304, 309, 310, 316
		$				JSL STAINLESS	JAJPUR	A			LINER SS 304
		$				INDUSTEEL LOIRE	FRANCE	A			GR-304, 309, 310, 316
		$				SAIL	BHILAI / SALEM	A			GR-304, 309, 310, 316
		$				COLUMBUS STAINLESS STEEL (ACRINOX)	SOUTH AFRICA	A			GR-304, 309, 310, 316
		$				NIPPON STEEL CORP	JAPAN	DR			

SR - NO	ITEM	QP /INS- -PN CAT -	QP NO. 9569-102-2	QP SUB-MISSION SCHEDU -LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB- SCHED ULE	SC APPL SCHED ULE	REMARKS
8	PLATES (SS)	$				THYSEEN KRUPP	GERMANY	DR			
		$				SUMITOMO	JAPAN	DR			
		$				ACRONI SLOVENIS	JAPAN	DR			
		$				DKC	KOREA	DR			

SR - NO	ITEM	QP /INS- -PN CAT *	QP NO. 9560-102-2	QP SUB-MISSION SCHEDU -LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHED ULE	SC APPL SCHED ULE	REMARKS

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PROJECT : Maitree STPP (2 x 6[illegible] MW) PACAKGE : EPC Sub Package: Steam Generator (BHEL-Trichy)-Additional CONTRACTOR : M/S BHEL CONT. NO.	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : REVISION NO. 00 DATE : 13th December 2015

S.No	ITEM	QP / Insp Cat.	QP No.	Proposed Sub-Supplier	Place	Sup' approval status / cat	Remarks
1.	SEAMLESS PIPES			JIANGSU CHENGDE STEEL TUBE	CHINA	DR	FOR CS GRADE
2.	SEAMLESS PIPES			YANGZHOU CHENGDE STEEL TUBE CO LTD	CHINA	DR	FOR CS GRADE
3.	SEAMLESS PIPES			HENGYANG	CHINA	DR	FOR P12,P22 & P91 GRADE
4.	SEAMLESS PIPES			ZIZIANG GROSS	CHINA	DR	FOR CS,AS & P91 GRADE
5.	SEAMLESS TUBES			JANGSU WUJIN STAINLESS STEEL PIPE	CHINA	DR	FOR SS304,304H,347H GRADE
6.	Gratings & Platforms			PINAX STEEL INDUSTRIES PVT.LTD	India	DR	
7.	Gratings & Platforms			VINFAB ENGINEERS INDIA PVT LTD	India	DR	
8.	Gratings & Platforms			ANKIT ELECTROGRATING	India	DR	
9.	Light Bonded Mineral Wool			POLYBOND INSULATION PVT.LTD	India	DR	
10.	Castable Refractory			ABS REFRACTORIES PVT.LTD	India	DR	
11.	Castable Refractory			INDUSTRIAL ASSOCIATES	India	DR	
12.	Castable Refractory			CASTWEL INDUSTRIES	India	DR	
13.	Pourable Insulation			ABS REFRACTORIES PVT.LTD	India	DR	
14.	Pourable Insulation			INDUSTRIAL ASSOCIATES	India	DR	
15.	Pourable Insulation			CASTWEL INDUSTRIES	India	DR	
16.	HEA Ignitor			FIVES COMBUSTION SYSTEMS PVT. LTD	India	DR	
17.	Control Valve for Start up system			KOSO INDIA PRIVATE LIMITED	India	DR	
18.	Control Valve for Start up system			CONTROL COMPONENT INDIA PVT LTD	India	DR	
19.	Control Valve for Soot blower pressure reducing, SH/RH			CONTROL COMPONENT INDIA PVT LTD	India	DR	

BIFPCL 1 of 1 ENGINEERING DIV / QAI CONTRACTOR 12/14/2015

SR - NO	ITEM	QP /INS- -PN CAT *	QP NO. 9560-102-2	QP SUB- MISSION SCHEDU -LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB- SCHED ULE	SC APPL SCHED ULE	REMARKS
31	HANGER & SUPPORTS - (Other than CLH & VLH)	I				BHEL	TRICHY	A			
32	SNUBBERS	III				PIPE SUPPORTS	U K	N			
		III				CARPENTER PATTERSON	U K	N			
		III				SANWA TAKI	JAPAN	N			
		III				LEEGA	GERMANY	N			
		III				ITT GRINELL	GERMANY	N			
33	CONVENTIONAL VALVES (Gate, Globe & check) BHEL RANGE	I				BHEL	TRICHY	A			
34	OTHER VALVES (2/3 WAY VALVES) BHEL RANGE	I				BHEL	TRICHY	A			
35	CONVENTIONAL VALVES (Gate, Globe & check) OTHER THAN BHEL	I				VELAN	H4T1X8 Montreal Canada	A			Gate/Check v/v upto 22"Cl 2500
		I				LEADER VALVES	JALANDHAR	A			CCS Globe v/x 24"Cl 600, Globe v/v 24"Cl 300, Check v/v 24"Cl600
		I				CRESCENT VALVES	MUMBAI	A			UPTO NB 300 CL 600
		I				VELAN VALVE CORP	USA	A			Gate v/v 2-24"Cl 900-4500, Cast Steel Gate v/v 18-48"Cl 150-600
		I				VELAN	UK	A			1) Globe v/v 1/4"-2"Cl 4500, 2) Bonnetless Globe v/v 1/2-2.5"Cl 150-600
		I				VELAN	Qubec Canada	A			Gate/Globe/Check v/v upto 3"Cl 2680

Bangladesh-India Friendship Power Company (Pvt.) Ltd. BIFPCL

BHEL अंतर्राष्ट्रीय परिचालन प्रभाग INTERNATIONAL OPERATIONS DIVISION New Delhi-3 (India)

SR. NO	ITEM	QP /INS--PN CAT*	QP NO. 9560-102-2	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
35	CONVENTIONAL VALVES (Gate, Globe & check) OTHER THAN BHEL	1				L&T VALVES	COIMBTORE	A			1) CAST 2500 CL: Gate(CS&AS)upto 20"& Check(CS&AS) upto 16", 2) Forged 4500 Cl (CS&AS) Gate upto 1"&Globe/Check upto 2"
		1				BDK	HUBLI	A			UPTO NB 300 & CL600,FORGED UPTO NB 50 CL 800
		1				FOURESS ENGG. INDIA LTD.	MUMBAI	A			UPTO NB 200 CL 600; NB 250-600 CL 300
		1				NITON VALVES	AURANGABAD	A			WCB/WCC (Gate valve upto 36 "Cl 600)
		1				SAMSHIN	SOUTH KOREA	A			2500 Cl Gate/Globe/Check upto 24" ; Cl 3500 Gate upto 18"& Globe upto 6"; 4500 Cl Gate upto 6"& Globe/Check/Angle upto 2"
		1				VELAN	H4T1G2 Montreal Canada	A			Gate/Globe/Check upto 24 "Cl 4500
		1				VELAN	PORTUGAL	A			Cast Steel Gate/Globe/Check 2-12"Cl 150-600
		1				ROCKWELL	USA	A*			
		1				CRIS	FRANCE	A*			
		1				OKANO VALVES	JAPAN	A*			
		1				RAIMONDI	ITALY	A*			
		1				HP VALVES	NETHERLANDS	A*			Trim Valves

SR. NO	ITEM	QP /INS--PN CAT *	QP NO. 9560-102-2	QP SUB-MISSION SCHEDU-LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHED ULE	SC APPL SCHED ULE	REMARKS
35	CONVENTIONAL VALVES (Gate, Globe & check) OTHER THAN BHEL	1				FLOW SERVE	USA	A*			
		1				DRESSER MASONEILAN	USA	A*			
		1				OKANO VALVES	JAPAN	A*			
		1				TOA	JAPAN	A*			
		1				CRIS	FRANCE	A*			
		1				TYCO SEMPELL	GERMANY	A*			
		1				MIL CONTROLS	KERALA	A*			
		1				FOURESS INDIA	INDIA	A*			
		1				DEUTSCHE BABCOCK	GERMANY	A*			
		1				KSB	COIMBTOR E	A*			
		1				SPX PROCESS EQUIPMENTS / COPES VULCAN	USA	A*			
		1				TOA/MEIWA	JAPAN	A*			
		1				RAIMONDI	ITALY	A*			
		1				BABCOCK BORSING	ESPANA	A*			
		1				DEWARNCE	UK	A*			
36	SAFETY VALVE (SPRING TYPE)	1				DRESSER	USA	A			
		1				SEMPELL AG	GERMANY	A			
	SAFETY VALVES (SPRING TYPE)	1				TYCO (PENTAIR VALVES & CONTROLS)	USA	A			
		1				FUKUI	JAPAN	A			
		1				RIENEKE GMBH	GERMANY	A			HYD TYPE
		1				BOPP & REUTHER	GERMANY	A			HYD TYPE

SR. NO	ITEM	QP /INS--PN CAT*	QP NO. 9560-102-2	QP SUB-MISSION SCHEDU-LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHED ULE	SC APPL SCHED ULE	REMARKS
36	SAFETY VALVES (SPRING TYPE)	I				VALVE TECHNOLOGIES	USA	A*			
		I				MEIWA	JAPAN	A*			
		I				BHEL	TRICHY	A*			
37	ERV	I				VALVE TECHNOLOGIES	USA	A			BHEL, INDIA IS ALSO ACCEPTABLE
		I				FUKUI	JAPAN	A			
		I				SEMPELL AG	GERMANY	A			
		I				DRESSER	USA	A			
		I				MEIWA CORP	JAPAN	A*			
		I				RIENEKE GMBH	GERMANY	A*			
38	PLUG VALVE	II				FLOWSERVE INDIA CONTROLS	KANCHIPURAM	A			UPTO 150 NB CL 300, UPTO 400 NB CL 150
		II				3Z CORP	KOREA	A*			
		II				BDK	HUBLI	A*			
		II				ZED VALVES CO. PVT. LTD.	AHMEDABAD	DR			
39	SILENCERS	III				BBM ACCOSTIC	PUNE	N			
		III				INDIRA INDUSTRIES	RANIPET	N			
		III				BURGESS MANNING	USA	N			
		III				CCI FLUID KINETICS	USA	N			
		III				CCI	HOSUR	N			
		III				PR ACOUSTIC	TRICHY	N			
40	MAIN & AUX COLUMNS, CEILING GIRDERS, BUILT UP BEAMS	I				BHEL	TRICHY	A			

SR NO	ITEM	QP /INS--PN CAT *	QP NO. 9560-102-2	QP SUB-MISSION SCHEDU-LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHED ULE	SC APPL SCHED ULE	REMARKS

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY BIFPCL)

A - For those items proposed vendor is acceptable to BIFPCL. To be indicated with letter "A" in the list alognwith the condition of approval, if any.

DR - For those items "Detailed Required" for BIFPCL review. To be identified with letter "DR" in the list.

DR* - For those item "Detail Required by BIFPCL for record updation only

NOTED : For these items vendors are approved by Main Supplier and accepted by BIFPCL without specific vendor approval from BIFPCL. To be identified with "NOTED"

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by BIFPCL and final acceptance will be on physical inspection witness by BIFPCL

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CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by BIFPCL shall be on the basis of Certificate of Conformance by main supplier

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SR NO	ITEM	QP /INS-PN CAT *	QP NO. 9561-101	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS /CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
9	RIGIFLEX COUPLING FOR AXIAL FANS	III				KTR COUPLINGS INDIA PVT. LTD.	PUNE	DR			
10	COOLER FOR FAN LOS	III				SOUTHERN LUBRICATION	BANGALORE	A			Upto 200 LPM.
		III				POSITRON	BELGAUM	A			Upto 16 Kg/sq cm. & 225 LPM
		III				RADIANT	PUNE	A*			
		III				REYNOLDS	BELGAUM	A*			
		III				UHE	COIMBATORE	A*			
11	P.A.AXIAL FANS BLADES FORGED	***				TLT	GERMANY	A			
		***				HAL,	BANGALORE	A			
		***				FINE FORGE	HYDERABAD	DR			
12	P.A. AXIAL FANS BLADES CAST	***				HAL,	BANGALORE	A			
		***				TLT	GERMANY	A			
		***				VEDANTA	PUNE	DR			
13	F.D.AXIAL FANS BLADES CAST (SIZE 16)	***				TLT	GERMANY	A			
		***				HAL	BANGALORE	A			
		***				VEDANTA	PUNE	DR			
14	F.D.AXIAL FANS BLADES FORGED (SIZE 16)	***				HAL	BANGALORE	A			
		***				TLT	GERMANY	A			
		***				FINE FORGE	HYDERABAD	DR			
15	SCREW PUMP FOR LOS	III				LEISTRITZ	GERMANY	A			

13/12/2015

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15	SCREW PUMP FOR LOS	III				ALEKTON	CHENNAI	A			
		III				KRAL	AUSTRIA	A			
		III				TUSHACO (DELTA),	DAMAN	A*			
		III				DELTA PD PUMPS PVT. LTD.	MUMBAI	DR			
		III				UT PUMPS	FARIDABAD	DR			
16	EMITTING ELECTRODE FOR ESP	II				SIVA SPRINGS	MADURAI	A			
		II				VENKATESWARA STEEL & SPRINGS (INDIA) PVT LTD	COIMBATORE	A			
		II				NAGAPPASPRINGS	RANIPET	A			
		II				KWALITY COILS	MADURAI	A			
		II				BEST COILS	RANIPET	A*			
17	COLLECTING ELECTRODE FOR ESP	II				BHEL	RANIPET	A			
18	COLUMNS OF ESP SUPPORTING STRUCTURES	I				BHEL &NTPC APPD SUBCONTRACTORS WITH BHEL MATERIAL	RANIPET	A			
19	ROOF BEAMS	I				BHEL &NTPC APPD SUBCONTRACTORS WITH BHEL MATERIAL	RANIPET	A			
20	COLLECTING/ EMMITTING ELECTRODE SUSPENSION ASSY	II				BHEL &NTPC APPD SUBCONTRACTORS WITH BHEL MATERIAL	RANIPET	A			
21	ELECTRICLLY OPERATED HOIST FOR ESP-3 TON CAPACITY	III				BHEL &NTPC APPD SUBCONTRACTORS WITH BHEL MATERIAL	RANIPET	A			

13/12/2013

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Signature

ENGINEERING DIV / QAI

S. No.	Package	PMD Vendor/ Sub Vendor	Vendor Address
1	LV MOTORS (NON FLAME PROOF)	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003
2	LV MOTORS (NON FLAME PROOF)	BHARAT BIJLEE LTD.	BHARAT BIJLEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK, PUSA ROAD, NEW DELHI - 110 060.
3	LV MOTORS (NON FLAME PROOF)	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA
4	LV MOTORS (NON FLAME PROOF)	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032
5	LV MOTORS (NON FLAME PROOF)	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055
6	LV MOTORS (NON FLAME PROOF)	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA
7	LV MOTORS (NON FLAME PROOF)	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006
8	LV MOTORS (NON FLAME PROOF)	NGEF	POCKET NO.10, FLAT NO. 37 & 38, EXPANDABLE DDA FLATS, NASIRPUR DWARKA, PHASE-I NEW DELHI-110 045
9	LV MOTORS (NON FLAME PROOF)	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053
10	LV MOTORS (NON FLAME PROOF)	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA
11	LV MOTORS (FLAME PROOF)	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053
12	JUNCTION BOXES (NON FLAME PROOF)	JASPER ENGNIREES PVT. LTD.	A-23, SECTOR - 8, NOIDA-201301
13	JUNCTION BOXES (NON FLAME PROOF)	Electro Controls & Devices	M/S ELECTRO CONTROLS & DEVICES, F-41, SITE-C, SURAJPUR INDUSTRIAL AREA GREATER NOIDA, UTTAR PRADESH :201308
14	JUNCTION BOXES (NON FLAME PROOF)	M/s Shrenik & Co.	39A/3, PANCHRATNA INDUSTRIAL ESTATE, SARKHEJ-BAVLA ROAD, CHANGODAR, AHMEDABAD – 382 213
15	JUNCTION BOXES (NON FLAME PROOF)	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115
16	JUNCTION BOXES (NON FLAME PROOF)	Adroit Control Engineers Pvt.Ltd.	M/S ADROIT CONTROL ENGINEERS PVT.LTD. PLOT-3, KRISHNA INDL. AREA, SECTOR-25 FARIDABAD – 121004
17	JUNCTION BOXES (NON FLAME PROOF)	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115
18	JUNCTION BOXES (NON FLAME PROOF)	MIKA ENGINEERS	BRANCH OFFICE : 'D'-101, DHEERAJ HERITAGE RESIDENCY II, SHASTRI NAGAR, SANTACRUZ (W), MUMBAI 400 054.
19	JUNCTION BOXES (NON FLAME PROOF)	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115
20	JUNCTION BOXES (NON FLAME PROOF)	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049
21	JUNCTION BOXES (NON FLAME PROOF)	AJMERA INDUSTRIES & ENGG. WORKS	AJMERA INDL. AND ENGG. WORKS. AJMERA HOUSE, A-61 / KHAIRANE MIDC. , TTC INDL. AREA, NAVI MUMBAI – 400705.
22	JUNCTION BOXES (NON FLAME PROOF)	S.B. ELECTRICAL ENGINEERING CORPORATION	03, SARDAR GRIHA BUILDING, LOHAR CHAWAL, MUMBAI-400002

23	JUNCTION BOXES (FLAME PROOF)	SUDHIR SWITCHGEAR	305/6, APEEJAY HOUSE, 130, BOMBAY SAMACHAR MARG, MUMBAI - 400 023. INDIA
24	FRP CABLE TRAYS & ACCESSORIES	EPP COMPOSITES PRIVATE LIMITED	Mr. Jayraj Shah Plot No. 2646, Kranti Gate Main Road, Rajkot Phone- 02827-287060 Pincode : 360021 Email : vaishalijoshi@epp.co.in
25	FRP CABLE TRAYS & ACCESSORIES	SUMIP COMPOSITES PVT.LTD.	Mr.Suhrud Shah/Mr.Pulin Shah 39-A Panch Ratna Industrial Estate Sarkhej-Bavla Road. Changodar Ahmedabad Phone- 0271-7610701 Pincode : 382213 Email : sales@sumip.com
26	FRP CABLE TRAYS & ACCESSORIES	ERCON COMPOSITES	Mr. Mukesh Maheshwari F-123, M.I.A., Phase-II, Basni, Jodhpur Phone- 0291-2744064 Pincode : 342005 Email : ercon@ercon-india.com
27	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	PREMIER POWER PRODUCTS (CAL) PVT. LTD.	Chatterjee International Centre, 33A, Jawaharlal Nehru Road, 6th Floor, Suit No. - 11A, Kolkata, Phone-9331008739 Pincode : 700071 Email : pppdaga@airtelmail.in
28	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	INDUSTRIAL PERFORATION (I) PVT.LTD.	MR. A. K. SAHA 327, R.N.GUHA ROAD, DUM DUM KOLKATA Phone- 9830241788 Pincode : 700028 Email : ipipl@cal2.vsnl.net.in
29	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	MR. G.D. SINGHEE/MR. MAHESH SINGHEE 26, P.K. TAGORE STREET, MAIN BUILDING KOLKATA Phone-9830177331 Pincode : 700006 Email : mahesh@ratans.com
30	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	INDMARK FORMTECH PVT. LTD.	Mr. Narendra R. Meher J Block, Plot No.-375, MIDC BHOSARI PUNE Phone- 020-27130546 Pincode : 411026 Email : indmarkformtech@vsnl.net
31	CABLE GLANDS	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA
32	CABLE GLANDS	ARUP ENGG & FOUNDARY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068
33	CABLE GLANDS	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018
34	CABLE GLANDS	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063
35	CABLE GLANDS	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
36	CABLE GLANDS	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI-400059
37	CABLE GLANDS	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001
38	CABLE LUGS	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
39	CABLE LUGS	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA-700001
40	GI CONDUITS	BIS APPROVED MAKE	

SUB-VENDOR LIST FOR **C&I**
2X660 MW MAITREE STPP- BANGLADESH

Sl No	Package Code	Package Name	Supplier Name	Tech Limit
1	145-04000-A	CONTROL VALVE	FORBES MARSHALL ARCA PVT.LTD.	No technical limit exists except for feed control valve. For feed control valves, approved up to sub-critical power plants of 600 MW rating.
2	145-04000-A	CONTROL VALVE	INSTRUMENTATION LTD.	
3	145-04000-A	CONTROL VALVE	Koso India Private Limited,	
4	145-04000-A	CONTROL VALVE	BOMAFA SPECIAL VALVE SOLUTIONS PVT LTD	
5	145-04000-A	CONTROL VALVE	KSB MIL CONTROLS LTD.	
6	145-04000-A	CONTROL VALVE	SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD.	
7	145-04000-A	CONTROL VALVE	WALDEMAR PRUSS ARMATURENFABRIK GMBH	
8	145-04000-A	CONTROL VALVE	Mascot Valves Pvt. Ltd.	
9	145-04000-A	CONTROL VALVE	R.K.CONTROL INSTRUMENTS PVT. LTD.	For subcritical power plant up to 150MW
10	145-04000-A	CONTROL VALVE	Valvitalia S.P.A. ,	
11	145-04000-A	CONTROL VALVE	PARCOL S.p.A	
12	145-04000-A	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	
13	145-04000-A	CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD	
14	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	
15	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	
16	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	
17	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	
18	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	
19	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	
20	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	
21	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	
22	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	
23	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	
24	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	
25	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	
26	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	
27	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	
28	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	
29	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	

30	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	
31	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	
32	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	
33	145-10000-A	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	
34	145-10000-A	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	
35	145-10000-A	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	
36	145-10000-A	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	
37	145-10000-A	TEMPERATURE GAUGE	H.GURU INDUSTRIES	
38	145-10000-A	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	
39	145-10000-A	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	
40	145-10000-A	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	
41	145-10000-A	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	
42	145-11000-A	LEVEL GAUGE	BLISS ANAND PVT. LTD.	
43	145-11000-A	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	MAKE:NIVO CONTROLS
44	145-11000-A	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	
45	145-12000-A	FLOW ELEMENT	MICRO PRECISION PRODUCTS PVT. LTD.	
46	145-12000-A	FLOW ELEMENT	TM TECNOMATIC SPA	
47	145-12000-A	FLOW ELEMENT	STAR-MECH CONTROLS (I) PVT.LTD.	
48	145-12000-A	FLOW ELEMENT	INSTRUMENTATION LTD.	
49	145-13000-A	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	
50	145-13000-A	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	
51	145-13000-A	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	
52	145-13000-A	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	
53	145-13000-A	TEMP. ELEMENT	TECHNO INSTRUMENTS	
54	145-13000-A	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	
55	145-13000-A	TEMP. ELEMENT	TM TECNOMATIC SPA	
56	145-13000-A	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	
57	145-13000-A	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	
58	145-13000-A	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	
59	145-13000-A	TEMP. ELEMENT	Nesstech Instruments Private Limited	

60	145-13000-A	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	
61	145-14000-A	TRANSMITTERS	ABB LIMITED	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER
62	145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	Only for capacitance Type Level Transmitter
63	145-14000-A	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS
64	145-14000-A	TRANSMITTERS	Moore Industries International Inc.	
65	145-14000-A	TRANSMITTERS	PANAM ENGINEERS	For Pressure and Diff. Pressure transmitter
66	145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	
67	145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	
68	145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	
69	145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	FOR CAPACITANCE TYPE.
70	145-14000-A	TRANSMITTERS	SIEMENS LIMITED	
71	145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	
72	145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.
73	145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	For Capacitance type only
74	145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	
75	145-25000-A	JUNCTION BOX	Shrenik & Company,	
76	145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	
77	145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Metal type junction box only
78	145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	
79	145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	
80	145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	
81	145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	
82	145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	
83	145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	
84	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.	
85	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	Sapcon Instrument Pvt Ltd.	
86	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	
87	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	

88	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	Flow Star Engineering Pvt. Ltd.,	
89	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	NIVO CONTROLS PVT. LTD.	For Capacitance type level switch.
90	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	Baumer Technologies India Pvt. Ltd.	
91	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	Pune Techtrol Pvt. Ltd.	
92	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	BLISS ANAND PVT. LTD.	
93	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	SOR INC.	
94	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	LEVCON INSTRUMENTS PVT. LTD.	
95	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	SOR INC.	
96	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	LEVCON INSTRUMENTS PVT. LTD.	
97	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	
98	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.	Vendor shall source import contents of Level Switch (Conductivity Type) from Levelstate Systems Ltd., United Kingdom.
99	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.	Vendor shall source import contents of Level Switch (Conductivity Type) from Mobrey Measurement, an operating unit of Morbey Ltd., Slough, Berkshire, United Kingdom.
100	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	Sapcon Instrument Pvt Ltd.	
101	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	SIGMA INSTRUMENTS CO.	
102	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	BLISS ANAND PVT. LTD.	
103	145-37000-A	LEVEL SWITCH-FLOAT TYPE	SIGMA INSTRUMENTS CO.	
104	145-37000-A	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.	
105	145-37000-A	LEVEL SWITCH-FLOAT TYPE	D.K. INSTRUMENTS PVT.LTD.	
106	145-37000-A	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	
107	145-37000-A	LEVEL SWITCH-FLOAT TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	
108	145-37000-A	LEVEL SWITCH-FLOAT TYPE	LEVCON INSTRUMENTS PVT. LTD.	
109	145-37000-A	LEVEL SWITCH-FLOAT TYPE	GENERAL INSTRUMENTS CONSORTIUM	
110	145-37000-A	LEVEL SWITCH-FLOAT TYPE	Baumer Technologies India Pvt. Ltd.	
111	145-37000-A	LEVEL SWITCH-FLOAT TYPE	SBEM PVT. LTD.	
112	145-37000-A	LEVEL SWITCH-FLOAT TYPE	SOR INC.	
113	145-37000-A	LEVEL SWITCH-FLOAT TYPE	BLISS ANAND PVT. LTD.	
114	145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	
115	145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	
116	145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	
117	145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	
118	145-42000-A	ULTRASONIC FLOW METERS	CHEMTROLS INDUSTRIES PVT. LTD.	For Flexim Fluxus non-invasive ultrasonic flowmeter only;
119	145-42000-A	ULTRASONIC FLOW METERS	Rockwin Flowmeter India Pvt. Ltd.	
120	145-42000-A	ULTRASONIC FLOW METERS	FLASH FORGE PVT LTD	

121	145-42000-A	ULTRASONIC FLOW METERS	NIVUS GMBH	
122	145-43000-A	FLOW ELEMENT - ORIFICE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	
123	145-43000-A	FLOW ELEMENT - ORIFICE	STAR-MECH CONTROLS (I) PVT.LTD.	
124	145-43000-A	FLOW ELEMENT - ORIFICE	TANSA EQUIPMENTS PVT. LTD.	
125	145-43000-A	FLOW ELEMENT - ORIFICE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	
126	145-43000-A	FLOW ELEMENT - ORIFICE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	
127	145-43000-A	FLOW ELEMENT - ORIFICE	MICRO PRECISION PRODUCTS PVT. LTD.	
128	145-43000-A	FLOW ELEMENT - ORIFICE	INSTRUMENTATION LTD.	
129	145-43000-A	FLOW ELEMENT - ORIFICE	HYDROPNEUMATICS PVT. LTD.	
130	145-43000-A	FLOW ELEMENT - ORIFICE	Flow Star Engineering Pvt. Ltd.,	
131	145-43000-A	FLOW ELEMENT - ORIFICE	CHEMTROLS INDUSTRIES PVT. LTD.	
132	145-43000-A	FLOW ELEMENT - ORIFICE	INSTRUMENTATION ENGINEERS PVT LTD	
133	145-44000-A	FLOW ELEMENT - NOZZLE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	except P91 material pipes;
134	145-44000-A	FLOW ELEMENT - NOZZLE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	
135	145-44000-A	FLOW ELEMENT - NOZZLE	HYDROPNEUMATICS PVT. LTD.	
136	145-44000-A	FLOW ELEMENT - NOZZLE	STAR-MECH CONTROLS (I) PVT.LTD.	
137	145-44000-A	FLOW ELEMENT - NOZZLE	INSTRUMENTATION LTD.	
138	145-44000-A	FLOW ELEMENT - NOZZLE	MICRO PRECISION PRODUCTS PVT. LTD.	
139	145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	
140	145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	
141	145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	
142	145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	
143	145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	
144	145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	
145	145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	
146	145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	
147	145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	
148	145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	
149	145-47000-A	ELECTROMAGNETIC FLOW METER	Electronet Equipments Pvt Ltd.	
150	145-47000-A	ELECTROMAGNETIC FLOW METER	Adept Fluidyne Pvt. Ltd.	
151	145-47000-A	ELECTROMAGNETIC FLOW METER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	

ANNEXURE- III

FUNCTIONAL GUARANTEE AND LIQUIDATED DAMAGES

GENERAL

The term "Performance Guarantees" wherever appears in the technical specification shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly, the term "Performance Tests" wherever appears in the technical specification shall have the same meaning and shall be synonymous to "Guarantee Test(s)".

PERFORMANCE GUARANTEES / PERFORMANCE TESTS

GENERAL REQUIREMENTS

1. The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in the specifications.

2. The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.

3. All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.

4. The performance tests shall be performed using only the normal number of BHEL and Customer supplied operating staff. Bidder or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.

5. It shall be responsibility of the bidder to make the plant ready for the performance guarantee / demonstration tests.

6. **Test Instrumentation, Flow Measurement and their Calibration**

   All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the bidder shall get these instruments calibrated in an independent test Institute approved by the BHEL and Customer. All test instrumentation required for performance tests shall be supplied by the bidder and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the BHEL and Customer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

   Tools and tackles, thermowells (both screwed and welded) instruments/ devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the bidder free of cost.

7. The P&G test procedures shall be submitted for equipment/ system & subsystem under Bidder's scope for all Guarantees mentioned below, as per latest International codes/ standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.

8. The Bidder shall submit for BHEL and Customer's approval the detailed Performance Test procedure containing the following:
   a) Object of the test
   b) Various guaranteed parameters & tests as per contract.
   c) Method of conductance of test and test code.
   d) Duration of test, frequency of readings & number of test runs.
   e) Method of calculation.
   f) Correction calculations & curves.
   g) Instrument list consisting of range, accuracy, least count, and location of instruments.

h) Scheme showing measuring points.
i) Sample calculation
j) Acceptance criteria.
k) Any other information required for conducting the test.

The Performance test shall be carried out as per the agreed procedure.

9. Test Reports

After the conductance of Performance test, the bidder shall submit the test evaluation report of Performance test results to BHEL and Customer promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the BHEL and Customer after completing each test run. Six (6) hard copies and two (2) soft copies on CD-ROM of each test report of final conducted test on each equipment/plant/system shall be submitted to BHEL and Customer for approval.

10. The performance guarantee test will be carried out within three months after the successful completion of Initial Operation of facilities or as per the time frame specified for a particular equipment/ plant/ system in the Technical specifications. Delay in conductance of the test beyond this period will not be normally permitted by the BHEL AND CUSTOMER. In the event of BHEL AND CUSTOMER agreeing to conductance of such tests after three months, for reasons not attributable to the BHEL AND CUSTOMER, as assessed by the BHEL and Customer, no factor for ageing shall be considered for computing performance of the equipment.

11. Performance Guarantee Tests on the equipment/systems not covered in this Sub-section shall be carried out as per the procedure/test codes specified in respective detailed section.

12. The guarantee tests shall be conducted by the bidder at site in presence of BHEL/ CUSTOMER. All costs associated with the tests shall be included in the bid price. In case during demonstration test /PG test, it is found that the equipment/system has failed to meet the guarantees, the bidder shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the BHEL/ CUSTOMER and re-conduct the demonstration test(s) / PG test with BHEL/ CUSTOMER's consent.

Functional guarantees included following:

1. TECHNICAL GUARANTEES

1.1 SOLID WASTE MANAGEMENT SYSTEM

The operation and final applicable outlet parameters of the Solid waste management system must meet the applicable all statuary/ applicable pollution control requirements of Government of Bangladesh.

However, in case the guaranteed parameters as per the latest Bangladesh Pollution Control board (BPCB) and other applicable statutory norms of Bangladesh Government is more stringent than the specified parameters then the requirement of BPCB and other applicable statutory requirement of Bangladesh must be followed and guaranteed.

2. NOISE

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in the technical specifications.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969.

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.
Noise level of all pumps and blowers at the rated duty point shall be demonstrated at site.

Attachment G-03

Standards for Water, Sewage, Discharge, Waste

E.C.R.- Schedule-3 ২০৫

SCHEDULE – 3

Standards for Water
[See Rule 12]

(A) Standards for inland surface water

Best Practice based classification	Parameter			
	pH	BOD mg/l	DO mg/l	Total Coliform number/100
a. Source of drinking water for supply only after disinfecting:	6.5-8.5	2 or less	6 or above	50 or less
b. Water usable for recreational activity :	6.5 – 8.5	3 or less	5 of more	200 or less
c. Source of drinking water for supply after conventional treatment :	6.5 – 8.5	6 of less	6 or more	5000 or less
d. Water usable by fisheries:	6.5 - 8.5	6 of less	5 or more	---
e. Water usable by various process and cooling industries :	6.5 – 8.5	10 or less	5 or more	5000 or less
f. Water usable for irrigation:	6.5 - 8.5	10 or less	5 or more	1000 or less

Notes:

1. In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg l.
2. Electrical conductivity for irrigation water 2250 µmhoms cm (at a temperature of 25°C); Sodium less than 26%; boron less than 0.2%.

(B) Standards for drinking water

Sl. No.	Parameter	Unit	Standards
1	2	3	4
1.	Aluminum	mg/l	0.2
2.	Ammonia (NH_3)	,,	0.5
3.	Arsenic	,,	0.05
4.	Balium	,,	0.01
5.	Benzene	,,	0.01

BHEL INTERNATIONAL OPERATIONS DIVISION New Delhi-3 (India)

Bangladesh-India Friendship Power Company (Pvt) Ltd. BIFPCL

Bangladesh-India Friendship Power Company (Pvt) Ltd. BIFPCL

1	2	3	4
6.	BOD, 20°C	,,	0.2
7.	Boron	,,	1.0
8.	Cadmium	,,	0.005
9.	Calcium	,,	75
10.	Chloride	,,	150 – 600*
11.	Chlorinated alkanes		
	carbontetrachloride	,,	0.01
	1.1 dichloroethylene	,,	0.001
	1.2 dichloroethylene	,,	0.03
	tetrachloroethylene	,,	0.03
	trichloroethylene	,,	0.09
12.	Chlorinated phenols		
	- pentachlorophenol	mg/l	0.03
	- 2.4.6 trichlorophenol	,,	0.03
13.	Chlorine (residual)	,,	0.2
14.	Chloroform	,,	0.09
15.	Chromium (hexavalent)	,,	0.05
16.	Chromium (total)	,,	0.05
17.	COD	,,	4
18.	Coliform (fecal)	n 100 ml	0
19.	Coliform (total)	n 100 ml	0
20.	Color	Hazen unit	15
21.	Copper	mg/l	1
22.	Cyanide	,,	0.1
23.	Detergents	,,	0.2
24.	DO	,,	6
25.	Fluoride	,,	1
26.	Hardness (as $CaCO_3$)	,,	200 500
27.	Iron	,,	0.3 – 1.0
28.	Kjeldhl Nitrogen (total)	,,	1
29.	Lead	,,	0.05

E.C.R.- Schedule -3

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1	2	3	4
30.	Magnesium	,,	30 35
31.	Manganese	,,	0.1
32.	Mercury	,,	0.001
33.	Nickel	,,	0.1
34.	Nitrate	,,	10
35.	Nitrite	,,	<1
36.	Odor	,,	Odorless
37.	Oil and grease	,,	0.01
38.	pH	,,	6.5 - 8.5
39.	Phenolic compounds	,,	0.002
40.	Phosphate	,,	6
41.	Phosphorus	,,	0
42.	Potassium	,,	12
43.	Radioactive materials (gross alpha activity)	Bq/l	0.01
44.	Radioactive materials (gross beta activity)	Bq/l	0.1
45.	Selenium	mg/l	0.01
46.	Silver	,,	0.02
47.	Sodium	,,	200
48.	Suspended particulate matters	,,	10
49.	Sulfide	,,	0
50.	Sulfate	,,	400
51.	Total dissolved solids	,,	1000
52.	Temperature	°C	20-30
53.	Tin	mg/l	2
54.	Turbidity	JTU	10
55.	Zinc	mg/l	5

Bangladesh-India Friendship Power Company (Pvt.) Ltd. BIFPCL

Bangladesh-India Friendship Power Company (Pvt.) Ltd. BIFPCL

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SCHEDULE – 9

Standards for Sewage Discharge
[See Rule 12]

Parameter	Unit	Standard Limit
BOD	miligram l	40
Nitrate	..	250
Phosphate	..	35
Suspended Solids (SS)	..	100
Temperature	Degree Centigrade	30
Coliform	number per 100 ml	1000

Notes :

(1) This limit shall be applicable to discharges into surface and inland waters bodies.

(2) Sewage shall be chlorinated before final discharge.

SCHEDULE – 10

Standards for Waste From Industrial Units or Projects Waste
[See Rule 13]

Sl. No.	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage system connected to treatment at second stage	Irrigated Land
1	2	3	4	5	6
1	Ammonical Nitrogen (as elementary N)	mg/l	50	75	75
2	Ammonia (as free ammonia)	..	5	5	15
3	Arsenic (as)	..	0.2	0.05	0.2
4	BOD_5 at 20°C	..	50	250	100
5	Boron	..	2	2	2

1	2	3	4	5	6
6	Cadmium (as CD)	,,	0.50	0.05	0.05
7	Chloride	,,	600	600	600
8	Chromium (as total Cr)	,,	0.5	1.0	1.0
9	COD	,,	200	400	400
10	Chromium (as hexavalent Cr)	,,	0.1	1.0	1.0
11	Copper (as Cu)	,,	0.5	3.0	3.0
12	Dissolved Oxygen (DO)	,,	4.5 – 8	4.5 – 8	4.5 – 8
13	Electro-conductivity (EC)	micro mho cm	1200	1200	1200
14	Total Dissolved Solids	,,	2,100	2,100	2,100
15	Fluoride (as F)	,,	2	15	10
16	Sulfide (as S)	,,	1	2	2
17	Iran (as Fe)	,,	2	2	2
18	Total Kjeldahl Nitrogen (as N)	,,	100	100	100
19	Lead (as Pb)	,,	0.1	1.0	0.1
20	Manganese (as Mn)	,,	5	5	5
21	Mercury (as Hg)	,,	0.01	0.01	0.01
22	Nickel (as Ni)	,,	1.0	2.0	1.0
23	Nitrate (as elementary N)	mg/l	10.0	Not yet Fixed	10
24	Oil and Grease	,,	10	20	10
25	Phenolic Compounds (as C_6H_5OH)	,,	1.0	5	1
26	Dissolved Phosphorus (as P)	,,	8	8	15
27	Radioactive substance	To be specified by Bangladesh Atomic Energy Commission			
28	pH		6 – 9	6 – 9	6 – 9
29	Selenium (as Se)	mg/l	0.05	0.05	0.05
30	Zinc (as Zn)	,,	5	10	10

1	2	3	4	5	6
31	Total Dissolved Solids	,,	2,100	2,100	2,100
32	Temperature	Centig rade	40	40	40- Summer
			45	45	45- Winter
33	Suspended Solids (SS)	mg l	150	500	200
34	Cyanide (as Cn)	,,	0.1	2.0	0.2

Notes:

(1) These standards shall be applicable to all industries or projects other than those specified under the heading "Standards for sector-wise industrial effluent or emission."

(2) Compliance with these standards shall be ensured from the moment an industrial unit starts trial production. and in other cases. from the moment a project starts operation.

(3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environmental conditions of a particular situation.

(4) Inland Surface Water means drains ponds tanks water bodies ditches, canals. rivers, springs and estuaries.

(5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.

(6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.

(7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

Bangladesh-India Friendship Power Company (Pvt) Ltd. BIFPCL

Bangladesh-India Friendship Power Company (Pvt) Ltd. BIFPCL

Attachment G-04

Project Handbook (typical)

ANNEXURE IV

DRAWING DOCUMENTS DISTRIBUTION PROCEDURE

Documents:	**PEM**
Documents for approval	8
Documents for information	8
Schedules, diagrams, lists, tables, calculation, specifications and other documents	8
Final as-built drawings:	
CD-ROMs of final as-built drawings	10
Final as-built drawings (hard copy)	14
Final O&M manuals	18
CD-ROMs of Final O&M Manuals	10
Detailed project time schedules	5

- Quantity of prints may change during detailed engineering stage based on BHEL/ Customer requirement. However the same will be adhered by the bidder without any delivery/ commercial implication to BHEL and Customer.
- All the drawings/ documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copes whichever is later.
- All the drawings shall be prepared on computer Auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying with the requirement shall not be considered. For the execution of the contract regular meetings (generally once in 15 days or as per project requirement) are required.
- Bidder has to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice without any price implication to BHEL & Customer.
- Bidder to submit instrument schedule, cable schedule along with cable interconnection and valve schedule in MS- Excel format during detailed engineering.
- Bidder to also furnish the Auto cad copy/ MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/ MS-Excel/ MS-word of any other document as per the insistence of BHEL & Customer will also be submitted by the bidder without any delivery/ commercial implication to BHEL & Customer.
    - P&IDs.
    - Equipment layouts.
    - Equipment cable tray layouts.
    - Civil scope drawings.
    - Piping layout drawings.

Note: In addition to above, bidder to comply the requirement stipulated in Annexure XI.

ANNEXURE- V

PAINTING SPECIFICATION

The painting details for the water treatment system components shall be as per below mentioned specification:

Applicable standards are:

DIN 2403	Indication of pipe lines according to flowing material.
DIN 4762	Surface roughness.
ISO 8503	Surface roughness.
DIN 8201	Part 1-9 Tight Blasting agents.
DIN 50976	Corrosion protection, hot–dip batch galvanizing of single parts requirements & testing.
DIN 55928	Part 1-9 corrosion protection of structural steel works through protective coatings and topcoats.
ISO 8501	Preparation of steel substrates before application of paints and associated products.
ISO 12944	Paints and varnishes–Corrosion protection of steel structures by protective paint systems.
RAL	Color card.
ISO 8501-1	Preparation of steel substrates before application of paints and related products.
SSPC	Vol. 1 & 2 steel structure painting council.

SURFACE PREPARATION AND CLEANING OF SURFACES IN SHOP:

Prior to blasting, areas to be cleaned from oil, grease, paint residues, splatters, welding splashes and welding slag using a suitable aqueous degreaser or solvent for more severe grease contamination. The cleaning should be to provide a “Water break free surface”. Sharp edges have to be rounded off.

Contamination caused by salts, acids and alkali solution shall be eliminated by rinsing with water up to a pH value of 6-8. Soluble salt contamination is to be tested using the weber Reilly test method (or similar approved method) and pH is to be tested using universal indicator paper strips prior to continuation with blasting.

CLEANING TO BE PERFORMED ON SITE:

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

Transport and erection damages, as well as damages which result out of additional welding have to be repaired as soon as possible. The damaged areas have to be derusted with rotating or steel brushes, abrasive wheels and abrasive blasting according to DIN ISO 8505-1.

CLEANING OF PRIME AND INTERMEDIATE COATS (IF REQUIRED):

To prevent contamination by mineral oil products, areas with prime and intermediate coat have to be treated with suitable cleaning agent. Cleaning has to be done free of residues, e.g. with alkaline detergents and thorough washing done with fresh water. Rusty spots have to be removed according to required purity. Metallic areas which are provided with temporary corrosion protection have to be cleaned. No oxidation products shall remain on the surface. Further care shall be taken that on hot components, no destructive or reaction products will be released when heating which could injure insulation.

APPLICATION PROCEDURE:

When using the provided coating material, strict adherence to all application instructions given in product data of coating manufacturer is necessary. To obtain maximum performance, technical data as well as application instructions for the individual coating material have to be strictly followed. For a multi-layer coating system each layer has to have a different color shade in order to clearly identify number of coats applied. The last finish coat has to be applied in the specified color shade.

All painting shall be performed according to ISO 12944. The durability of all painting shall be “high” which corresponds to 15 years.

The interval between applying the different coats has to follow according to supplier’s precautions. Each layer has to be cleaned and released from spray dust before the next layer will be applied. Prior to applying a further layer, the last one has to be repaired. All coatings have to be applied without retarding.

Application procedures are mentioned below:

1. Primer coats by airless spray- Areas like disconnections, angels, corners etc. which are difficult to be reached can be applied by brush or roller.
2. Repair of prime coat by brush.
3. Finish coats – At works by airless spray, roller or brush.
   – At site by roller or brush or airless Spray.

GALVANIZING:

Galvanizing work shall conform in all respect to ISO 1461 or equivalent standards and shall be performed by the hot dip process unless otherwise specified.

Careful cleaning of welds is necessary before welded assemblies are dipped. All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with BS 4360. All drilling, cutting, welding, forming and final fabrication of the unit members and assemblies shall be completed, where feasible, before the structures are galvanized.

The minimum coating thickness shall be as specified in table -1 of BS: 729. Structural steel items shall be first grit –blasted to BS 4232, second quality,(SA 2 ½) or pickled in a bath, and minimum average coting weight on steel sections 5 m thick and over shall be 900 g/m^2, on steel sections 2-5 mm thick 600 g/m^2.

Painting of the equipment coming under Water treatment packages shall be as per below mentioned painting schedule only:

SL. NO.	ITEM	TEMP °C	SURFACE PREPERA-TION	COATING	NO. OF COATS	GENERIC TYPE	DFT PER COAT (µm)	TOTAL DFT (µm)
1.	(Indoor)- Structural steel works, piping, vessels, tanks	Up to 120	SA2.5	Primer Finish	1 1	Zinc -Epoxy Epoxy high solid	80 80	80 80 Total =160
2.	(Outdoor)- Structural steel works, piping, vessels, tanks	Up to 120	SA2.5	Primer Intermediate Finish	1 1-2 1	Zinc -Epoxy Epoxy high solid 2-Comp. polyurethane	80 80/ 160 50	80 160 50 Total =290
3.	(Indoor)- Pumps, motors, valves & other equipment	Up to 120	SA2.5	Primer Finish	1 2	Zinc -Epoxy Epoxy high solid	80 50	80 100 Total =180
4.	(Outdoor)- Pumps, motors, valves & other equipment	Up to 120	SA2.5	Primer Intermediate Finish	1 1 1	Zinc -Epoxy Epoxy high solid 2- Comp. polyurethane	80 110 50	80 110 50 Total =240
5.	Steel surfaces permanently in contact with water, also river water splash zone	Up to 60	SA 2.5	Primer and finish coat in one	1	Glass flake reinforced high solid epoxy	500	500
6.	Galvanised Surfaces.	Up to 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine sand.	When finish coat is required, such as sea climate with chloride exposure	1	Epoxy high solid, Additionally 1 x Finish coat of 2-Comp. Polyurethane	125 50	125 50 Total =175
7.		Piping for Instrument air, service air & Service water, potable water & DM water comprises of is aboveground piping, so cathodic protection shall not be applicable.						

Note: In addition to painting requirements indicated above, bidder to refer the painting requirements specified in Annexure-XI.

ANNEXURE- VI

MANDATORY SPARE LIST & RECOMMENDED SPARES

CLAUSE NO.	
B0.3.8.1	**Spare Parts**

I. Initial Spares (Mandatory) Part List

The Bidder shall include in his scope of supply the spare parts comprising the following "Initial Spare Parts":

(a) All the spares listed below as basic minimum requirement of Initial Spare Parts.

(b) In addition to the aforesaid basic minimum requirement of Initial Spare Parts, the Bidder shall further assess requirement of additional spare parts as part of the Initial Spare Parts which are necessary to operate, repair / maintain the plant to achieve the guaranteed availability during the warranty period (i.e. 24 months from the PAC/COD) and maintain the plant efficiency.

The Bidder shall provide the Initial Spares List twice in the Bid: (i) un-priced in the Envelope-I(Techno-Commercial) Bid comprising details as per the format enclosed in Bid Form, and (ii) priced in the Envelope-II (Financial) Bid.

The Bidder shall indicate the prices for each and every item of Initial Spare Parts (except for items not applicable to the Bidder's design) in their Envelope-II (Financial) Bid . If the Bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The Bidder shall furnish the population of each item in the Schedules. Whenever the quantity is mentioned in "sets" the Bidder has to give the item details and prices of each item.

The spares under Initial Spare Parts List shall be part of Lump sum Turnkey Contract Price and shall be considered for Financial Evaluation.

If for any item of the enclosed Initial Spare Parts List, if Bidder in its Bid indicates as "NOT APPLICABLE" , but same is found applicable subsequently during detailed design and/or at the time of commissioning of the unit/ system/sub-system/equipment, same shall be supplied by the Bidder without any extra cost implication to BHEL/ Customer.

Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the Project, unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by **) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as 'set' (marked by *) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings.

The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly.

Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.

CLAUSE NO.	

Handling, Storage, Preservation and Handing over:

All Initial Spares shall be delivered at site in due time and at least two (2) months before COD/PAC of first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.

The Initial Spares shall be received at site by the Contractor on behalf of the Employer and the same shall be stored by the Contractor in the Plant store.

Each item shall be labeled in English language and be separately packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years storage in a dry weatherproof building. The spare parts shall be placed in bins, racks, drawers, shelves, cabinets, etc. to be provided by the Contractor with code for proper and easy identification both for storage as well as retrieval. While storing, the Contractor shall prepare and / or update directory of the Initial Spares co-relating with the item code and its storage locations.

All the Initial Spares shall be handed over to the Employer before PAC of first unit. At the time of handing over the Contractor shall hand over atleast three (3) sets of updated directory of Initial Spares in hard copy as well as in soft copy. After handing over, if any spare is required by Contractor for use in the plant during warranty period the same may be issued to the Contractor on loan basis and the same shall be replenished by Contractor at their cost at the earliest. Before issuance of PAC all the Spares Parts taken by Contractor shall be replenished by them at their own cost.

II. Final Spare Parts List (Recommended Spares)

The Bidder/Contractor shall provide a "Final Spare Parts List" which shall comprise of all items of the Initial Spare Parts List as well as other spares required for long term routine/planned and breakdown maintenance. Bidder/Contractor shall indicate all details for each item of aforesaid Final Spare Parts List, such as vendor's / original equipment manufacturer's (OEM's) name and location, drawings, normal delivery period, quantity, life time/ service life, vendor's/ OEM's serial numbers and price labeling according to the plant numbering code etc. ~~The format and content of the Final Spare Parts List shall be agreed in the basic/detailed engineering phase and shall be subject to Employer's approval. This Final Spare Parts List shall be submitted by the Contractor to the Employer for approval not late than eighteen (18) months prior to the Scheduled Commercial Operation Date (COD)/ Issuance of Provisional Acceptance Certificate (PAC) of 1st Unit.~~

The Contractor shall name OEMs/ three (3) vendors with complete address for each of the spare parts.

Spare part remain available for order anytime during the first three (3) years commencing from COD of each unit, at the initial Unit prices as adjusted pursuant to the indexation mechanism approved by employer.

However, the Employer shall have the freedom to decide at its sole discretion to purchase spare parts either from ~~EPC~~ Contractor (according to agreed unit price as stated above) or directly from vendors/OEMs or from any other source

Bidder/ Contractor shall submit list of recommended/ final spare parts list along with price of each item at the time of techno commercial bid submission. Price of recommended spares will not be used for bid evaluation.

CLAUSE NO.	

III. START-UP & COMMISSIONING SPARES

Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the COD/PAC shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of PAC. All start up spares which remain unused at the time PAC shall remain the property of the Contractor. These start-up & commissioning spare part list shall not be included in Initial Spare parts List.

IV. General Requirements Pertaining to the Supply of Spares given below:

All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccator packs as necessary.

All the spares (Initial Spares) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.

The Contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares.

The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship.

The Contractor shall ensure long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Sub-Contractors, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the

Inspection of mandatory spares shall be in line with the approved quality plans for the respective items/ equipment. The inspection categorization of mandatory spares shall also be in line with the approved Categorization plan for the respective items/ equipment.

The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

Mandatory spares for other items indicated elsewhere in the technical specification shall also be in bidder's scope.

LIST OF BASIC MINIMUM SPARES

14)	Gasket for each flanged connection on high pressure steam and feed line.	3 Nos. per unit
15)	Trim assy. for angle valves up to inlet size 50 NB which shall include stem with plug , cage assy. , guide bushes & seat ring(if replaceable)	02 sets for each type, material, size & class for size up to 50NB inlet per unit
16a)	Safety valve up to 50 NB size	02 nos. of each type, material, size & class per unit
16b)	Safety valve above 50 NB size	01 no of each type, material, size & class per unit
17)	**Steam traps and Y-Strainers**	
17a)	Steam trap & Y strainers up to 25 NB	10 nos. of each type, material, size & class per unit
17b)	Steam trap & Y strainer above 25 NB & up to 50 NB	05 nos. of each type, material, size & class per unit
17c)	Steam trap & Y strainer above 50 NB	02 nos. of each type, material, size & class per unit
18)	**Other Valves (PCP)**	
18a)	Each type, material, size and class for 250 NB & below but above 50 NB	2 nos. each per unit
18b)	Each type, material, size and Class above 250 NB	01 no. each per unit

2. Low Pressure Piping (For solid waste management Package)

1)	Valves	5% of the total population of each type, size and class OR minimum 1 no. of each type, size & class. **Note**:- Wherever valves are specified as mandatory spare, complete valve along with actuator and all other accessories which are the part of original supply shall also be supplied.
2)	Spare gaskets for valves	3 sets for each type, material, size &

		class per unit
3)	Gland packing for valves	05 sets for each type, material, size & class per unit

3. L.P. Chemical dosing system

Sl. No	Description	Quantity
(1.)	Drive shaft cum worm	1 No. for each type of pump per unit.
(2.)	Drive worm wheel	3 Nos. for each type of pump per unit.
(3.)	Connecting rod plate	1 No. for each type of pump per unit.
(4.)	Cross head guide bush	3 Nos. for each type of pump per unit.
(5.)	Plunger	1 No. for each type of pump per unit.
(6.)	Plug	1 No. for each type of pump per unit.
(7.)	Oil seal	1 No. for each type of pump per unit.
(8.)	Washer	2 Nos. for each type of pump per unit.
(9.)	Gland nut	2 Nos. for each type of pump per unit.

Notes:

1. Wherever valves are specified as mandatory spare, complete valve along with actuator and all other accessories which are the part of original supply shall also be supplied

XVI. MANDATORY SPARES FOR ELECTRICAL

Switchyard 400kV GIS

Sr. No.	Description	Quantity
1.00.00	400kV GAS INSULATED SWITCHGEAR	
1.01.00	SF6 gas pressure Relief Devices, 3 Nos. of each type	2 Sets

000368

LIST OF BASIC MINIMUM SPARES

	Consumable like fillers/light sources	100%
	Calibration gases of all types and ranges.	one year supply
(vi).	***Measuring Instruments** (For solid waste management Package)	
a)	Electronic Transmitters	
(i)	Transmitters of all type, range and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10% or minimum 1 No. which ever is more
(ii)	Electronic cards / PCB's for each type and model of transmitters.	10% of each type
b)	Temperature elements	
(i)	RTD's	10% of each type and length or minimum 1 No. which ever is more
(ii)	Thermocouples	10% of each type and length or minimum 1 No. which ever is more
(iii)	Thermo well for above applications	10% of each type and length or minimum 1 No. which ever is more
(iv)	Temperature Transmitters	10%

*List of Measuring instruments as specified with individual system / sub-system shall be applicable for the respective system. Spare list of measuring Instruments will be governed by this clause, for system/subsystem which are not mentioned/specified exclusively in the list of spares.

3.	**Mandatory spare list AAQMS**	
(i)	SO2 analyser	
	SO2 analyser instrument	1 no. complete instrument
	Electronic Card Assemblies of each type	10%
	Sets of Gaskets/"O" rings	2 sets
	Heater Assembly/Thermister.	20%
	Air flow meter.	1 no.
	Consumables like filter elements light sources etc.	100%
	Calibration gases of all types and ranges.	One year supply.

000401

LIST OF BASIC MINIMUM SPARES

(iii)	Client Work Stations with monitor	1 no.
(iv)	Network Switches	10% of each type
(v)	Camera/Database Server	1 no.
(vi)	Mechanism motors	10%
(vii)	Media Converters	10%

9.00.00 PROCESS CONNECTION PIPING (FOR IMPULSE PIPING/TUBING, SAMPLING PIPING/TUBING AND AIR SUPPLY PIPING AS APPLICABLE) (For solid waste management Package)

Sl. No.	ITEM	QAUNTITY
(i)	Valves of all types	10%
(ii)	2 way, 3 way, 5 way valve manifolds	10% of each type, class, size and model
(iii)	Fittings	10%
(iv)	Purge meters	5% of each model
(v)	Filter regulators	20% of each model

Note:

1. In case the main population of any item is only one no., then the spare quantity shall also be one no.

FLUE GAS DESULFERIZER

SL. NO.	Description	Qty (Nos.)
	Mechanical items:	
1	System isolation dampers for FGD	
1.1	Not used	
1.2	Not used	

ANNEXURE VII

DRAWING / DOCUMENTS SUBMISSION SCHEDULE

After award of LOI/ LOA, following minimum drawing/ documents shall be submitted by the bidder for BHEL/ Customer approval. However any additional drawing/ document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL. For the Drawings/ Documents Submission Procedure, please refer following Annexure-A. Bidder has to submit the revised drawing/ document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The number of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-V.

Every revised submission incorporating comments shall be resubmitted within 7 days.

BHEL shall provide observation / approval within 15 days from the date of document submission by bidder. Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineers along with project manager to PEM office or at customer office without fail.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account.

S. No.	DOCUMENT / DRAWING NO.	DRAWING / DOCUMENT TITLE FOR SOLD WASTE MANAGEMENT SYSTEM	SCHEDULE OF SUBMISSION FROM LOI (IN WEEKS)	SIZE
	MECHANICAL			
1	PE-V0-411-177A-A001	SITE SELECTION STUDY REPORT FOR SWM INCLUDING LAND FILL AREA *	4	A4
2	PE-V0-411-177A-A002	PROCESS DESIGN & SIZING CALCULATIONS ALONGWITH PROCESS FLOW DIAGRAM FOR SWM *	4	A0
3	PE-V0-411-177A-A003	EQUIPMENT LAYOUT OF SWM (EXCLUDING LANDFILL AREA) *	4	A0
4	PE-V0-411-177A-A004	LAYOUT OF LAND FILL AREA INCLUDING BASAL LINER SYSTEM & LEACHATE DRAINAGE & LEACHATE TREATMENT SYSTEM*	4	A4
5	PE-V0-411-177A-A005	SUB VENDOR LIST AND INSPECTION CRITERIA*	6	A4
6	PE-V0-411-177A-A006	CONTROL WRITE UP*	6	A4
7	PE-V0-411-177A-A007	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF REFUSE COMPACTOR VEHICLE (RCV)WITH AUTOMATIC COMPACTION CYCLE	10	A4
8	PE-V0-411-177A-A008	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF TIPPER TRUCK	10	A4
9	PE-V0-411-177A-A009	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF VACCUM SUCTION MACHINE MOUNTED ON TRUCK	10	A4

10	PE-V0-411-177A-A010	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF BACKHOE LOADER	10	A4
11	PE-V0-411-177A-A011	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF VIBRATION COMPACTOR FOR LAND FILL	10	A4
12	PE-V0-411-177A-A012	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF TROMMELS ALONG WITH MOTOR	10	A4
13	PE-V0-411-177A-A013	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF SCREW SHREDDER ALONG WITH MOTOR	10	A4
14	PE-V0-411-177A-A014	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF DENSITY SEPERATOR WITH ASPIRATOR/DESTONER ALONG WITH BLOWER AND MOTOR	10	A4
15	PE-V0-411-177A-A015	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF HORIZONTAL/ VERTICAL HYDRAULIC BALE PRESS ALOGN WITH MOTOR	10	A4
16	PE-V0-411-177A-A016	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF VEHICLE WHEEL CLEANING SYSTEM	10	A4
17	PE-V0-411-177A-A017	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF SORTING TABLE	10	A4
18	PE-V0-411-177A-A018	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF BINS/ CONTAINER (PVC & MS)	10	A4
19	PE-V0-411-177A-A019	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF WEIGH-BRIDGE	10	A4
20	PE-V0-411-177A-A020	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF BASAL LINER SYSTEM FOR LAND FILL AREA	10	A4
21	PE-V0-411-177A-A021	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF LEACHATE DRAINAGE SYSTEM FOR LAND FILL	10	A4
22	PE-V0-411-177A-A022	MECHANICAL GA DRAWING OF LEACHATE POND	10	A1
23	PE-V0-411-177A-A023	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF VERTICAL SUBMERSIBLE TYPE LEACHATE TRANSFER PUMPS	10	A4
24	PE-V0-411-177A-A024	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF RO BASED LEACHATE TREATMENT SYSTEM	10	A4
25	PE-V0-411-177A-A025	MECHANICAL GA DRAWING OF GROUNDWATER MONITORING WELLS	10	A1
26	PE-V0-411-177A-A026	MECHANICAL GA DRAWINGS OF SUMPS FOR RO BASED LEACHATE TREATMENT SYSTEM	10	A1
27	PE-V0-411-177A-A027	MECHANICAL GA DRAWING OF LEACHATE COLLECTION SUMP NEAR SWM AREA	10	A1

28	PE-V0-411-177A-A028	TECHNICAL DATASHEET ALONG WITH GA DRAWING OF ENVIRONMENTAL CONTROL AND MONITORING EQUIPMENT	10	A4
29	PE-V0-411-177A-A029	DATASHEET AND GA DRG OF STRAINER	10	A4
30	PE-V0-411-177A-A030	DATASHEET AND GA DRG OF MOTORISED VALVE	10	A4
31	PE-V0-411-177A-A031	DATASHEET AND GA DRG OF VALES	10	A4
32	PE-V0-411-177A-A032	DATASHEET AND GA DRG OF NRV	10	A4
33	PE-V0-411-177A-A033	VALVE SCHEDULE	10	A4
34	PE-V0-411-177A-A034	PIPING SCHEDULE	10	A4
35	PE-V0-411-177A-A035	PAINTING SCHEDULE	10	A4
36	PE-V0-411-177A-A036	CIVIL INPUT DRAWING OF SOLID WASTE MANAGAMENT	12	A1
37	PE-V0-411-177A-A037	CIVIL INPUT DRAWING OF ALL SUMPS FOR SWM	12	A1
38	PE-V0-411-177A-A038	CIVIL INPUT DRAWING OF FOUNDATION OF EQUIPMENT FOR SWM	12	A1
39	PE-V0-411-177A-A039	PIPING LAYOUT FOR SWM ALONG WITH DETAILS OF SUPPORTS	16	A1
40	PE-V0-411-177A-A040	PG TEST PROCEDURE FOR SWM	20	A4
41	PE-V0-411-177A-A041	ENGINEERING BOQ	20	A4
42	PE-V0-411-177A-A042	O & M MANUAL	20	A4
	ELECTRICAL			
43	PE-V0-411-177A-A101	ELECTRICAL LOAD LIST	8	A4
44	PE-V0-411-177A-A102	DATASHEET OF MOTORS	10	A4
45	PE-V0-411-177A-A103	CABLE TRAY/ TRENCH & CONDUIT ROUTING DIAGRAM INCLUDING JB LOCATION OF INSIDE AND OUTSIDE SWM	12	A0
46	PE-V0-411-177A-A104	EARTHING LAYOUT OF INSIDE AND OUTSIDE SWM	12	A0
	CONTROL AND INSTRUMENTATION			
47	PE-V0-411-177A-A201	LIST OF DRIVES, JB GROUPING AND I/O LIST	10	A4
48	PE-V0-411-177A-A202	INSTRUMENT SCHEDULE	10	A4
49	PE-V0-411-177A-A203	DATASHEET OF ANALYSERS (AS APPLICABLE)	10	A4
50	PE-V0-411-177A-A204	DATASHEET OF TRANSMITTERS	10	A4
51	PE-V0-411-177A-A205	DATASHEET OF LOCAL INSTRUMENTS	10	A4
52	PE-V0-411-177A-A206	DATASHEET OF SOLENOID VALVE (AS APPLICABLE)	10	A4

53	PE-V0-411-177A-A207	DATA SHEET AND GA FOR JUNCTION BOXES	10	A4
54	PE-V0-411-177A-A208	CABLE SCHEDULE AND INTERCONNECTION DIAGRAM	12	A4
55	PE-V0-411-177A-A209	INSTRUMENT INSTALLATION DRAWINGS/ HOOK UP DIAGRAM FOR INSTRUMENTS	12	A4
	QAP			
67	PE-V0-411-177A-A301	QAPs FOR SOLID WASTE MANAGEMENT SYSTEM	10	A4
	MANDATORY SPARE			
68	PE-V0-411-177A-A401	MANDATORY SPARES LIST FOR SOLID WASTE MANAGEMENT SYSTEM	14	A4

'*' Basic engineering documents.

A) ELECTRIC HOIST

S. No.	DOCUMENT / DRAWING NO.	DRAWING / DOCUMENT TITLE FOR ELECTRIC HOIST	SCHEDULE OF SUBMISSION FROM LOI (IN WEEKS)	SIZE
1	PE-V0-421-158-A500	MANUFACTURING QUALITY PLAN WITH SUB VENDOR LIST	8	A4
2	PE-V0-421-158-A501	GA DRAWING FOR ELECTRIC HOIST, DSL ARRANGEMENT AND PAINTING DETAILS	10	A4
3	PE-V0-421-158-A502	SCHEMATIC CIRCUIT DIAGRAM FOR ELECTRIC HOIST	10	A4
4	PE-V0-421-158-A503	MECHANISM SIZING CALCULATION	10	A4
5	PE-V0-421-158-A505	O&M MANUAL INCLUDING ERECTION PROCEDURE	16	A4

S. No.	DOCUMENT / DRAWING NO.	DRAWING / DOCUMENT TITLE FOR CHAIN PULLEY BLOCK	SCHEDULE OF SUBMISSION FROM LOI (IN WEEKS)	SIZE
1	PE-V0-421-158-A600	MANUFACTURING QUALITY PLAN	8	A4
2	PE-V0-421-158-A601	GA DRAWING FOR CPB WITH DETAIL BOM WITH PAINTING DETAILS	10	A4
3	PE-V0-421-158-A602	O&M MANUAL INCLUDING ERECTION PROCEDURE	10	A4
4	PE-V0-421-158-A700	MANDATORY SPARES LIST FOR ELECTRIC HOIST AND CHAIN PULLEY BLOCK	14	A4

Notes:-

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.: -
   a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
   b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
   c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
   d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
   e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.
   f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
   g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
   h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.
   i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
   j) Bidder to follow the following the drawing submission schedule:
   k) 1st submission of drawings from date of LOI as per the submission schedule.
   l) Every revised submission incorporating comments – within 7 days.
   m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

ANNEXURE- VIII

LIST OF TOOLS AND TACKLES

Bidder to consider necessary tools and tackles for mechanical, electrical and control & instrument as per their system requirement. In addition, bidder to adhere relevant clauses indicated elsewhere in the technical specification.

ANNEXURE IX

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

	TITLE : **2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT**	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**Cover page**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX, email address, Emergency Contact number				
1.5	Name and sign of prepared by, checked by & approved by				
1.6	Revision history with approval Details				
2.0	**Index**				
2.1	Showing the sections & related page nos. All the pages should be numbered section wise				
3.0	**Description of Plant/System**				
3.1	Description/ write up of operating principle of system equipment/ associated sub-systems & accessories/controls system, operating conditions, performance parameters under normal , start up and special cases.				
3.2	Equipment list and basic parameter with Tag numbers.				
3.3	Data sheets approved by Customer/ for information and catalogues provided by original manufacturer.				
3.4	Associated other packages and Interface /terminal points.				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/ system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**Operation Guidelines for plant personal/user/operator**				

5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/ lubrication failure/ any other condition.				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair, Testing and calibration procedures				
6.0	**Maintenance guidelines for plant personal**				
6.1	List of Special Tools and Tackles required for Overhaul/ Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/ handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centers ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				

6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

Bidder to refer Annexure-XI/ sub-section IA for addition requirements.

ANNEXURE X

SITE STORAGE AND PRESERVATION

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

b) GENERAL PRESERVATION REQUIREMENTS

c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
    a. Rust preventive fluid (RPF)
    b. Rust protective paints
    c. Tarpaulin covers, in case of outdoor storage
    d. De-oxy aluminate for weld-ments

c) **GENERAL INSPECTION REQUIREMENTS**

1. Period inspection of materials with specific reference to –
    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.
    - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
    - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere**. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.

ii **Semi-closed storage**. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.

iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as "scrap yard" slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

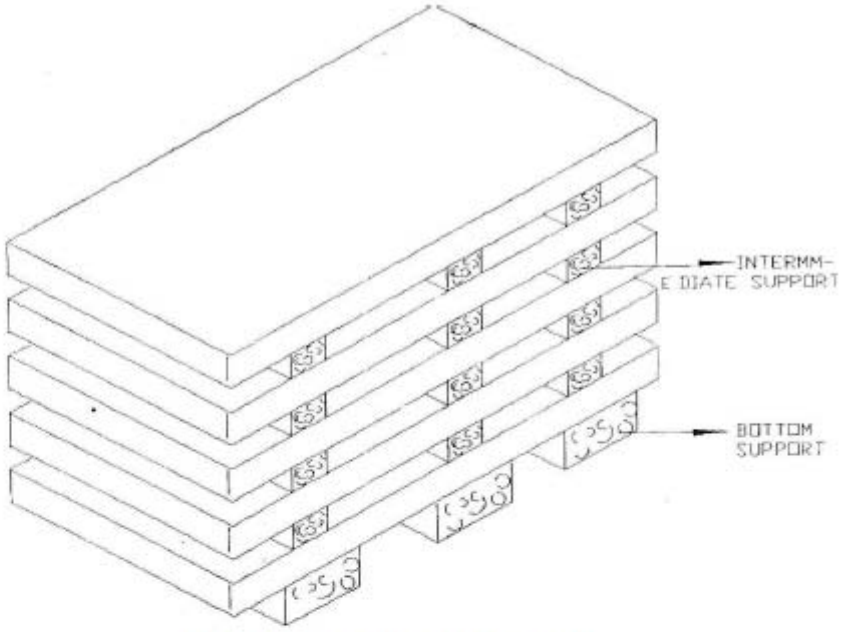

Figure – 1 – PLATE STACKING ARRANGEMENT

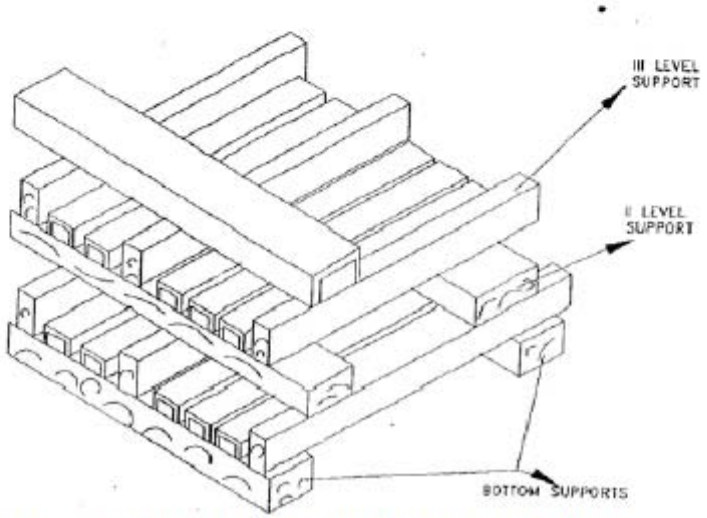

Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

Note: - Bidder to refer Annexure-XI/ sub-section IA for addition requirements.

ANNEXURE XI

CUSTOMER TECHNICAL REQUIREMENTS

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B0. General Specification

Preamble

The Technical Specification is amended in accordance with following Technical Clarifications to Bidding Documents ("Clarification Batches"), which are already published on the BIFPCL's Website:

- Clarification No. 1 (Clarification #01);
- Clarification No. 3 (Clarification #03);
- Clarification No. 5 (Clarification #05);
- Clarification No. 7 (Clarification #07); and
- Clarification No. 8 (Clarification #08).

Only technical clarifications with regard to content and consequently causing alterations of Scope of Services and Supplies, Technical Requirements, Data Sheets and/or Annexes are incorporated.

General clarifications such as "Subject to BIFPCL's approval during Basic/Detailed Engineering" or "Details to be discussed during Engineering" are not incorporated as it is self-evident that Contractor's design and engineering shall subject to Employer's approval.

Already published Amendments (reference is made to Amendments No. 1 and No. 2) are not again incorporated/included in the amended Technical Specification. This applies for instance for:

- B3, B4 including Data Sheets (replacement of the original documents, refer to Amendment No. 1);
- B12.8 PV Plant and B12.9 Waste Management including Data Sheets (additional documents, refer to Amendment No. 2);
- Annex C, G-05 Health and Safety Manual (additional document, refer to Amendment No. 2); and
- Annex C, M-03 Design Limestone List (replacement of the original document, refer to Amendment No. 1).

In addition some parts of the Technical Specification are modified without reference to a published Clarification or Amendment. This applies for instance for:

- Annexes M-06, M-07, M-08 and M-10, which are revised according to Amendment of B3 and B4 and which shall replace the respective original Annexes.
- Annexes M-04 and M-12, which are revised according to the latest available river water sampling and analysis.

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B0.1 Subject of Specification

The Joint Venture of Bangladesh-India Friendship Power Corporation (pvt) Ltd (BIFPCL) intends to construct a 2x 660 $MW_{e, gross}$ coal fired power plant (the Plant, the Maitree-STPP Project or the Project) in the district of Khulna for which BIFPCL firms as Employer, utilizing high availability, high efficiency steam cycle technology.

The Contractor shall cover all works for the engineering, procurement, construction and commissioning of the whole plant on a turnkey basis.

Two power units with steam generator, steam turbine generator and ancillary systems shall be proposed in a technology that enables the Contractor to guarantee a high net efficiency while achieving a high reliability (certain restrictions regarding the technology and the design parameters apply, as detailed herein). A second phase of the same capacity is foreseen as a future possibility, however, this Specification deals only with 2 x 660 $MW_{e, gross}$ unless otherwise and expressly stated.

The Plant shall be built on a "green field" basis. It shall be conceptualized in accordance with the above criteria, the thermodynamic cycle adopted must be capable of working successfully over prolonged periods and the system shall be able to withstand severe shocks when connected to the Grid as specified in this **Section B0.** The steam cycle shall operate with once-through technology at supercritical.

The Plant shall be based on supercritical technology. The main steam (MS) pressure at turbine inlet shall be in the range of 250 to 270 bar(g). The MS temperature at turbine inlet shall be in the range of 568 to 600 °C. The reheat steam (RH) temperature at turbine inlet shall be chosen by the Bidder/Contractor accordingly. That means, a proposed plant with a MS pressure at turbine inlet between 250 and 270 bar(g) and MS/RH temperature at turbine inlet upto 600°C/600° will be acceptable.

The Plant shall be suitable to be operated with the specified fuel. Only proven equipment and materials shall be used.

With the Tender the Bidder shall provide evidence:

- that the proposed Plant is based on proven supercritical technology, with similar MS pressure, MS/RH temperature, design and materials; However, Reference plant of MS pressure and temperature at turbine inlet in the range of 242 to 270 bar(g) and 565 to 600 °C respectively, shall also be considered to quqlify.
- that the proposed design of the steam generator and auxiliary equipment has been fully proven by extensive successful commercial operation (the experience base for main component and the design data shall be demonstrated by the Bidder);

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- that the proposed Plant is based on a reference plant(s) which shall be based on supercritical technology, which shall be of similar design and which shall use similar fuel as specified (The Bidder shall submit with the Tender detailed information on this reference plant(s) and shall allow the Employer and/or his representatives to contact and visit and examine the reference plant(s) in detail).

Regarding the Qualifying Requirements reference is made also to Section I IFB.

Transmission lines (OHL connections) from power plant to HV substation as well as transmission lines (GIL) within HV substation area are included in Bidder's/Contractror's scope of services and supplies. However, transmisson lines for PGCB grid connection are out of Bidder's/Contractror's scope of services and supplies. For detailed scope at interface points refer to section B10.3.3 and B10.3.5.

The engineering design of the Plant shall be conceptualized in accordance with the above criteria, and therefore it is vital that the thermodynamic cycle adopted must be capable of working successfully over prolonged periods and the system shall be able to withstand severe load adjustments when connected to the Grid. The proposed Plant shall be based on a reference plant of equal size firing similar fuel, which shall have a proven track record. The Tenderer shall submit with the tender detailed information on this reference plant(s) and shall allow the Employer and / or his representatives to contact and visit and examine the reference plant(s) in detail.

The steam boilers shall be designed to burn coal from Australia, Indonesia, South Africa, Mozambique and potentially other countries and to burn high speed diesel for start-up and shut-down purposes. The Plant is designed for the coal range as per design coal list attached in the **Annexes in Part C**. The steam turbo-generators and thermal cycles shall be selected such, that the Plant heat rate would be optimized under consideration of the investment costs. The condenser cooling systems shall be realized with induced draft wet cooling towers.The turbine generators and all grid relevant parameters shall be designed in accordance with applicable Grid Code and the requirements of NLDC.

The Plant shall be equipped with suitable emission abatement technologies, consisting of primary measures for the CO- and NO_x-reduction, an electrostatic precipitator and a wet flue gas desulphurization plant operating with limestone.

The Project shall include the facilities for the export of the produced power consisting of switchyards, substations and transmission lines.

In addition the Plant shall include all auxiliary and ancillary systems required within the terminal points to render the Plant fit for purpose, this

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shall also include workshops, admin and staff amenities buildings and the likes unless expressly excluded in this specification.

B0.2 General Plant Description

B0.2.1 General purpose of the plant

The Plant is intended to serve the increasing power demands of the electricity market in Bangladesh. It will be operated in base load operation but frequency support operation must also be possible.

The scope under the EPC turnkey contract shall cover all services and supplies required to meet the purpose of the Power Plant even if not expressively mentioned in the Bidding Documents. This shall include but shall not be limited to: design, engineering, manufacturing, shop testing, procurement, supply, transportation to site (location of use), handling, storage, insurance, taking any permit/approval required, erection, testing at site, commissioning, performance testing, training Employer's personnel and final completion of entire Power Plant inter alia including steam generators and auxiliaries, turbine generators and auxiliaries, all associated BOP packages, all civil, electrical and I&C works for the entire Power Plant as well as for the jetty and associated facilities and the 400kV/230kV substation as described in the Bidding Documents and complete in all respects for successful operation of both units of 660 MW to dispatch power from the Plant to the grid.

The Plant covers the following main systems and components (including all systems not specifically mentioned):

B0.2.2 General scope of supply

The following data are applicable per unit, unless they refer to common systems. For further information see the respective **Sections B1 to B12**.

- **Boiler systems** (refer to **Section B1**)
  - steam generator (supercritical once-through)
  - regenerative air preheater
  - coal pulverizers
  - coal bunker system
  - bottom ash extraction system (dry)
  - boiler fans (PA, SA/FD fans)
  - HP steam / feed water piping
  - HP bypass system
  - air system
  - auxiliary boiler .

- **Turbine systems** (refer to **Section B2**)

- steam turbine generator
- LP bypass
- condenser system incl. evacuation
- Condenser cleaning system
- LP/HP heaters
- deaerator/feed water tank
- condensate pumps
- feed water pumps
- water/steam piping system
- drip collecting and pump system
- EOT crane and hoists.

- **Flue gas treatment systems** (refer to **Section B3)**
  - dust filter system (ESP)
  - FGD system (based on wet limestone process)
  - ID fans
  - flue gas ducts.

- **Fuel and Ash handling system** (refer to **Section B4**)
  - coal handling system, including:
    - coal unloaders (grab type)
    - stackers
    - portal scraper reclaimers
    - coal yard (90 days capacity at BMCR with worst coal)
    - coal yard roof cover (take-out option)
    - coal dust suppression systems
    - coal crushers
    - Coal screens
    - emergency coal supply by front end loader
    - belt conveyors, junctions towers and other systems as required
    - coal blending silos
  - limestone handling system, including:
    - Stacker
    - limestone yard for 90 days
    - limestone transportation system from jetty to stockyard, as required
    - transportation from stockyard to limestone intermediate silo by front end loader
  - HSD handling, including:
    - HSD truck unloading station
    - HSD tanks
    - HSD transfer pumps and pipe distribution system
  - fly ash handling , including:
    - pneumatic fly ash transportation to intermediate fly ash silos
    - intermediate fly ash silos
    - pneumatic fly ash transportation fly ash storage silos at jetty
    - fly ash storage silos at jetty with truck and ship loading
  - bottom ash handling, including:
    - bottom ash transportation to intermediate bottom ash silos
    - intermediate bottom ash silos

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- bottom ash storage silos at jetty with truck loading
- gypsum handling, including:
  - Gypsum storage silo at jetty with truck and ship loading
- common residue handling systems
  - transportation of limestone, bottom ash and gypsum from intermediate silos to storage silos at the jetty by pipe conveyor
  - discharge of fly ash and bottom ash via high concentrated slurry/solids disposal (HCSD) to the ash point.

- **Plant Water and Cooling Systems** (refer to **Section B5**)
  - Plant water intake channel
  - Plant water intake structures
  - Plant water screening plant
  - Plant water supply pumps
  - Plant water pre-treatment and storage
  - Main cooling water system
  - Cooling Water pump station
  - Induced Draft Cell Cooling Towers
  - Main cooling water collection basin
  - Desalination feed water supply system
  - Auxiliary cooling water system
  - Plant water discharge system
  - Cathodic corrosion protection systems.

- **Water Treatment Systems** (refer to **Section B6**)
  - Plant water pre-treatment storage and supply
  - Electrochlorination plants
  - Desalination plant
  - Potable water treatment plant
  - Demineralization plant
  - Condensate polishing plant
  - FGD Waste Water Treatment Plant (FGDWWTP)
  - Process waste water treatment facilities including oil separators
  - Sewage treatment plant for sanitary wastes
  - Chemical handling and storage facilities
  - Chemical dosing of cooling water and feed water conditioning
  - Monitoring system for the water/steam cycle.

Note:
The Desalination and Demineralization Plant shall be common for all the units.

- **Electrical systems** (refer to **Section B7**)
  - All electrical components related to turbine / boiler / flue gas treatment system and BOP systems
  - Power transformers incl. GT, SUT, UAT, all MV- and LV-T
  - Switchboards and power distributions (busducts, cabling etc.)
  - Emergency diesel, DC and safe AC Systems

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- 400/230kV GIS including auxiliary and ICT.

Electrical works like illumination, communication, etc. outside plant boundary are not included in the scope of works.

- **I&C systems** (refer to **Section B8**)
  - All I&C components related to turbine / boiler / flue gas treatment system and BOP systems
  - Central DCS and decentralized PLC Logics
  - Power Plant training simulator.

- **Civil works** (refer to **Section B9**)
  - site surveys and investigations to ensure safe civil design and undisturbed construction
  - site preparation (incl. site filling works) and temporary site installation.

    No grading activities outside the plant boundary shall be considered.

  - all civil related works for the Power Plant including turbine/boiler/flue gas treatment system/cooling water system/electrical system/balance of plant etc.
  - Marine Works including coal jetty, plant water intake and discharge.
  - Power Plant related buildings and structures
  - ancillary buildings such as admin building, canteen, storage and workshop building
  - ash pond
  - HVAC
  - Biomass generation plant (use organic waste of Township and Power Plant)

    It is to be noted that the biomass plant shall not produce power. The biomass plant is understood as waste segregation and treatment plant. (Refer to B12.9 in Amendment No. 2).

  - Cranes.

- **Infrastructure** (refer to **Section B9**)

The following works are included in the infrastructure lot

- all internal roads incl. tie-in with existing roads at bridge and access roads to nearest township

Bridge and highway from bridge to Khulna-Mongla-Highway will be provided by GOB.
The Interface Point is at the roundabout.
Remark:
Access Road
GOB will construct a 6 Km road connecting the Site with Khulna-Mongla Highway. It is to be highlighted that:

- Bidder/Contractor cannot expect that the access road will be available when the site works start.
- Bidder/Contractor cannot expect that the access road will be suitable for the transportation of heavy equipment to Site.
- Site access and transportation of personnel, material and equipment etc. to Site shall be in the sole responsibility of the Contractor.
- Bidder/Contractor shall execute a transportation study to familiarize himself with the local and Site condition and to elaborate how equipment can be transported to Site.

All roads, except town ship roads are in Bidder's/Contactors' scope.Interface is the roundabout, whereas the roundabout itself shall be constructed by the Bidder/Contractor.

- fencing, gate house inside the boundary
- landscaping in all areas where Contractor work will be performed
- Infrastructure related works outside the boundary wall

Electrical works like illumination, communication, etc. outside plant boundary are not envisaged.

- underground services (non-pressurized - rain water discharge, domestic waste water
- rain water retention basin
- oil water separators.

- **Electrical Works 400/230 kV Substation** (refer to **Section B10**)
  - 400 kV gas insulated switchgear
  - 400 kV AIS equipments and accessories
  - 230 kV gas insulated switchgear
  - 230 kV AIS equipments and accessories
  - 230 kV XLPE Cables
  - 400/230 kV 520 MVA interconnection transformers
  - Substation Control and Monitoring System (SCMS)
  - 11/0.415 kV auxiliary power transformers
  - Telecommunication Equipment
  - AC/DC installations
  - Power and control cables, bus ducts
  - Tariff metering
  - Substation outdoor lighting
  - Earthing system & lightning protection system
  - Power & auxiliary systems for 400 kV and 230 kV area, incl. coordination with overall system
  - Fire detection, alarm and fire fighting system
  - Substation other supply and services.

- **Jetty structure** (refer to **Section B11**)
  - Retaining wall
  - Revetment and Shore protection.

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

B0.2.3 Interface points

For interface points see below.

B0.2.4 Site conditions

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

Location, accessibility and present condition of the Site
The site for the Maitree-STPP Project is geographically located between 22° 370'0'' N to 22°34'30''N and 89°32'0''E to 89°34'5''E, approximately 14 km northeast of the Mongla Port and 14 km northwest of the Sundarbans, is infringed by the Passur and Moidara Rivers to the west and south east respectively. The project requires an area of approximately 500 acres.

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

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

Currently, the Site is accessible by boat only.

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

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

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

In general the subsoil conditions can be described as follows:

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

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

Seismic zone

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

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

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

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

Site climatic conditions

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

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

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

During the Monsoon Season occasional cyclonic storms can occur.

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

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

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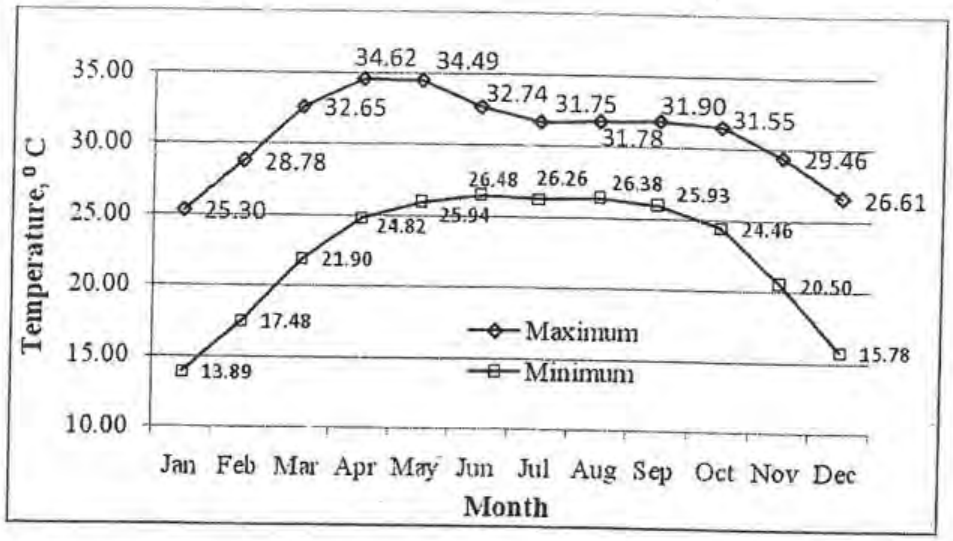
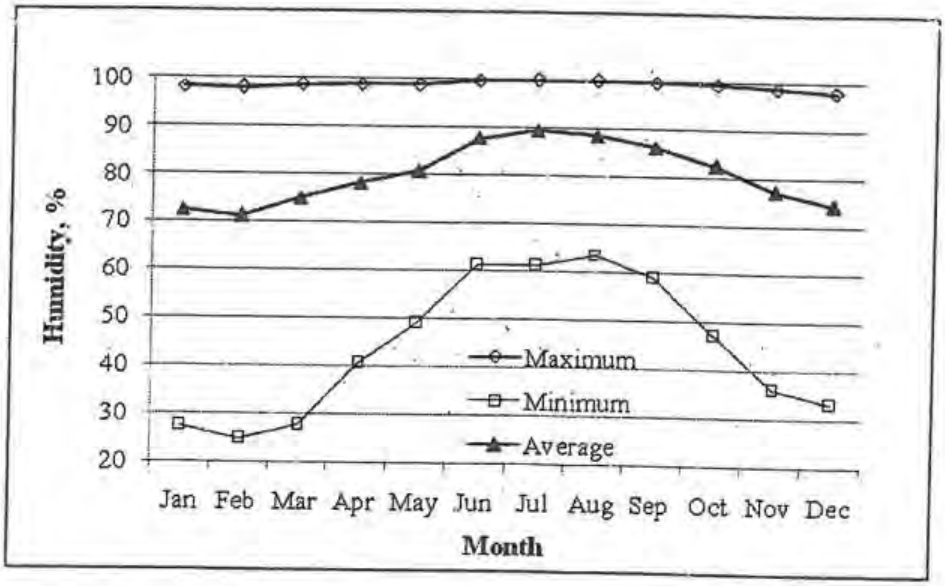


The relative humidity varies drastically during the Monsoon Season with 80% to 90% and the lowest levels of 20% to 30% during the Summer Season. The humidity profile recorded in the same period as the temperature is visualized in below figure.



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

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

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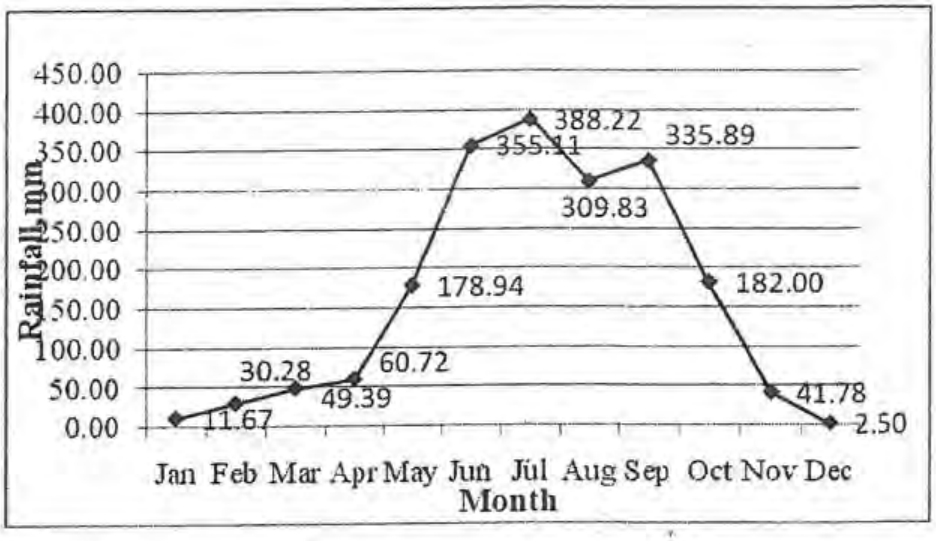

Below definitions are to be used as typical data for the different climatically seasons at the site.

Average Site Condition ASC

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

Summer Site Condition SSC

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

Winter Site Conditions WSC

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

Reference Site Conditions RSC

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

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

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

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

Design ambient conditions for Electrical Systems

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

Marine conditions

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

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

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

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

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

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

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

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

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

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

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

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

1	7-Jan	27.8	7.74	30.[illegible]	879	36	68.7	1565	1510	55	5.1	0.8	55	1.6
2	7-Jan	27.1	7.72	3020	[illegible]	36	68.5	1570	1510	60	5.1	0.8	55	1.6
3	7-Jan	27.8	7.71	3030	879	36	68.8	1565	1510	55	5.1	0.8	55	1.6
1	11-Feb	29.8	7.66	4380	1262	36	182	2390	2180	210	4.7	1	76	2.3
2	11-Feb	29.2	7.63	4380	1268	36	178	2390	2190	200	4.7	1	76	2.3
3	11-Feb	29.1	7.65	4385	1263	36	179	2380	2180	200	4.7	1	76	2.3
1	9-Mar	32.6	7.56	11780	2944.4	38	176	6080	5890	190	4.7	1.2	76	6.7
2	9-Mar	32.6	7.57	11780	2945.2	38	178	6080	5890	190	4.7	1.2	76	6.7
3	9-Mar	32.1	7.55	11780	2946.4	38	177	6090	5890	200	4.7	1.2	76	6.7
1	17-Apr	32.6	7.59	25300	8273	36	185.6	12950	12700	250	4.6	0.7	136	15.5
2	17-Apr	32.6	7.59	25300	8273	36	186.2	12950	12700	250	4.6	0.7	136	15.5
3	17-Apr	32.6	7.59	25300	8273	36	184.8	12950	12700	250	4.6	0.7	136	15.5
1	5-May	32.6	7.59	29200	9480	36	198.6	14900	14600	300	4.5	1.2	177	17.6
2	5-May	32.9	7.54	29300	9470	36	198.6	14600	14600	300	4.4	1.2	177	17.6

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

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Loc ati on	Date	Tem p.	pH	EC	Cl-	T. Alkal inity	Turbid ity	T S	TDS	SS	DO	BOD	COD	Sali nity
		°C		µS/c m	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3	5-May	33.2	7.57	29700	9470	36	199.6	14900	14600	300	4.5	1.2	177	17.6
1	13-Jun	31.6	7.69	18900	5820	36	112.6	9200	9000	200	4.7	1.1	97	10.8
2	13-Jun	31.6	7.69	18900	5800	36	113.2	9200	9000	200	4.7	1.1	97	10.8
3	13-Jun	31.6	7.69	18900	5810	36	112.4	9200	9000	200	4.7	1.1	97	10.8
1	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
2	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
3	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
1	5-Aug	31.6	7.69	275	15.6	36	68.6	192	137	55	5.3	0.7	22	-
2	5-Aug	31.6	7.69	275	15.6	36	68.6	192	137	55	5.3	0.7	22	-
3	5-Aug	31.6	7.69	275	15.6	36	68.6	192	137	55	5.3	0.7	22	-
1	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
2	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
3	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
1	12-Oct	30.6	7.79	290	25.6	36	62.6	192	145	47	5.6	0.7	22	-
2	12-Oct	30.6	7.78	290	25.6	36	62.6	192	145	47	5.6	0.7	22	-
3	12-Oct	30.6	7.78	290	25.6	36	62.6	192	145	47	5.6	0.7	22	-
1	5-Nov	24.8	7.79	340	38.6	36	58.6	210	170	40	5.6	0.7	22	-
2	5-Nov	24.8	7.79	340	38.6	36	58.6	210	170	40	5.6	0.7	22	-
3	5-Nov	25.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
1	12-Dec	21.5	7.72	320	62.6	36	72.6	320	260	60	5.1	0.9	25	0.4
2	12-Dec	20.9	7.71	320	62.6	36	73.6	320	260	60	5.1	0.9	25	0.4
3	12-Dec	21.1	7.72	320	62.6	36	71.6	320	260	60	5.1	0.9	25	0.4

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

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

Wind data

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

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

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

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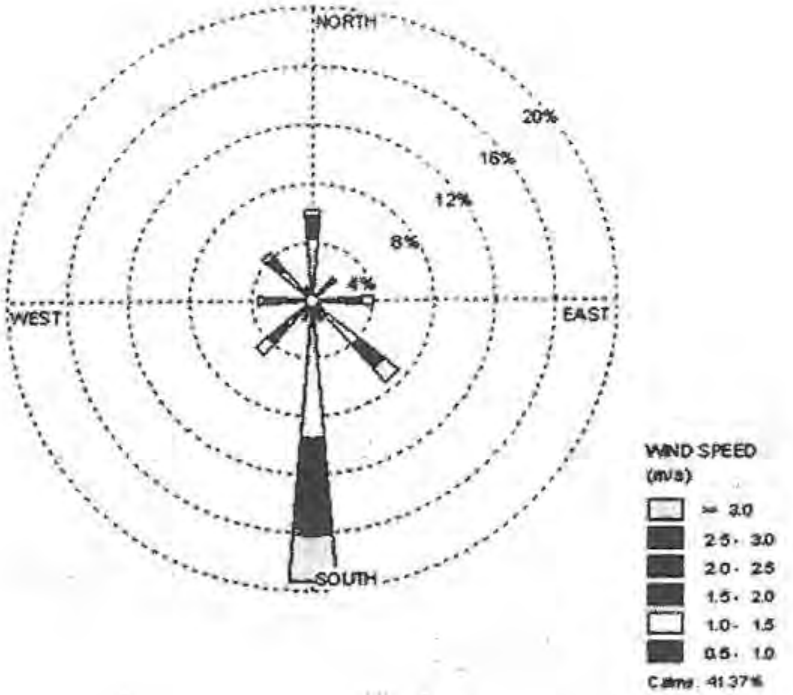

B0.2.5 Configuration

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

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

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B0.2.6 Layout

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

An indicative general layout is shown in **Part C Annexes** where only the major Plant components have been indicated. The indicative layout takes into consideration the location of the river water intake and jetty, however the final layout is subject to hydraulic studies and optimizations by the Contractor. The design shall allow access vessels with a draught of 9.60m at the jetty. The vessels shall be suitable for transport of coal, ash, gypsum and limestone. The dredging works for the construction of the intake and outfall are part of the Contractor's scope.

The intake and outfall locations may change according to the permitting process, results of calculations or model tests or clarifications with the Contractor.

The substations for the export of the produced power are located in the northern portion of the Site. The EHV transmission lines to Dhaka and Khulna are not part of these Tender Documents.

Any costs for relocations or reconfigurations shall exclusively be borne by the Contractor.

The general layout enclosed in Section V TS, Part C is only indicative. Bidder/ Contactor shall elaborate the final layout, which shall be subject to approval by BIFPCL during basic/detailed engineering.

B0.2.7 Design requirements

This specification entails a functional technical specification (FTS). Hence, the Contractor is given as much freedom as possible in designing the main Plant components, characteristics and design data according to the Contractor's experiences and good engineering practice. One main acceptance requirement is that the Contractor's proposed design work shall be based on a very good reference basis. Prototype equipment and/or design features will not be accepted. All parts and equipment shall be arranged in such a manner as to facilitate surveillance by the operator and for ease maintenance, operation and control.

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In the event of contradictions or discrepancies within B0 or between requirements in B0 and stipulations other parts of the Technical Specifications these shall be clarified by mutual consent before Contract signature. In case contradictions have been not clarified the more stringent requirements shall apply.

The main design features (basic design reports, drawings, PFD, P&IDs, design data etc.) and the main vendors and subcontractors shall be subject to the approval by the Employer.

The main equipment/system subcontractors for: steam generator, steam turbine, main transformers, flue gas desulphurization plant shall be firm with the tender. Bidder's/Contractor's sub-suppliers and vendors shall

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comply with Provennes Criteria as stipulated elsewhere in the biding document.

The Employer has the right to refuse design features and vendors or subcontractors, if the Contractor cannot verify the reliability of the suggested design, vendor or subcontractor.

Following transformers shall be considered as "Main transformers":

- generator transformer
- unit auxiliary transformer
- start-up/stand-by transformer
- 400/230 kV interconnection transformers.

The Plant is expected to operate in base-load mode with high plant load factor. The design lifetime of the Plant shall be of not less than 30 years of operation or 200,000 full load operating hours, whichever is longer. The Plant and all its auxiliaries shall be designed to operate for the complete lifetime under the site conditions as described in **Section B0** and dedicated other part of this FTS.

All Plant equipment and material must be suitable for the range of ambient site conditions. In particular the saline atmosphere has to be considered.

The thermodynamic process of the Plant is to be optimized by the Contractor according to the proposed equipment. An economic optimal balance between investment, maintenance and operation expenses and Plant availability (planned and unplanned outages) shall be proposed.

The Contractor shall ensure a design of the Plant to achieve an average target availability of 90 % (regarding the definition and calculation of the availability please refer to Chapter B0.2.9.5). The Contractor shall accordingly provide for all systems:

- sufficient redundancies
- sufficient storage capacity
- appropriate adjustment of control parameters, and
- shall provide an appropriate spare part concept/proposal as further described under Chapter B0.3.7.

A stockyard capacity of 90 days at BMCR operation with design coal is envisaged

The stockpile height shall be approx. 10 m and the angle of repose shall be approx. 37°.

But is is to be underlined that it is Bidder's/Contractor's sole responsibility to determine the actual coal yard dimensions (length, width, height angle etc.)

to achieve the envisaged stockyard capacity under consideration of the soil bearing capabilities and the selection of coal yard equipment.

The 90 days storage area is shown in Annex C-01. The extension for further 90 days storage shall be done on the areas which are marked as "construction laydown area" and "site installation".

Redundancy concept
All equipment shall be implemented with (n+1) redundancy - unless otherwise stated -, where n is the number of equipment required to maintain the maximum capacity of a unit. N+1 means that even in case of outage of the biggest component sufficient capacity is available to maintain the maximum capacity of the Power Plant unit.

For all components which are not redundant, the Contractor shall provide a maintenance and spare part concept to ensure that outage times are minimized and to ensure that the required availability is met (refer to Amendment No. 3 and Annexure I to Amendment No. 3, both already published on BIFPCL's Website). Each equipment whose unavailability due to a failure could result in damages to another equipment shall be backed up by a stand-by equipment, one of them being fed by an emergency source in case of external black out.

Failure of any single item of auxiliary equipment including the Power Plant's DCS and electrical systems shall not result in a reduction in power evacuated from the Power Plant.

Replacement and repair of redundant components shall be possible without interrupting Plant operation.

Future Extension
The Contractor shall ensure sufficient space to enlarge the coal storage capacity from 90 day storage to 180 day storage capacity.

All provisions to enable generally the later extension of the coal storage shall be implemented but no additional costs shall be incurred which are not immediately required for the first phase only, unless expressly mentioned here or in the respective parts of this specification.

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B0.2.8 Fuel

The Plant shall be operated with imported sub-bituminous and bituminous coal as the principle fuel. Coal will be supplied via bulk carrier vessels (barges and vessels up to 25,000t, to be unloaded at the Coal Jetty.

The Plant will have to be able to be fully operational and in accordance with all guarantee parameters with all coals on a 100 % basis that comply with the coal characteristics as indicated in **Part C**.

For reference purposes, the list that contains the performance coal and the design range for the coals is included in **Part C Annexes**.

For start-up, low-load operation and shut-down, high speed diesel (HSD) shall be used. HSD will be supplied by truck. A typical analysis is given in **Part C Annexes**.

Special technical requirements for the HSD system are given in **Section B4**.

B0.2.9 Output, heat rate and availability requirements

B0.2.9.1 Guarantee definitions

The following guarantees are defined:

Acceptance Guarantees:
The acceptance guarantees must be met in all operating gases unrestrictedly. They are not subject to any correction. Acceptance Guarantees are specified in the Technical Schedules of **Section B0**. The acceptance guarantees are required to be achieved or executed as a condition precedent to Taking Over.

Special Guarantees:
These guarantees are subject to correction, e.g. for fuel characteristics or ambient conditions and if they are not met, they are subject to payment of performance damages. Special Guarantees are specified in the Technical Schedules of **Section B0**.

Minimum Acceptance level (MAL):
Minimum acceptance level (MAL) means the relevant minimum performance levels for the Plant as specified in the relevant part of the Technical Schedules of **Section B0**. The MAL are required to be achieved or executed as a condition precedent to Taking Over.

Liquidated Damages (LD)
Liquidated Damage means the monetary amount to be paid by the Contractor to the Employer if the Special Guarantees are below the Guaranteed Value but above Minimum Acceptance Levels.

B0.2.9.2 Plant output

Gross Electrical Power Output
The gross electrical power output per unit is determined at the turbine generator terminals to the isolated phase busbars, downstream of the connection for the excitation transformer.

The gross electrical power output per unit shall be: **660.0 $MW_{e,gross}$** (plus excitation power requirement in case of static excitation) and shall be kept for the whole coal range.

Net Electrical Power Output
The net electrical power output per unit is determined at the off-take point in the switchyard that means at the high voltage (HV) terminals of the dedicated generator transformer (GT).

The net output is determined by subtracting the consumption of the auxiliary transformer including transformer losses from the gross output.

Export Power Output
The export power output of the Plant is determined at the tariff meterings of the Plant.

The export power output of the Plant equals the net power output of both units minus the losses of the interconnection transformers (ICTs) and start-up transformers.

Dependable Capacity
Dependable Capacity means - according to the Power Purchase Agreement (PPA) - at any given time the net amount of capacity at the tariff metering; either for the first generating unit or for the Plant, as the case may be.

MCR - Maximum Continuous Rating
MCR is defined as the maximum continuous rating (gross electrical power output) of one (1) power plant, coal within the coal range, under Reference Site Conditions (RSC), governor valves being throttled to provide frequency variation as required, boiler in normal operating mode including blow down (if applicable), auxiliary steam consumption (if applicable) etc.). All load percentages apply to MCR, unless otherwise noted.

The dedicated net electric power output at MCR with PF and RSC is:

- $P_{MCR\text{-}PF\text{-}RSC}$ in [MWe]

The dedicated steam generator load at MCR with PF and RSC is.

- $F_{MCR\text{-}PF\text{-}RSC}$ in [kg/s]

TMCR - Turbine Maximum Continuous Rating / VWO - Valves Wide Open (Peak Load)
TMCR/VWO is defined as the maximum continuous rating, at which the steam turbine is capable of operating under normal operating conditions (see MCR). However, when the governor valves are fully opened TMCR/VWO shall be at least 103% of MCR, i.e.:

- $P_{TMCR} = 1.03 \times P_{MCR}$

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That means, Gross Electrical Power Output at

- MCR shall be 660 MW ((plus excitation power requirement in case of static excitation)
- TMCR shall be 679.8 MW.

BMCR - Boiler Maximum Continuous Rating
BMCR is defined as the maximum continuous steam generating capacity, at which the boiler is capable of operating under normal operating conditions (see MCR). BMCR shall be at least 105% of MCR, i.e.:

- $F_{BMCR} = 1.05 \times F_{MCR}$

The steam flow at superheater outlet at BMCR shall be 105% MCR flow. Reheater steam flow at BMCR shall be as per Heat Balance Diagram.

MNCR - Minimum Continuous Rating
MNCR is defined as the minimum rating of a power plant unit under normal, continuous operating conditions (see MCR) with coal fire only (without back-up firing with start-up/ignition fuel) with any coal within the coal range. MNCR shall be 30% of MCR.

$P_{MNCR} = 0.3 \times P_{MCR}$.

B0.2.9.3 Net heat rate

The guaranteed Net Heat Rates of the Units and the Plant are to be given in the Technical Schedules of **Section B0.**

The competitiveness of the bid will be evaluated by considering the lowest life-cycle-costs of the bids, which will strongly be influenced by the Bid price on the one hand and the guaranteed Net Heat Rate on the other hand. The optimization criterion which may be utilized by the Contractor in the determination of the proposed power station design is the penalty imposed by not achieving the guaranteed Net Heat Rate as per the Contract.

The guaranteed Net Heat Rates refer to the following load points:

- 100% MCR
- 80% MCR
- 60% MCR
- 50% MCR

The „Net Heat Rate" is the heat rate for the dedicated unit. It is defined according to ASME PTC 46.

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PerformanceTests/Guarantee Tests at MCR shall correspond to rated pressure (with throttled valves); whereas for part load (i.e 80%, 60%. 50% MCR) the PerformanceTests/Guarantee Tests shall be under modified sliding pressure (with 5% throttled turbine inlet valve(s)).

B0.2.9.4 Auxiliary power consumption, losses, own consumption,

Auxiliary Power Consumption
The auxiliary power consumption is the power that is required by the auxiliary power transformer of each unit.

ICT Losses and Start-up Transformer Losses
The losses of the ICTs and start-up transformers apply for the complete switchyard of the Plant.

Own Consumption
The own consumption is the sum of the auxiliary power of both units and the ICT losses and star-up transformer losses.

B0.2.9.5 Plant availability

The Contractor shall:

a. design and configure all components of the Plant;
b. propose spare parts stock, comprising as minimum requirement the Initial Spare Parts as requested in Amendment No 3 and Annexure I to Amendment No.3 (both already published on BIFPCL's Website; and
c. propose maintenance works

in such a way that the average availability of each unit for a period of two year is not lower than 90 %.

The availability for the year means the yearly availability of the Dependable Capacity of each unit for dispatch by the Control Centre, calculated in accordance with the following formula:

$$AF_n = \frac{DC \times \text{hours in the year} - ((MO_{cap} \times MOH) + (FO_{cap} \times FOH) + (SO_{cap} \times SOH))}{DC \times \text{hours in the year}}$$

Where:

AF_n	Availability Factor for the year "n"
DC	Dependable Capacity of the Unit as per the Contract
MO_{cap}	capacity reduction during each maintenance outage in the year n"
MOH	maintenance outage hours for each maintenance

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	outage (MO_{cap}) in the year "n"
FO_{cap}	capacity reduction during each forced outage in the year "n"
FOH	forced outage hours for each forced outage (FO_{cap}) in the year "n"
SO_{cap}	capacity reduction during each scheduled outages in the year "n"
SOH	scheduled outages hours for each scheduled outage (SO_{cap}) in the year "n"
$\Sigma(MO_{cap} \times MOH)$	maintenance outage energy for the year "n"
$\Sigma(FO_{cap} \times FOH)$	forced outage energy for the year "n"
$\Sigma(SO_{cap} \times SOH)$	scheduled outage energy for the year "n"

B0.2.9.6 Maintenance intervals

The Plant shall be designed to follow at least the following requirements for maintenance intervals:

	Recommended outage duration (days)	**Recommended intervals between maintenance outages (years)**
Scheduled Maintenance (Minor Overhauls)	to be determined by Contractor, see B0 TS	> two years
Major Overhaul	to be determined by Contractor, see B0 TS	> eight years

It is meant that the Bidder/Contractor shall determine the final maintenance intervals which shall > 2 years for minor overhauls and > 8 years for major overhauls, supposed that the plant is operated with the specified fuels and according to the operation and maintenance manuals.

In case a minor or major overhaul has to be carried out in the first two years after PAC that means during the warranty period it will have an impact on the availability and as the case may be on the availability guarantee.

B0.2.10 Mode of operation

The Plant shall be designed for base load operation and is expected to participate in the system frequency regulation by free governor operation.

All the equipment and the facilities shall be suitable for:

- Continuous and short-time operation under average ambient air and river water conditions present on site; and
- Continuous and short-time operation under extreme ambient air and river water conditions present on site.

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The design of the Plant shall be based on the following operation and dispatching requirements:

a. It shall be capable of following the daily and seasonal demand profile of the electrical network.
b. Full compliance with the conditions of the admissible air pollution is required within the power range.
c. The power generation shall be fully dispatch able within the technical limits of the Plant to be specified by the Contractor but at least between MNCR and 100 % of the Net Output of the Plant at BMCR.

The units shall be operated as base load plant. It must be capable for following operation modes:

- Fixed/Constant pressure operation upton 40% MCR load;
- Sliding pressure operation from rated pressure down to 40% of rated with as well as without any throttle reserve. At any operating load, the throttle reserve shall be sufficient so as to achieve an instantaneous increase in turbine output by 5% (except MCR, 3% for MCR) of the corresponding load by opening turbine control valve wide open VWO/TMCR). The throttle reserve shall be adjustable to 0% for pure sliding pressure mode operation;
- Fixed/Constant pressure from 100% MCR to 103% MCR (TMCR/VWO) load. Consequently the plant shall be designed also for fixed pressure operation as much higher load than 40% upto to 100% load;
- start-up modes from notice to start to synchronization:
  - hot start: start-up following a continuous shutdown for a period of 8 hours or less in max. 3 hours;
  - warm start: start-up following a continuous shutdown for a period between 8 and 48 hours in max. 4 hours;
  - cold start: start-up following a continuous shutdown for a period more than 48 hours in max. 12 hours;
- shut-down mode;
- Each Unit shall be capable of automatic operation and control and full cyclic operation between MNCR and BMCR without restriction;
- operation without HP heater;

With all HP heaters out of service 100% el. load shall be generated with maximum cooling water temperature, 3% make up and normal auxiliary steam requirement being tapped from cold re-heat line. For bypass of HP heaters a full bypass shall be considered.

- house load operation;
- In case of sudden load throw-off, the steam generator shall be capable of automatically bringing down the steam generating capacity from BMCR to match with HP-LP bypass capacity;

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- The Power Plant shall be designed for minimum rate of loading/unloading mentioned below without compromising on design life of pressure parts;
- step load change: Minimum ± 10% /min;
- ramp rate: Minimum ± 3%/min (MNCR to 50% BMCR);
  Minimum ± 5% /min (50% MCR to 100% BMCR).

In addition to the the following requirements shall be considered:

- Steam Generator (refer also to Bidding Documents, Section V TS, B1.3.1.1 Operational requirements): "The steam generator shall be operable in the variable (i.e. sliding or modified sliding) and fixed pressure mode";
- Steam Turbine (refer to Bidding Documents, Section V TS, B2.3.15 Control and monitoring equipment): "The steam turbine shall be capable of operating in both the sliding and fixed pressure modes. The Bidder/Contractor shall propose the operating regime which will maintain a highest efficiency of the Plant at various loads."

The Performance Tests/Guarantee Tests shall be executed for the load points as specified. Performance Tests/Guarantee Tests at MCR shall correspond to rated pressure (with throttled valves); whereas for part load (i.e 80%, 60%. 50% MCR) the guarantee test shall be under modified sliding pressure (with 5% throttled turbine inlet valve(s)).

For more detailed requirements refer also to Chapter B0.2.12.

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B0.2.11 Electrical network connection conditions

The Plant shall comply with:

a. the Essential Electrical Requirement of the PPA
b. the latest edition of the Electricity Grid Code of the Bangladesh Energy Regulatory Commission; and
c. the Great Britain Grid Code.

In case of contradictions or discrepancies the order of precedence shall be as follows:

a. Essential Electrical Requirements of the PPA
b. Electricity Grid Code of the Bangladesh Energy Regulatory Commission
c. Great Britain Grid Code.

Any other requirements of the Bangladesh Power Development Board (BPDB) or Power Grid Company of Bangladesh (PGCB) shall also be considered.

The Tenderershall list all those grid connection requirements which cannot be met by the proposed Plant.

B0.2.11.1 Essential Electrical Requirements of the PPA

In this chapter essential electrical requirements for the grid connection and Plant operation are extracted from the PPA. For ease of reference, the relevant chapters/articles of the PPA are indicated.

PPA Section 11: Power Evacuation and Switchyard

11.1 Power Evacuation

The Company shall deliver power at the Delivery Point and BPDB shall evacuate power from the Delivery Point. In this regard, BPDB itself or through PGCB shall construct Power Evacuation Facilities at its own costs and expenses. The Company shall construct switchyard for evacuation of power, with the provision for termination of two 400 kV circuits and two 230 kV circuits of PGCB. This switchyard along with line breaker, CT, PT and other necessary equipment and associated relays, controls, protection, communication and instrument system situated within this switchyard, will be operated and maintained by the Company. The company will also construct connecting lines (U/G or O/H) from power plant to this switchyard. The Company shall provide suitable interface unit at the Company premises for communication links to the power grid SCADA system to accommodate the PGCB and the National Load Dispatch Center (NLDC) requirements. The communication interface unit provided in the Company premises shall be adequate to fulfil the PGCB/NLDC information requirement and may be in the form of RTU or a suitable Gateway on company switchyard automation network at a mutually agreed communication protocol (i.e. IEC-60870-5-101/104). The Company shall be responsible for construction of the interconnections between the switchyard and the Facility. The company Switchyard including the interconnecting link with the generation facility should have design standards as per Minimum Functional Specification. Line relays and controls at the switchyard shall be provided by the Company.

In addition refer to B10.

Only the "start up transformer" and the "future GT's" shall be connected by means of 230 kV cables. Connection between GT's and GIS switchyard shall be done by overhead line.

BPDB shall provide by no later than two hundred and seventy (270) Days prior to Scheduled Initial Operation Date, the following facilities to the Company for the purpose of Commissioning, synchronization and operation of the Facility:

i. One number 230 KV D/C transmission line from the BPDB / PGCB 230 KV system, to be terminated at the specified point at the switchyard of the Facility;

ii. (ii) Start-up power of not less than 50 MVA capacity, to be supplied to the Facility through this 230 KV transmission line, by no later

than two hundred and seventy (270) Days prior to Scheduled Initial Operation Date;

iii. One number 400 KV D/C transmission line from the BPDB / PGCB 400KV system, to be terminated at the specified point at the switchyard of the Facility, with adequate capacity to evacuate entire power generated by the Contracted Capacity of the Facility, by no later than one hundred and eighty (180) Days prior to Scheduled Initial Operation Date;

11.2 Electrical

a. Communication link

The Company shall provide suitable interface unit at the Company premises for communication links to the power grid SCADA system to accommodate the PGCB and the National Load Dispatch Center (NLDC) requirements. The communication interface unit provided in the Company premises shall be adequate to fulfil the PGCB/NLDC information requirement and may be in the form of RTU or a suitable gateway on Company switchyard automation network at a mutually agreed communication protocol (i.e. IEC-60870-5-101/104).

The Company shall be responsible for construction of the interconnections between the switchyard and the Facility. The Company switchyard including the interconnecting link with the generation facility should have design standards as per Minimum Functional Specification. Line relays and controls at the switchyard shall be provided by the Company.

b. Control of Switchyard

Provision and installation of all control and signal cables between the company switchyard and the Facility shall be responsibility of the Company. Necessary interface shall be provided within the switchyard control facility for receiving the signals from PGCB grid control. It shall be responsibility of the Company to lay and terminate cables for this purpose.

All circuit breakers and disconnect switches shall be capable of being electrically controlled from the three control positions as follows:

i. Local Control: Located adjacent to switching devices, to facilitate maintenance, inspection, and emergency operation.

ii. Remote Control: Located at the switchyard control room, where switching devices are controlled by direct wire.

iii. Supervisory Control: Located at the Load Dispatch Centre (NLDC) at Dhaka, for remote control and supervision via the tele-control systems to be supplied by the Company.

Also refer to B10.

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The Company shall provide all the necessary control-selector switches, position indicating contacts, and interposing relays.

11.3 Electrical Protection, Communication and Instrument Systems
The Company shall provide a complete and comprehensive protection system for the generators/generator transformers/service transformers, transmission lines and the station electrical distribution systems. The Company shall undertake the installation of the protection relay panels within the control room, wiring between panels and switchyard equipment, and commissioning tests of the protection schemes.

The Company (in consultation with BPDB) shall provide suitable interface unit at the Company premises for communication links to the PGCB's SCADA system for Communication, control, monitoring and voice channels required for PGCB's National/Regional Control Center.

Communication, telemetry, fiber optical terminal, and tele-protection equipment (PLCC) shall be supplied and installed by PGCB at company switchyard end, matching with PGCB's remote substation end requirements. However, line trap and capacitive voltage transformer of required rating along with 48V DC/AC auxiliary supply at company switchyard end shall be provided by company. The wiring of all signalling and control circuits required for the system shall be cabled out to interface marshalling cubicles by the Company. The Company shall supply and install necessary cabling and cubicles. Cabling between the Company's cubicles and PGCB' LDC equipment shall be provided and installed by the Company.

PPA Schedule 1: Minimum Functional Specifications
3. ELECTRICAL REQUIREMENTS
3.1 Generators

a. Each generator shall comply with IEC 34: Latest Edition and shall be rated to match [each][the] Steam turbine[s] and the steam turbine output over the full range of ambient temperatures. Generator and exciter windings shall possess insulation that is non-hydroscopic and of Class F type in accordance with IEC 85 standard.

b. Not Used

c. The quality management of the generator[s] and accessories shall be in accordance with the requirements of ISO 9001, EN 29001 or BS 5750 Part 1 or such other equivalent international quality standards and Prudent Utility Practices.

d. Temperature detectors shall be provided (to be placed in the hottest zone as decided by manufacturer) to monitor the maximum operating temperature of the machine.

e. The generator[s] shall be capable of operating within 48.5 Hz and 51.5 Hz and +/- 5% of nominal rated voltage within the power factor

range 0.85 lagging and 0.95 leading at the generator terminal. However, the combined variation in voltage and frequency shall not exceed 5%.

f. Generator[s] shall have a minimum short circuit ratio complying with IEC 34.

3.2 Excitation System

a. A continuous fast acting automatic excitation control system of proven design shall be provided to control each generator's voltage without hunting or instability over the entire operating range of the generators.

b. The excitation system shall be provided with a fast acting MVAR limiter so as to prevent the generator output falling below safe limits. A power system stabiliser shall be incorporated in the excitation system of each generator. BPDB shall provide the settings for the power system stabiliser. The AVR shall be provided with but not limited to Quadrature Droop Compensation and Cross Current Compounding. Protection features, as part of the system shall include overvoltage, overcurrent, voltage transformer (VT) fuse failure, diode failure, overfluxing, and AVR power supply failure. A field shorting or discharge switch feature shall be included in the system as protection against over stressing the generator insulation in the event of a fault.

c. Manual excitation control facilities shall be provided as back up to the automatic channel, and shall have an adequate range to allow for control of excitation for testing purposes. A true null balance shall be provided to allow for smooth excitation transfer between manual and automatic control.

Bidder's/Contractor's/OEM's standard and proven static excitation system with advanced duall channel digital voltage regulator system which do not require true null meter or follow up device for smooth AVR control transfer between auto and manual will be accepted.

The requirement related to on load tap changer is not applicable to excitation transformer.

3.3 Power and Auxiliary Transformers

The Facility shall include a main transformer for each generator, together with all protection, busbars and disconnectors where required. These main transformers shall be equipped with on load [to be discussed with BPDB] tap changers and shall be of OFAF (forced oil, forced air) or ODAF (oil direct, forced air cooled) or suitable type rated for the full continuous output of the generator.

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All service station auxiliary transformers (utilization voltage <650V) shall be OFAF, ODAF or ONAN cooled if located outside, or resin type design if situated inside the buildings.

3.4 Control and Supervision

a. Supervisory control, monitoring, and data acquisition information shall comply with BPDB's system control concept and proposed/current system. BPDB shall provide all supervisory control, monitoring, and data acquisition circuits from BPDB's National/Regional Control Center, all of which shall conform to the Company's requirements.

b. Manual synchronising facilities, with such check facilities shall be provided as a minimum for all circuits except for station/service transformer circuits.

c. The Facility shall be provided with a central on-site control room (CCR) so that operators can control the generators and perform switching and load dispatch duties. A Distributed Control System (DCS) shall be provided to coordinate the control and supervision of the Facility including half hourly Dependable Capacity correction for Reference Site Condition

d. The Facility shall be equipped with terminals to receive command from the BPDB load dispatch center to allow control from Load Dispatch Center.

3.5 Electrical Protection, Communication Instrument Systems

The Facility shall incorporate a protection system for generators, generator transformers, service transformers, and station electrical distribution systems as per Prudent Utility Practice.

Communication, control, monitoring, and voice channels will be provided between the Facility and BPDB's National/Regional Control Center by BPDB. The Company shall provide interconnection within the Facility for all such communication circuits/channels.

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3.6 Power Tariff Metering

a. The Metering System to be installed at the Facility shall include tariff metering and indicative metering.

b. For each unit, the measurements, which are used for calculation of the main tariff metered energy, are taken at the outgoing side of the interconnecting lines (main and check) and Back-Up Metering System on the high voltage side of each generator transformer and station transformers, as applicable. The tariff meters installed will measure the net energy sent out from the facility. As provided in Section 12.1, the Back-Up Metering System shall also be of the same type and identical to the Metering System.

Main and check meters shall be provided on HV side of generator and start-up transformer as well as at the outgoing side of the interconnection lines (Reference is made to chapter B10.3.13).

c. The tariff meters shall have separate facilities for recording the net inflow to the Facility and net outflow of energy from the Facility, and the aggregate of these parameters. This information shall be available for transmission to remote locations via the communication circuit to be provided by BPDB.

d. Sufficient indicative metering facilities will be installed to allow efficient normal operating and maintenance procedures and automatic control functions to be conducted at the Facility. The metering shall be logged by the Facility's DCS.

PPA Schedule 1: Technical Limits and Contracted Characteristics

1.3 Frequency, Power Factor and Voltage Limits

a. At rated voltage and frequency, the Facility will operate at 100% load with a power factor in the range 0.85 lagging to 0.95 leading at the generator terminals, which range shall not be exceeded. The curves from the manufacture(s) showing the Reactive Power capability of the generators form part of Schedule 2.

b. The Facility will operate within the line voltage range used in practice by BPDB and in no case shall the Facility be required to operate more than +5% or less than -10% on the 400 kV high voltage system.

c. The Facility shall operate within the frequency range 48.5 Hertz to 51.5 Hertz which range shall not be exceeded. The Facility shall be capable of continuous operation for the periods defined in Table 3,

Table 3: As per PPA

Frequency Range (Hz)	Minimum Sustainable Operation
48.5 to 51.5	Continuous
47.5 to 48.5	10 minutes
Less than 47.5	Trip Condition
Greater than 51.5	Trip Condition

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B0.2.11.2 Essential Requirements of Electricity Grid Code of the Bangladesh Energy Regulatory Commission

In this chapter essential requirements for the grid connection and Plant operation are extracted from the BGC. For ease of reference, the relevant chapters/articles of the BGC are mentioned in brackets.

The full compliance with the BGC shall be proven by electrical system studies and investigations.

The ratio of X/R can be considered as 40 based on the table 10 given in IEEE C37.010.

It is to be emphasized that there are some discrepancies between the requirements of the BGC and the requirements of the International Electrotechnical Commission Standard IEC 60034. In case of contradictions the requirements and stipulations of IEC 60034 shall prevail.

The Tenderer shall discuss all deviations from the grid connection conditions, which will result in an economic advantage for the investment and the operation of the Plant.

B0.2.11.2.1 System performance (Section 5.4)

Each generating unit shall be capable of generating at full rated power output within following ranges:

	From	To
Frequency	47.5 Hz	52 Hz
Rated Voltage	-10%	+ 10%
Power factor	0.85 lagging *)	0.95 leading

*) This value deviates from the BGC and is chosen as common for generator of this size.

The Transmission System frequency shall normally be 50.0 Hz and shall normally be controlled in the range 49.0 – 51.0 Hz (50 Hz ± 2%). The User shall however be subject to the grid discipline directed by the Commission.

Voltage variation on the Transmission System shall normally be +/- 10% during emergencies and +/- 5% during normal operation, in accordance with the provisions of Planning and Security Standards for Transmission System. Insulation coordination of the **Users'** equipment and rupturing capacity of switchgear shall conform to applicable Bangladesh Standards/Codes.

Protection schemes and Metering schemes shall be as detailed in the Protection & Metering Sections of the Code.

For new Power Stations the equipment within their site for data transmission and communications shall be owned and maintained by the respective Generator.

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B0.2.11.2.2 Connection point (Section 5.6.1)

Unless specifically agreed with the Licensee the Connection point shall be the outgoing gantry of Power Station switchyard. The metering point shall be at the outgoing connection point. All the substation equipment including Protection, Control and Metering equipment owned by the Generator within

the perimeter of the Generator's site shall be maintained by the Generator. Other Users' equipment shall be maintained by the respective Users. From the outgoing feeder gantry onwards, the Licensee shall maintain all electrical equipment.

B0.2.11.2.3 Data requirements (Section 5.7)

Users shall provide the Licensee with data for this Section as specified in the Data Registration Section.

B0.2.11.2.4 Frequency management & responsibilities (Section 8.3 and 8.4)

Generators shall follow the dispatch instructions issued by the **NLDC**.

All Generating Units shall have the governor available and in service and must be capable of automatic increase or decrease in output within the normal declared frequency range and within their respective capability limit.

Under certain conditions the system frequency could rise to 52 Hz or fall to 47.5 Hz. All Generating Units should be capable of operating within the range and the **NLDC** informed promptly of any restrictions. **Generators** shall be responsible for protecting their Generating Units against damage should frequency excursions outside 52 Hz and 47.5 Hz ever occur. Should such excursions occur, the **Generator** should decide whether or not to disconnect his apparatus for reasons of safety of apparatus, Plant and/or personnel. The **Generator** shall inform the **NLDC** immediately after taking such action.

Sustained rising frequency

Under rising frequency conditions, the **NLDC** shall take appropriate action to issue instructions to **Generators** to arrest the rising frequency and restore frequency within normal range. Such instructions may include reducing generated output or de-synchronizing Generating Units from the Transmission System. When the frequency rises above 51.0 Hz actions must be taken immediately by the **Generator**. Under such condition, the Generating Units which were responsible for seeing frequency of the system shall decrease their Generating Output at a rate of – (minus) 2% per 0.1 Hz for departure of frequency above 51.0 Hz until the frequency is restored within the normal range. The **Generator** shall inform the **NLDC** immediately after taking such action.

Sustained falling frequency

Under falling frequency conditions, the **NLDC** shall take appropriate action to issue instructions to arrest the falling frequency and restore it to be within normal range. Such instructions may include dispatch instructions to **Generators** to increase output, to synchronize standby Generating Units to

the Transmission System and/or instructions to Distribution Utilities to reduce load demand by appropriate manual and /or automatic load shedding.

When the frequency falls below 49.0 Hz the Generating Units which were responsible for seeing frequency of the system shall increase their Generating Output at a rate of + (plus) 2% per 0.1 Hz (if available) for departure of frequency below 49.0 Hz until the frequency is restored within the normal range. The **Generators** shall be responsible for protecting own units should frequency excursions occurs outside 47.5 to 52 Hz range. The **Generator** shall inform the **NLDC** immediately after taking such action.

All Generating Units that have been declared available shall be required to be synchronized and loaded in the event of the sustained low frequency below 49.0 Hz provided local and safety conditions permit. This action shall be performed without delay after failed attempts to contact the **NLDC**. The Generator shall inform the **NLDC** immediately after taking such action.

B0.2.11.2.5 Voltage management (Section 8.5)

The **Licensee** and **NLDC** shall carry out load flow studies from time to time to predict where voltage problems may be encountered and to identify appropriate measures to ensure that voltages remain within the defined limits. On the basis of these studies the **NLDC** shall instruct **Generators** to maintain specified voltage levels at interconnecting points.

The **Licensee** shall continuously monitor 400 kV/ 230 kV/ 132 kV transmission grid voltage levels at strategic substations. The **NLDC** and the Licensee shall regulate voltage levels within the prescribed levels.

The **NLDC** and the **Licensee** shall jointly take appropriate measures to control Transmission System voltages that may include but not be limited to transformer tap changing and use of MVAR reserves with Generating units within technical limits agreed to between the **NLDC, Licensee** and Generating units.

All Generating Units shall have Automatic Voltage Regulator (AVR) in service.

Generators shall inform the **NLDC** of their reactive reserve capability promptly on request. **Generators** shall make available to the **NLDC** the up-to-date capability curves for all Generating Units, as detailed in **Section 5**, indicating any restrictions, to allow accurate system studies and effective operation of the Transmission System.

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B0.2.11.2.6 Monitoring of generation (Section 8.7)

For effective operation of the Transmission System, it is important that a **Generator's** declared availability is realistic and that any departures are continually fed back to the **Generator** to help effect improvement.
The monitoring by the **NLDC** of Generating Unit output, and active and reactive reserve capacity, shall be carried out to evaluate the reliability and performance of plant.

The **NLDC** shall continuously monitor Generating Unit outputs and bus voltages (by SCADA). More stringent monitoring may be performed at any time, as detailed in the Testing Section, when there is reason to believe that a **Generator's** declared availability may not match the actual availability or declared output does not match the actual output.

Generators shall provide to the **NLDC** hourly generation summation outputs where no automatically transmitted metering or SCADA equipment exists.

The Generator shall provide other logged readings that the **NLDC** may reasonably require, for monitoring purposes where SCADA data is not available.
Generators shall submit data to **NLDC** as listed in Data Registration Section, termed as Frequency and Voltage Management.

B0.2.11.2.7 Contingency planning (Section 9)

Total System Blackout (Section 9.3.1)
NLDC shall instruct all relevant Generators having Power Stations with Black Start capability to commence their pre-planned Black Start procedure.

Remark: The Maitree-STPP shall **not** have Black Start capability.

Partial Transmission System Blackout (Section 9.3.2)
NLDC shall ensure with the **Licensee** and **Users** that security of the healthy part of the Transmission System is maintained.

NLDC and the **Licensee** shall gradually extend the healthy system to provide start-up power to appropriate Generating Units.

NLDC and the **Licensee** with close coordination with Distribution Utilities and **Generators** shall gradually restore demand to match generation as it becomes available.

All **Users** shall take care to ensure load generation balance is maintained at all times under **NLDC's** direction.

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Special Consideration (Section 9.5)
During the restoration process following Transmission System blackout conditions, normal standards of voltage and frequency shall not apply.

B0.2.11.2.8 Protection (Section 12)

General Principals (Section 12.3)
No item of electrical equipment shall be allowed to remain connected to the Transmission System unless it is covered by appropriate protection aimed at reliability, selectivity, speed and sensitivity. Guidelines mentioned in protection manuals may be kept in view.

All **Users** shall co-operate with the **Licensee** to ensure correct and appropriate settings of protection to achieve effective, discriminatory removal of faulty equipment within the time for target clearance specified in this Section.

Protection settings shall not be altered, or protection bypassed and/or disconnected without consultation and agreement of all affected Users. In the case where protection is bypassed and/or disconnected, by agreement, then the cause must be rectified and the protection restored to normal condition as quickly as possible. If agreement has not been reached the electrical equipment will be removed from service forthwith.

Fault Clearance Times (Section 12.5)
From a stability consideration the maximum fault clearance times for faults on any **User's** system directly connected to the Transmission System, or any faults on the Transmission System itself, are as follows:

Target Clearance Times:

i. 400 kV : 100 ms
ii. 230 kV : 160 ms
iii. 132 kV : 160 ms.

Slower fault clearance times for faults on a Users system may be agreed to but only if, in the **Licensee's** opinion, system conditions allow this.

Generator Requirements (Section 12.6)
All Generating Units and all associated electrical equipment of the **Generator** connected to the Transmission System shall be protected by adequate and coordinated protection so that the Transmission System does not suffer due to any disturbance originating from the Generating Unit.

In the event of failure of the protection systems provided to meet the fault requirements detailed above, backup protection shall be provided by the **Generator** with a fault clearance time not slower than 400ms for faults on the Generating Unit's HV connections. The protection shall also cover EHV lines and transformers to the standards as for the Transmission System and

circuit breaker fail, pole slipping, loss of excitation, power system stabilizer and negative phase sequence tripping.

Transmission Line Requirements (Section 12.7/12.7.1/12.7.3)
Every 400 kV Line and 230 kV Line taking off from a Power Station or a substation shall have main protection and backup protection as mentioned below. The **Licensee** shall notify **Users** of any changes in its policy on protection from time to time.

- Two distance protections plus directional earth-fault protection (in directional comparison scheme) shall be provided as the Main-1 and Main-2 protection respectively.
- One stand alone directional 3-phase or 2-phase over-current relay and one directional earth-fault relay shall provide the backup protection.
- Three pole and/or single pole single shot auto-reclosing equipment shall be fitted, as appropriate, as considered by the licensee. All auto-reclosing equipment will be made inoperative for three phase trip-out and/or back-up protection operation.
- Both distance and directional earth-fault functions shall have compatible communication aided transfer trip scheme.

For short transmission lines Line Differential Protection along with backup Directional normal, Directional time-lag and/or Non-Directional Over-current and Earth-fault protection shall be provided as an appropriate protection scheme.

Relay Panels for the protection of lines of the **Licensee** taking off from a Power Station shall be owned and maintained by the **Licensee**. **Generators** shall provide space, connection facility and access to the **Licensee** for such purpose.

The **Generator** shall ensure that all common facilities needed for installing required protective relaying are made available to the Licensee.

Transformer Requirements - Generating Station/Transmission System (Section 12.9.1)
All windings of auto-transformers and power transformers of EHV class shall be protected by differential relays and REF relays as main protection. In addition there shall be one backup time lag 3-phase Over-current and Earth-fault protection relay. For parallel operation such backup protection shall have directional feature. For protection against heavy short circuits, the Over-current and Earth-fault relays should incorporate a high set instantaneous element. In addition to electrical protection, gas operated relays, winding temperature protection and oil temperature protection shall be provided. Over-voltage, thermal overload and over-fluxing protection should also be provided.

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Substation Busbar and Fire Protection (Section 12.10.1/12.10.2)
All **Users** shall provide adequate main and backup bus zone protection incorporated with Local Breaker Backup (LBB) or Breaker Fail Protection (BFP) for busbars in all 400 kV, 230 kV and 132 kV class substations.

Adequate precautions shall be taken and protection shall be provided against fire hazards to all Apparatus of the Users conforming to relevant Bangladesh Standard Specification and/or provisions in the Electricity Rules, 1937 and amendments thereof and other standard engineering practices.

Data Requirements (Section 12.11)
Users shall provide the **Licensee** with data for this Section as specified in the Data Registration Section.

B0.2.11.2.9 Testing (Section 14)

Introduction (Section 14.1)
This Section specifies the responsibilities and procedures for arranging and carrying out Tests which have (or may have) an effect on the Transmission System or the **Generator's** or **Distributor's** systems.

Objective (Section 14.2)
The objective of the Section are to establish whether Generating Units can operate within their Generation Schedule and Dispatch parameters as registered under the Data Registration Section and that the Generator and Distributor comply with the Connection Section. It shall also establish whether each Generating Unit's declared availability capacity is as declared and that the requirements of the provisions of frequency, voltage management and reserve capability are met in accordance with the provisions of the Grid Code.

B0.2.11.2.10 Performance standards for transmission (Section 17)

Purpose and Scope (Section 17.1.1/17.1.2)
Purpose:

a) To ensure the quality of electric power in the Grid.
b) To ensure that the Grid will be operated in a safe and efficient manner and with a high degree of reliability; and
c) To specify safety standards for the protection of personnel in the work environment

Scope of Application:
This Chapter applies to all Grid Users including:

a) the Licensee
b) the System Operator/ NLDC
c) generators

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d) distribution utilities, and
e) any other entity (e.g. owners of HVDC converter, large furnaces, etc.) with a User System connected to the Grid.

Power Quality Standards (Section 17.2)

Power Quality Problems (Section 17.2.1)

For the purpose of this Article, Power Quality shall be defined as the quality of the voltage, including its frequency and the resulting current that are measured in the Grid during normal conditions.

A Power Quality problem exists when at least one of the following conditions is present and significantly affects the normal operation of the System:

a) The System Frequency has deviated from the nominal value of 50 Hz.
b) Voltage magnitudes are outside their allowable range of variation.
c) Harmonic Frequencies are present in the System
d) There is imbalance in the magnitude of the phase voltages.
e) The phase displacement between the voltages is not equal to 120 degrees.
f) Voltage Fluctuations cause Flicker that is outside the allowable Flicker Severity limits, or
g) High-frequency Over-voltages are present in the Grid.

Frequency Variations (Section 17.2.2)

The nominal fundamental frequency shall be 50 Hz. The control of System frequency shall be the responsibility of the System Operator. The System Operator shall maintain the fundamental frequency within the limits of 49.0 Hz and 51.0 Hz during normal conditions.

Voltage Variations Section 17.2.3)

For the purpose of this Section, Voltage Variation shall be defined as the deviation of the root-mean-square (RMS) value of the voltage from its nominal value, expressed in percent. Voltage Variation will either be of short duration or long duration.

A Short Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one-half cycle of the power frequency but not exceeding one minute. A Short Duration Voltage Variation is a Voltage Swell if the RMS value of the voltage increases to between 110 percent and 180 percent of the nominal value. A Short Duration Voltage Variation is a Voltage Sag (or Voltage Dip) if the RMS value of the voltage decreases to between 10 percent and 90 percent of the nominal value.

A Long Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one minute. A Long Duration Voltage Variation is an Under-voltage if the RMS value of the voltage is less than or equal to 90 percent of the nominal voltage. A Long Duration Voltage Variation is an Overvoltage if the RMS

value of the voltage is greater than or equal to 110 percent of the nominal value.

The Grid Owner and the System Operator shall ensure that the Long Duration Voltage Variations result in RMS values of the voltages that are greater than 95 percent but less than 105 percent of the nominal voltage at any Connection Point during normal conditions.

Harmonics (Section 17.2.4)
For the purpose of this Section, Harmonics shall be defined as sinusoidal voltages and currents having frequencies that are integral multiples of the fundamental frequency. The Total Harmonic Distortion (THD) shall be defined as the ratio of the RMS value of the harmonic content to the RMS value of the fundamental quantity, expressed in percent.

The Total Demand Distortion (TDD) shall be defined as the ratio of the RMS value of the harmonic content to the RMS value of the rated or maximum fundamental quantity, expressed in percent. The Total Harmonic Distortion of the voltage and the Total Demand Distortion of the current at any Connection Point shall not exceed the limits given in Tables 17-1 and 17-2, respectively.

Harmonic Voltage Distortion

Voltage Level	THD*	Individual	
		Odd	Even
400 kV	1.5%	1.0%	0.5%
132-230 kV	2.5%	1.5%	1.0%
66 kV	3.0%	2.0%	2.0%

* Total Harmonic Distortion

Table 17-1: Maximum Harmonic Distortion Factor

Harmonic Current Distortion

Voltage Level	TDD*	Individual	
		Odd	Even
400 kV	1.5%	1.0%	0.5%
132-230 kV	2.5%	2.0%	0.5%
66 kV	5.0%	4.0%	1.0%

* Total Demand Distortion

Table 17-2: Maximum Harmonic Distortion

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T.H.D of the line-to-line terminal voltage for the Generator shall be as per latest IEC 60034-3 (clause 9.11.2 - Limits (Total Harmonic Distortion (THD) for synchronous machines) will be accepted. As per this clause of IEC, it shall be limited to 5%. However, at the 400 kV and 230 kV grid connection points the requirements of the specification Section B0.2.11.2.10 shall apply.

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Voltage Unbalance (Section 17.2.5)

For the purpose of this Section, the Negative Sequence Unbalance Factor shall be defined as the ratio of the magnitude of the negative sequence component of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent. For the purpose of this section, the Zero Sequence Unbalance Factor shall be defined as the ratio of the magnitude of the zero sequence components of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent. The maximum Negative Sequence Unbalance Factor at the Connection Point of any User shall not exceed one (1) percent during normal operating conditions.

The maximum Zero Sequence Unbalance Factor at the Connection Point of any User shall not exceed one (1) percent during normal operating conditions.

Voltage Fluctuation and Flicker Severity (Section 17.2.6)

For the purpose of this Section, Voltage Fluctuations shall be defined as systematic variations of the voltage envelope or random amplitude changes where the RMS value of the voltage is between 90 percent and 110 percent of the nominal voltage. For the purpose of this Section, Flicker shall be defined as the impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time.

In the assessment of the disturbance caused by a Flicker source with a short duty cycle, the Short Term Flicker Severity shall be computed over a 10-minute period. In the assessment of the disturbance caused by a Flicker source with a long and variable duty cycle, the Long Term Flicker Severity shall be derived from the Short Term Flicker Severity levels.

The Voltage Fluctuation at any Connection Point with a fluctuating demand shall not exceed one percent (1%) of the nominal voltage for every step change, which may occur repetitively. Any large Voltage Fluctuation other than a step change may be allowed up to a level of three percent (3%) provided that this does not constitute a risk to the Grid or to the System of any User. The Flicker Severity at any Connection Point in the Grid shall not exceed the values given in Table 17-3.

	Short Term	Long Term
132 kV and above	0.8 unit	0.6 unit
below 132 kV	1.0 unit	0.8 unit

Table 17-3: Maximum Flicker Severity

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Transient Voltage Variations (Section 17.2.7)

For the purpose of this Section, Transient Voltages shall be defined as the high-frequency Over-voltages that are generally shorter in duration compared to the Short Duration Voltage Variations. Infrequent short-duration peaks may be permitted to exceed the levels specified in Section 17.2.4 for harmonic distortions provided that such increases do not

compromise service to other End-users or cause damage to any Grid equipment. Infrequent short-duration peaks with a maximum value of two (2) percent may be permitted for Voltage Unbalance, subject to the terms of the Connection Agreement or Amended Connection Agreement.

B0.2.11.2.11 House load operation (not requested by the Grid Code of Bangladesh)

Each Unit shall successfully go to house load operation in the event of disconnection or complete isolation of such Unit from the Grid.
Each Unit shall be capable of performing house load operation up to a maximum of 2 hours. A Unit that has achieved house load operation shall not be shut down without the prior consent of the NLDC.

1. Within such time, each Unit on house load operation shall be ready to be resynchronized to the Grid System and able to increase output in the usual manner.
2. In the event the Grid System is not energized, each Unit on house load operation shall have the capability to energize a dead bus and to start the other Unit, when instructed by the NLDC. Subsequently, upon instruction by the NLDC, such Unit shall be able to increase output in the usual manner.

B0.2.12 Facility technical limits

The following sections describe the minimum requirements regarding the facility.

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B0.2.12.1 Unit start

The facility shall be able to achieve the following operating levels within the same period (in minutes) specified in the following table.

Conditions	Boiler firing to turbine start	Steam turbine start to synchronous	Notice to start to steam turbine synchronous	Synchronous to full load	Total
Cold start after more than 48 hrs outage	TBD	TBD	12 hours	TBD	TBD
Warm start after 8 to 48 hrs shutdown	TBD	TBD	4 hours	TBD	TBD
Hot start after 8 hrs shutdown	TBD	TBD	3 hours	TBD	TBD

Table B0-3: Required start-up times (minutes)[1]

[1] To be determined by the Tenderer

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B0.2.12.2 Despatch ramp rates

Ramp rates of 3%/min to 5%/min are expected for the Power Plant when operating between 30% and 100% BMCR. Ramp rates of less than 5%/min are subject to Employer's approval.

The facility shall be able to achieve the following despatch ramp rates as specified in the following table:

Despatch ramp rates		(Excluding Pulverizer changing over time)	
		Loading (MW)	Ramp rates (MW/min)
Cold start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 660	TBD
Warm start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 660	TBD
Hot start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 660	TBD

Despatch ramp rates (per Unit) [2]

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B0.2.13 Environmental impact requirements

Air pollution

The permissible exhaust gas emissions shall comply with the stipulations of the generating license granted. Compliance for the following pollutants shall be guaranteed and proved:

Emission	Unit	Maximum Threshold
Total PM	mg/Nm^3	50
Sulphur dioxide (SO_2)	mg/Nm^3	200
Nitrogen oxide (NOx)	mg/Nm^3	510

Table B0-5: Emission limits

Note:

- NO_x refers to oxides of nitrogen, referenced to NO_2.

Reference conditions for NOx, SO2, and particulates are 6 % O2, dry (i.e. zero moisture), 0 °C and 1013 mbar atmospheric pressure, that means, unit for emissions is mg/Nm^3

[2] To be determined by the Tenderer

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The stack height shall follow the requirements of the Environment Conservation Rules, 1997 of Bangladesh.

Water pollution

Permissible emission limits for aqueous discharges into the river via the Plant Water Discharge System shall comply with the Waste Water Effluent Standards, see Technical Schedule of **Section B0** and IFC EHSG - TPP - Table 5 - Effluent Guidelines. If there are differences in effluent limits in the two guidelines the more stringent limit should be applied. But limit of TDS with 2100 ppm shall not be followed.

The findings of the Environmental Impact Assessment (EIA) shall be used for Plant design.

Other waste water which is not allowed to be discharged to the requirements waste water treatment plant will have to be disposed externally.

Soil contamination

The Plant should be designed, operated and maintained in such a way to prevent any soil contamination by oil and chemical spillage during subsequent operation and maintenance of the Plant.

Permissible noise levels

The Plant shall be designed and constructed inter alia in accordance with IFC Environmental, Health and Safety Guideline Thermal Power Plants (EHSG-TPP) to reduce the operating noise level as much as possible. No individual within the boundary of the Site shall be exposed to a noise level exceeding the limits stated in the EHSG-TPP and "The Sound Pollution (Control) Rules, 2006".
Far field noise under normal operation of the Plant measured along the Site boundary of the Plant towards the Township shall not exceed 50 dB(A) during daytime and 40 dB(A) during night-time.

For any other point of the Site boundary of the Plant the noise pressure level shall not exceed 60 dB(A) during daytime and 50 dB(A) during night-time. Day time is defined from 6:00 am to 9:00 pm. Night time is defined from 9:00 pm to 6:00 am.

During the engineering phase the Contractor shall award an independent Third Party to conduct noise propagation calculation to prove that the permissible noise levels at the Plant boundary are met.

In addition the statutory requirements of Bangladesh shall be followed as far as stricter as the other standards, such as EHSG-TPP.

Furthermore the following maximum noise pressure levels shall be not exceeded:

dB(A)

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- At 1 m horizontal distance from equipment/enclosures and 1.5 m above operating floor 85
- Within turbine building 90 (Note 1 & 2)
- Steam generator 90 (Note 1)
- Within central control rooms in power plants 55.

Notes:

1. At normal operation
2. Generally at maximum 88 dB(A), exceptions are the turbine stop valve and control valves 95 dB(A) and turbine drive boiler feed pumps 97 dB(A).
3. Noise level from non continuous operating valves (like pressure control valve, water separator drain control valve, etc.) shall be limited to 90 dB(A).
4. The noise level for safety valves including ERV shall be limited to 115dBA for the safety valves provided with silencer as per OSHA standard. Noise level around Mill will be 90 dBA.
5. Noise level at the boundary fence as specified must be complied with.

High noise areas (areas with noise levels >85 dB(A)), which require that personal noise protecting gear shall be used when working in such high noise areas, shall be marked.

Electromagnetic Field (EMF)
In accordance with the EHSG-TPP the occupational EMF exposure shall be prevented or minimized.

All technical measures and the required equipment necessary to fulfil the EHSG-TPP shall be provided by the Contractor. Inter alia areas with expected elevated EMF levels shall be indentified and marked.

Fire and explosion, electrical and chemical hazards
In accordance with the EHSG-TPP all technical measures to prevent, minimize and control physical, electrical and chemical hazards shall be include in the Contractror's scope of services and supplies.

B0.2.14 Provenness Criteria for Critical Equipments and Sub-systems shall be as per Annexure-I of B0 (Refer Amendment no.05 to Bidding Documents).

B0.3 Supplies and Services

B0.3.1 General

The scope of this specification covers all supplies and services required for meeting the purpose of the Plant, even if these are not expressively mentioned in the following.

The works include the following main components, where the detailed scope of supply is given in the corresponding Sections as listed below:

- **Section B1**: Steam generator plants
- **Section B2**: Steam turbine generator plants
- **Section B3**: Air and flue gas systems
- **Section B4**: Fuel and Ash handling system
- **Section B5**: Plant Water and Cooling Systems
- **Section B6**: Water treatment systems
- **Section B7**: Electrical works
- **Section B8**: Instrumentation and control works
- **Section B9**: Civil Works
- **Section B10**: Electrical Works 400/230 kV Substation
- **Section B11**: Jetty
- **Section B12**: Auxiliary plant systems

The corresponding Annexes and Attachments are contained in **Part C**.

The relevant costs of these supplies and services to be given in the price schedules are to be assigned corresponding to the individual items concerned for each of the sections. The costs of the common equipment and services have to be included in the corresponding Section prices.

B0.3.2 Scope of engineering services

The Engineering services refer to the complete specified Plant and covers following services:

- **Basic and detail engineering**

- **Permit engineering**
  The Contractor shall actively participate in drawing-up of all required licensing applications.

  All services shall be performed by the Contractor to affect the required permits to commence the works and operate the Plant, including but not limited to:

- preparation of all documents as required according to the pertinent laws
- clarifications with authorities
- participation in all clarification meetings
- construction permits
- boiler and pressure vessel approvals
- water/waste water permits
- operation permits
- fire fighting approvals
- and all other services as required.

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Furthermore, all other required engineering and other services to meet the purpose of the Project and the agreed project time schedule shall be executed by the Contractor.

B0.3.3 Deputation of Engineers during the Warranty Period

At least seven (7) English speaking graduate engineers, (3 operation experts, 1 Turbine & auxiliary expert, 1 Boiler & auxiliary expert, 1 for I&C, 1 for Generator and Switchyeard area expert),with adequate knowledge and at least fifteen years of relevant experience of pulverised coal fired power plant of 500 MW and above unit size including two years of relevant experience in power plant of same type and technology being offered here from the Contractor, shall be permanently at site during the Warranty Period that means two months prior to PAC of first unit of the Plant upto end of warranty period of second unit. They shall be competent to advise and lead the Employer's staff on all aspects of engineering, operation and maintenance.

B0.3.4 Common equipment and services

The following supplies and services are to be included in the corresponding Section prices:

B0.3.4.1 General

- Material and personnel costs for tests and inspections which are mandated in legislation

  Employer/employer representative/TPA will be responsible for their respective expenses in connection with inspection, examination and testing.

- Material and personnel costs for site inspections
- Declaration of conformity with requirements from Bangladesh and markings for all machines
- Engineering design of complete supplied equipment including interface coordination
- All as-built documents (on data carriers; data formats as requested by the Employer)
- Quality control plan and safety plan
- Complete documentation as set out in the tender specification
- Operating manual (5 hardcopies and 3 electronic copies)
- Detailed operating and maintenance instructions/manual (5 hardcopies and 3 electronic copies)
- A maintenance program for all equipment of the Plant instructions (5 hardcopies and 3 electronic copies)

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- For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDs shall be supplied in ACAD or other editable format, and all lists in Excel format.
- All insurances, such as, but not limited to:
- transport insurance, incl. marine cargo insurance
- installation all risks,
- third party liability,
- automobile liability,
- M.V. Policy for: motor vehicles, private cars & commercial vehicles,
- CPM policy for heavy construction equipment,
- Workmen's Compensation,
- Employer's liability,
- Group personal insurance, for contractor's & subcontractor's employees.

B0.3.4.2 Mechanical

- All necessary pipelines, valves, actuators
- All required line warm-up systems
- All connection and adaptation works for tie-in into general supply systems
- All necessary vents, drains and rinsing connections as well as tundishes with covers, as far as possible aggregated to common groups of on operating level
- All connection elements, screws, bolts, nuts, including gaskets and seals as necessary
- All temporary installations required for tie-in measures including post-weld heat treatment complete etc.
- All temporary pipework as required during connection measures
- Check of required existing structures, plant components and systems and their rehabilitation where they lie within the scope of supply, or definition of required measures in good time if they lie outside of the scope of supply
- All necessary support structures, hangers etc.
- All necessary base frames, mounting plates, grouted in parts, rag bolts, covers etc.
- All required steel parts embedded in concrete
- All couplings and coupling guards for electric motors and other drives
- All necessary lifting equipment and hoists (hooks and provisions for chain blocks to be provided for repair work where loads exceed 50 kg, hoists to be provided for repair work where loads exceed 200 kg, and electrical operated hoist for loads exceeding 2,500 kg)
- Required safety equipment, pressure relief valves etc.
- All thermal and noise insulation including cladding as well as any other noise attenuation measures
- Stairways, ladders, platforms, galleries and walkways to all plant components, including escape routes as necessary

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- All necessary steel structures, stairs, ladders on platforms weather protection
- All required ventilation or air conditioning equipment for safe operation of mechanical and electrical equipment, to be supplied
- All necessary corrosion protection measures for plant components and equipment stored or mounted on site up to the time of reliability test run
- Complete primer and top coatings conforming to colour code, clarified with the Employer
- Necessary noise abatements measures
- All required freeze protection and electric trace heating for outdoor installations
- Complete labelling of all plant components according to the Employers system and in plain language
- All fire protection measures
- All necessary lubrication systems
- Initial lubricant filling and sufficient lubricants for commissioning and reliability test run, minimization of lubricant types by screening and coordination with the Employer
- Water and demineralised water for pre-commissioning and commissioning activities,
- Provision of all connections and temporary pipework for acid cleaning, steam purging of the live steam line and flushing / cleaning of systems as necessary
- Flushing of all other lines including disposal of the effluents; protection with wood and/or plastic at all instrumentation and appendages to be installed during construction
- All standard accessories and auxiliary equipment which normally form part of the scope of supplies
- All necessary tests, inspections and works acceptances as well as all certificates and reports of these
- Exchange of filter elements following reliability test run
- Removal of temporary strainers
- Valve trims for purging and subsequent exchange
- Removal of any unused material
- Scaffolding for all work above ground level
- Necessary connection points for on line condition-based monitoring equipment.

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B0.3.4.3 Substation control and monitoring system

At least but not limited to:

- all field equipment such as bay control units, bay protection equipments (described under chapter "Substation Control and Monitoring System) to be installed at the substation. The field equipment for the substation shall be interconnected by separate IEC 61850 fiber optic station busses in ring configurations. (The use of an IEC 61850 optical fiber link is required for all connections of equipments which directly interact with the station bus (the switches). In the particular case where, for example, the IEDs are wired to the BCU and only the latter is connected to the station bus, electrical links (preferably IEC 61850) are allowed for wiring connection of the IEDs with the BCU but an IEC 61850 optical fiber link between BCU and switches is required.
- all equipment to control and monitor the auxiliary equipment of the substation connected to the SCMS by redundant fiber optic links
- common bay unit / station computers
- operator and engineering workstations with TFT monitors and printers to be installed at the substation control room
- all equipment necessary for the implementation of an OPC server/client architecture between the substation and the Power Plant control rooms in order to allow the supervision and monitoring of the substation from the Power Plant DCS facilities. The OPC-server configuration shall be redundant
- Maintenance / service laptop which shall also be used for protection and disturbance analysis by respective log-in.
- data communication gateway to the National Load Dispatch Center (NLDC),
- energy meters for active energy (kWh) with accuracy of 0.2 S and for reactive energy (kVarh) with an accuracy of 0.5 S for tariff metering shall be provided for each outgoing line.

B0.3.4.4 Electrical

- All necessary electrical drives
- Complete installation material, that is wiring, cabling and piping material, all needed fastenings, conduits, brackets and other supports
- All required junction boxes and cubicles
- All field control boxes
- All cubicles, junction boxes, marshalling racks, terminal boxes, etc.
- Complete labelling of electrical equipment (also inside of cabinets)
- Lightning protection
- Electrical earthing of the equipment
- Cable and cable trays
- All necessary cables and wires for power, AC and DC instrument transformers, control, measuring, signals, etc.

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- All necessary number plates for identifying the cables (numbering code to be determined)
- All necessary fixing materials
- All necessary fire protection materials for making good the cable openings through walls and ceilings as well as between switchgear and control, measuring, recording and switchgear cubicles, operating panels and desks, etc.,
- All necessary plastic protecting tubes for the cable runs
- All necessary materials for laying the cables in the ground
- All necessary cable connections including compression cable lugs, fixing and clamping materials, etc.
- All necessary cable sealing ends and cable connecting sleeves including fixing materials
- All necessary compression connectors.

B0.3.4.5 Instrumentation and Control

- All necessary control systems and auxiliaries
- All measurements and field control loops (thermometers, pressure gauges, transmitters, sensors, analyzers, local regulating devices, etc.) as well as all instruments for reliability test and checks for the duration of the performance tests
- Other special instruments/ systems like acoustic steam leak detection system (ASLD), acoustic pyrometer, communication systems, ambient air quality monitoring system (AAQMS), effluent quality monitoring system (EQMS)
- Complete installation material, that is wiring, cabling and piping material, all needed fastenings, conduits, brackets and other supports
- All required junction boxes and cubicles
- All field control boxes
- All instruments mounted on instrumentation racks
- All cubicles, junction boxes, marshalling racks, terminal boxes, etc.
- Signal exchange between local control system and DCS as well with instruments/control systems of other lots
- Complete labelling of I&C-equipment (also inside of control cabinets)
- Lightning protection
- Electrical earthing of the equipment
- Clarification of all logic interconnections: sequence, interlocking, protection, safeguarding for coordinated operation/start-up/shut down of individual items of equipment
- Cable and cable trays
- All necessary cables and wires for power, AC and DC instrument transformers, control, measuring, signals, etc.
- All necessary number plates for identifying the cables (numbering code to be determined)
- All necessary fixing materials

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- All necessary fire protection materials for making good the cable openings through walls and ceilings as well as between switchgear and control, measuring, recording and switchgear cubicles, operating panels and desks, etc.
- All necessary plastic protecting tubes for the cable runs
- All necessary materials for laying the cables in the ground
- All necessary cable connections including compression cable lugs, fixing and clamping materials, etc.
- All necessary cable sealing ends and cable connecting sleeves including fixing materials.

B0.3.4.6 Civil

- All necessary surveying works including all soil investigations required for safe and reliable design and construction
- Preparation of site, demolition works, removal of underground obstacles
- Earthworks, drainage, excavation and refilling works
- Piling of structures to prevent subsidence
- Concrete and reinforced concrete works, masonry and earthing
- Concreting of maintenance platforms and lay-down areas
- Water proofing works for pressing and non-pressing water
- Fire protection during construction
- Roofing; non asbestos
- Plumbing
- Facade works/glazing works; non asbestos
- Non-load bearing walls/installation partitions/dry construction works
- Metalwork and blacksmith work/raised flooring/doors and gates/sheet metal work
- Flooring work
- Fire protection with plumbing; fire protector
- Painting/varnishing
- Craneway works
- Room air conditioning systems, where required, e.g. control cubicle rooms, etc.
- Potable water, service water and waste water
- Housekeeping during construction
- Staff facilities during construction
- Transport of all dumping material to dump locations
- Performance and interpretation of soil bearing tests
- Temporary fencing of construction site
- Site offices for Employer and Employer's representatives
- The Contractor's site office
- Landscaping of areas required under this contract.

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B0.3.5 Packaging and transportation

- Suitable packaging and transportation of the entire scope of supplies,
- free construction site, on-site transportation and temporary storage including inspections and, if necessary, ensuring the prerequisites for transportation
- Disposal of packing and transportation material
- Customs clearance
- Crane or hoisting facilities at seaport and site
- Transportation to site
- Unloading at site.

B0.3.6 Erection, commissioning and testing

- Complete erection of the scope of supply up to operational readiness: This includes mobilization and provision of the required supervisory staff, skilled and unskilled personnel, as well as of installation scaffolding, cranes, hoists, equipment and materials, personnel accommodation, prescribed tests and inspections.
- Commissioning and optimization of all plant components as well as conducting all necessary measurements.
- Supervision of erection, commissioning and Reliability Test Run of complete supplied equipment.
- All testing as specified.

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B0.3.7 Training

The Contractor shall provide comprehensive training for Employer's engineering, operating and maintenance staff (Employer's staff) covering all aspects of the Power Plant equipment and systems and operation and maintenance.

The Contractor shall train, instruct and supervise the Employer's staff to an adequate standard of knowledge and capability for good trouble shooting, repair and of the plant equipment as well as to an adequate standard for safe and efficient commercial operation of the Plant.

The training shall at least include:

- training at manufacturer's works during the assembly of the major plant items
- classroom and hands on training
- on the job training during erection, commissioning and reliability test run; and
- simulator training.

The Contractor shall submit the training plan for the classroom, on the job and simulator training including schedule, place, content of lectures etc. for

the Employer's approval no less than six (6) months in advance to the cold commissioning.

Post training assessment shall be carried out and documented In case the results of the training are below the expectations, which have been agreed upon by both Contractor and Employer before training, the respective training modules shall be repeated in an improved way and the related cost for the repeated training shall be borne by the Contractor. In case the results are below expectations (to be agreed upon by both Contractor and Employer before training) the respective training modules shall be repeated in an improved way.

B0.3.8 Spare parts, tools, appliances, and consumables

B0.3.8.1 Spare parts

Reference is made to Amendment No 3 and Annexure I to Amendment No.3 (both already published on BIFPCL's Website).

B0.3.8.2 Tools and appliances

The following tools and appliances shall be supplied under this Contract for use by the Employer:

a. two (2) sets of all special tools and gauges required for the operation and maintenance of the Plant
b. one (1) set of special lifting and handling appliances required for the operation and maintenance of the Plant
c. suitable storage bins/racks/shelves for the above.
d. Standard tools according to the relevant Technical Schedules.

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For I&C e.g. following special tools and gauges shall be provided (including but not limited): pressure calibrator, portable pressure source, calibration pressure pump, deadweight testers, precision pressure gauges, manometers, temperature baths/calibrator, multimeters, RTD simulator/tester, thermocouple calibrator precision source and simulation equipment, direct temperature indicating meter, standard pH-tester, multi function process calibrator, loop calibrator, voltage/current/temperature reference generator, intrinsic safe multifunction calibrator, depth gauge, feeler gauge, dial indicators, portable handheld tacho meters, double channel digital storage oszilloscope, conductivity meter, electronic stethoscope, general purpose vibration meters, hand-held IR thermometers, humidity & moisture meters, hazardous and toxic leak detectors, field meters (leak and emission detectors), laser distance meters, US distance estimators, US handheld flow meters, US handheld level meters, portable sound level meter, anemometer, barometer, stop watch, standard technician tools etc.

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One set of tool shall be handed over in new condition and one set shall be used by the Contractor for erection/commissioning.

Each tool or appliance is to be clearly marked with its size and/or purpose.

The tools and appliances supplied may have been used for erection and commissioning purposes by the Contractor, but shall be handed over in good working order.

Each set of tools and appliances under category (a) and (d) shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the Plant and equipment in question. If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle in this contract.
Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved authority shall be supplied for each item of lifting tackle.

The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Employer/Engineer.

The Contractor shall provide all runway beams, trolleys, lifting blocks, special slings etc. necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to high level equipment such as deaerators. Electrically operated hoists and runway trolleys shall be provided for all lifts in excess of 2.5 tons.

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Employer at the time of taking over of the unit.

Where the Contract includes site erection, any special tools or appliances required solely for erection shall be provided by the Contractor for his own use and shall remain the property of the Contractor.

One set of tools shall be handed over in new condition and one set shall be used by the Bidder/Contractor for erection/commissioning.

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For handling of the generator stator the following alternative is also acceptable: Tandem/combined operation of two turbine hall EOT cranes for which the necessary arrangements shall be provided. In such case the combined capacity of two EOT cranes shall not be less than the 105% of weight of generator stator, including the weight of lifting beam with swiveling equipment and slings. Main Turbine hall building civil and structural design shall be done accordingly.

Special lifting and handling appliances may be used by the Contractor for erection and commissioning, but shall be refurbished by the Contractor and shall be handed over to the Employer as per in new condition.

B0.3.8.3 Consumables

The Contractor shall supply all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to COD including top up requirement at the time of issuance of PAC/ declearation of COD. All lubricants proposed for the Plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.

All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and a number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, the Contractor shall list at least three equivalent lubricants manufactured by alternative companies.

The Contractor shall submit to the Employer the list and schedule of lubricants, greases, chemicals and consumables items including items qualities and quantities required per month of the Plant operation for the Employer's approval eighteen (18) months prior scheduled COD of the 1st Unit.

B0.3.9 Documentation

B0.3.9.1 Documentation with tender

General

- If a consortial bid is submitted, documents on the consortial agreement
- Description of options and alternatives offered
- Completely filled in price-, guarantee-, time-, and data schedules of the specification
- List of proposed makes and vendors
- Reference lists for delivery and installation of plants of similar type and size with separate references for the steam generator and steam turbine operating at same or similar parameters
- Requirements of grid code which cannot be met (if any)

- Description of means to accomplish primary frequency control according to grid code
- Description of means to accomplish secondary frequency control according to grid code
- Time schedule engineering for deliveries, erection/installation, commissioning and reliability test run
- Complete description of the Plant offered including description of the process and the equipment
- Layout drawings of the Plant
- Dimensioned drawings and sectional views of the principal plant components including materials
- Schematics of the principal plant systems
- General descriptions of individual systems and descriptions of operation including description of start-up, shutdown and emergency shutdown procedures
- All other documents necessary for comprehension of the offered plants and equipment
- Documents on the quality assurance system, including Quality Assurance Plan (The Quality Assurance Plan shall meet the requirements of ISO 9001:2000 and cover all activities under this FTS.)
- Training program and schedule for Employer's personnel
- Space requirement for lay down area, construction site and equipment
- List of personnel including qualification to operate the Plant and to perform day-to-day maintenance
- Initial Spare Part List as described under B03.7
- Equipment maintenance schedules for reliable centered maintenance.

Mechanical

- Process flow diagram of all systems
- Performance diagrams of main pumps and fans
- Plant and major equipment start-up curves for cold (all material on ambient temperature), warm and hot start up to MCR
- Water and waste water mass balances.

Steam Generator

Description for the equipment offered, giving information about:

- general outline of installation
- main control loops
- description of boiler protection system
- graphs showing the performance characteristic versus the load (flue gas temperatures, steam temperatures etc., including h-p-diagram)
- correction curves for ambient conditions and fuel variations
- material diagram showing material, dimensions, highest flue gas temperature and highest steam temperature, design material temperature and maximum admissible material temperature and design pressure for components of the steam/water system

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- pulverizer performance diagram showing turn-down range of pulverizers and pulverizer outlet temperatures for different coal qualities.

Steam turbine generator
Description for the equipment offered giving information about:

- general outline of installation,
- main control loops,
- conclusive correction curves for steam turbine and cooling system with variations in:
  - power output with ambient temperature, humidity and river water temperature
  - specific heat rate with ambient temperature, humidity and river water temperature
  - generator efficiency vs. power output for varying power factor
  - degradation curves for the power unit and the Plant
  - diagram showing the output of the turbine, of the generator and of the generator transformer versus the ambient air temperature (from +10 °C to +40 °C), humidity (between 20% and 100%) and river water temperature (from +20 °C to +35 °C).

Electrical system

- Electrical single-line diagram for the Power Plant including LV, emergency, safes AC and DC power supply
- Electrical single line diagram for the 400/230 kV GIS
- Unit protection and measuring single line diagram
- Performance diagrams (circle diagrams) of generator, saturation curves, unbalanced load diagrams
- Diagram with the output of the turbine, the generator and the generator step-up transformer versus ambient temperature
- Preliminary lists of motors and electrical consumers including power demand
- Auxiliary power requirement of the plant unit
- Arrangement of generator bus duct up to generator transformer, H.V and L.V. Cubicles, unit auxiliary transformer
- General arrangement of main electrical equipment within the relevant buildings, rooms, etc., including cross-sections
- Arrangement of connection from generator transformers to 400 kV GIS
- Arrangement of connection from start-up/stand-by transformers to 230 kV GIS General arrangement of the 400/230 kV GIS substation including the related control building and connection 400/230 kV interconnection transformers to 400 kV and 230 kV GIS
- Architecture drawing of the 400/230 kV substation control and monitoring system
- Description of the individual protection relays with related reference lists
- Description of the main electrical equipment (e.g. generator, excitation, AVR, generator protection, generator step-up and unit auxiliary transformer, start-up/stand-by transformer, 400/230 kV interconnection

transformer, 400 kV reactors, 400/230 kV GIS, Substation Control and monitoring System, 400/230 kV protection systems, 11 kV switchgear, etc.)- with related reference lists.

Instrumentation & control system

- Control system architecture showing all components provided for this Plant in their actual structural arrangement
- Layout drawing central control room
- Description of hardware, software and design philosophy of the DCS
- Reference list for the DCS with indication of plant type, system architecture and size of the system
- Data sheets, descriptions and brochures of the offered BMS and BPS
- Data sheets, descriptions and brochures of the offered local control systems, in particular PLCs
- Data sheets, descriptions and brochures of the CEMS including (if applicable) common emission data evaluation devices
- Data sheets, description and brochures of the communication systems as specified in the relevant Sections of **Section B8**
- CCTV system philosophy description and configuration drawing
- Data sheets, description and brochures of the training simulator as specified in the relevant Section of **Section B8**
- Temporary list of all drives, such as unidirectional motors, MOV's, SOV's and remotely operated control valves
- List of modulating controls
- List of package systems (black boxes)
- Description of field equipment
- Description of structure of the control functions including list of unit co-ordination level, functional group level, sub-group level
- Description of the interface to the boiler protection system and the steam turbine generator protection system
- Procedure for calculation of the availability of the DCS.

Civil

- Architectural outline drawings for all buildings and building structures showing the arrangement of the complete Plant, inclusive of all levels and Sections
- Site plan of the complete Plant showing all buildings, building elements, roads, landscaping etc.
- Schematic design of main buildings
- Typical concrete block pad and chimney foundation
- Typical pole foundation for HV towers
- Details, with calculations, for the main foundation system proposed
- Basic design of Site infrastructure
- Basic design of the chimney
- Basic detail of the coal storage yard
- Basic detail of the ash pond.

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B0.3.9.2 Documentation after Award of Contract

The documents required for design, construction, installation, operation and maintenance of the entire Plant shall be submitted by the Contractor in good time so as to permit the Plant as a whole to be erected in compliance with the specified time table.

All documents, including the installation and operation and maintenance manuals as well as the related software shall be in fluent, legible English. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format.

The Contractor shall list all the drawings and submission schedule for the Employer's approval. Only the most important documents are listed below. These documents shall be submitted sufficiently in advance, so that corrections and amendments desired by the Employer as well as resubmission of the documents will not result in any delays with respect to the guaranteed time schedule. The Employer reserves the right to request from the Contractor additional drawings, documents, etc. as may be required for proper understanding and definition of the design and engineering of the Plant.

The overall responsibility with regard to completeness, correctness and suitability for the permit application process remains with the Contractor. In no case any comment, correction, amendment and approval (if any) by the Employer shall relief the Contractor from this responsibility.

The drawings and documents to be submitted during this stage are listed in the various Sections and comprise the following. They shall be submitted within the specified time scale calculated in weeks after Award of Contract. Details shall be agreed according to the approval procedure for drawings and documents above.

The Contractor may propose modifications to the list as given below, in order to ensure timely completion of permit application documents and performance of the works according to the project's requirements and in accordance with the specified project time schedule. Any modification to this list shall be submitted for Employer's review and approval.

The Employer reserves the right to require detailed information on the progress of drawing and document preparation from the Contractor at any time during this stage.

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
• **General**			
• Current list of drawings	I	4	every 1 month
• Complete list of documents	I	4	every 1 month

Document	Purpose	Weeks after Contract Award: Preliminary	Weeks after Contract Award: Final
with proposed submission deadlines			
• Progress reports	I		every 1 month
• Erection and installation progress reports	I	-	every 1 month after start of site activities
• Quality assurance procedure and program	A	with Bid	24
• structure of Contractors QA&QC manpower at site	A	with Bid	24
• indicative field quality plan for civil works	A	with Bid	24
• Plant layout		with Bid	16
• List of subcontractors/ manufacturers	A	with Bid	12
• Proposed inspection and testing programs	A	12	24
• Noise propagation calculations	A	-	24
• Detailed program for commissioning	A	24	6 months ahead start pre-commissioning
• Studies / surveys regarding water intake and water discharge	A	12	24
• Detailed program of Reliability Test Run	A	24	6 months ahead start Reliability Test Run
• Detailed program of Performance Tests	A	24	6 months ahead start Reliability Test Run
• Testing documents/Report of results of all tests	A	2 weeks after test	6 months ahead start Reliability Test Run
• Training program	A	-	6 months ahead of pre-commissioning
• As-built-documentation including drawings of all equipment	A	-	1 month after COD of the 1st Unit
• Declaration of conformance with all local regulations	I	-	latest with start of pre-commissioning
• Spare part lists	A	with Bid	18 months ahead of COD of 1st Unit
• **Time scheduling**			
• Overall time schedule for design, manufacture, supply, assembly, erection and commissioning broken down for the principal plant components and all	A	with Bid	every 1 month

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Document	Purpose	Weeks after Contract Award: Preliminary	Weeks after Contract Award: Final
construction works, stating dates for completion of any preparatory work from others which may be necessary			
• Detailed erection, installation and commissioning schedule	A	12	2 months ahead of erection / pre-commissioning
• **Mechanical Engineering**			
• Arrangement drawings of principal components with ducts and platform layout	A	with Bid	12
• Arrangement drawings of auxiliary equipment (cubicles, etc.)	A	12	24
• Process flow diagrams	A	with Bid	12
• Piping and Instrumentation schematics and isometric drawings, including list of pipelines and valves, stating materials, nominal diameters and pressure, dimensions, insulation thickness of all pipes	A	8	24
• Plans of main pipelines including location of cable routes	A	8	24
• Characteristics of pumps, fans etc.	I	16	24
• Details of required auxiliary energy sources and consumables (e.g. electricity, steam, chemicals, instrumentation air, working air) with condition data, required qualities and consumption values	I	16	24
• Water and waste water balances	A	with Bid	36
• Thermodynamic diagrams / heat balance diagrams	I	with Bid	24
• Start-up and shutdown diagrams with descriptions (cold, warm, hot)	A	with Bid	2 months before pre-commissioning
• Sectional and detail drawings of all components including materials	I	16	36
• Lifting plan for all lifting operations (repair, maintenance, etc.)	I	24	36
• Limits of coal and high speed diesel properties	I	-	with Bid

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		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
• Design calculations of pumps, isolations, piping, etc.	I	12	36
• Water hammer calculation of plant water and cooling water system	I	8	12
• Hydraulic model test procedure of plant water and cooling water systems; institute to perform the tests	A	4	8
• Hydraulic model tests reports of plant water and cooling water systems	A	-	12
• Cooling Tower Recirculation Study	I	-	12
• Sedimentation Study	A	-	12
• Pulverizer performance diagram with pulverizer turn-down range	A	with Bid	12
• Material diagrams for pressure part	A	with Bid	24
• Reference lists with information on successful operating years for: - steam turbines - steam generators - pulverizers - firing systems / burners	A		with Bid
•			
• System description of firing system	A	with Bid	24
• Final correction curves for Plant and equipment performance tests acc. to ASME PTC46 etc.	A	-	with Bid
• **Electrical Engineering**			
• Electrical single line diagrams	A	with Bid	12
• List of motors and consumers	I	8	every 1 month, final after erection completion
• Electrical equipment sizing calculations (generator main connection, transformers, emergency diesel generators, safe AC and DC power supply, power cables, etc.)	A	12	24
• Cable list	I	16	every 1 month, final after erection completion
• Standard circuit diagrams for all different kinds of electrical	A	12	24

Document	Purpose	Weeks after Contract Award	
		Preliminary	Final
consumers			
• Performance diagram (circle diagrams) of generator	I	with Bid	12
• Circuit diagrams for all individual electrical equipment	I	12	24
• Lists of equipment and devices	I	12	24
• Earthing and lightning plans with calculations	A	12	24
• Lightning protection plans with details of measuring locations and reports of measurements taken following commissioning	I	12	24
• EMC concept with coordinated overvoltage protection	I	12	16
• Arrangement drawings for switchgear and battery rooms, station service transformers, cable floors etc.	A	12	24
• Diagram showing power output of plant generator and related transformer vs. ambient temperature from +20 °C to +40 °C	A	with Bid	12
• Block diagram generator/unit protection	A	12	24
• Block diagram AVQC for the generator	A	12	24
• Line plans of fire alarm system if applicable	A	12	24
• Arrangement drawings showing exact location of fire alarm devices if applicable	I	12	24
• Power and lighting installation plans including related calculation	I	16	24
• General arrangement drawings of the required cable trays, cable laying plans	I	12	24
• Dimensional drawings and erection drawings for generator, transformers, switchgear etc., including frontal and plan views	I	12	24
• Dimensional drawings of generator auxiliary equipment	I	12	16
• Dimensional drawings of switching cubicles, generator leads and star point cubicles, voltage regulation cubicles, excitation cubicles, generator circuit breakers, including	I	12	24

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Document	Purpose	Weeks after Contract Award: Preliminary	Final
equipment configuration			
• Calculation of mechanical stresses of switchgear rooms due to arcing faults	I	12	16
• Short circuit calculation and determination of protection relay settings for generator protection, 400/230 substation and auxiliary electrical supplies under consideration of protection of the entire system	A	12	24
• Protection and metering diagram for unit protection, start-up/stand by transformer protection, 400/230 kV GIS protection	A	16	24
• Load flow, system transient stability and motor start-up study	A	16	24
• Information for electrical system study by PGCB (see relevant part in **Section B0)**	I	8	16
• Generator charts and exciter characteristics	I	12	16
• **Instrumentation and Control Engineering**			
• Control system architecture showing all components incl. design concept redundancy	A	with Bid	24
• Operation and control philosophy	A	8	16
• Design concept earthing	A	16	24
• Design concept explosion protection	A	16	24
• List of packaged systems (Black Boxes)	A	with Bid	24
• Layout drawings central control room showing spatial distribution of desks and panels (3 D view)	A	with Bid (2D only)	24
• Layout of electronic rooms showing spatial distribution of cubicles and racks	A	16	24
• Description for all functional group controls, functional schematics (both in machine language and according to ISA-standard)	A	16	24
• DCS/PLC interface	A	16	24

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Document	Purpose	Weeks after Contract Award	
		Preliminary	Final
documentation, I/O point assignment			
• Engineering drawings of control valves, control dampers together with their actuators, orifices, nozzles, venturi nozzles	I	16	24
• External connection diagrams, terminal connection diagrams, combined schematic and circuit diagrams	I	16	24
• Communication systems	A	16	24
• As built software programs for DCS, PLC or other systems	I	-	1 month after COD of the 1st Unit
• Instrument list	A	16	24
• Cable routing plan	I	16	24
• **Civil Engineering**			
• 3D model of the complete Plant incl. all civil structures, all mechanical equipment, piping (> 50mm Ø), electrical equipment e.g. cable trays, HVAC, etc.	I	16	24
• 3D model clash checking and walk through	A	3 weeks after 3D model distribution	3 weeks after 3D model distribution
• General layout plan of the Plant site including all buildings and outdoor installations, roads etc. prepared on the basis of the topographical survey of the site	A	with Bid	12
• Detailed civil arrangement drawings of all buildings and structures, including plan-views and Sections (scale 1 : 100)	A	with Bid	12
• Architectural views (all sides) for all buildings of the Plant	A	4	12
• Arrangement drawings for external systems including all supply and disposal facilities, roads with manoeuvring areas; outdoor facilities (sewage, drainage, ducts and trenches, fencing and gates; tank farm, outdoor foundations etc.	A	4	24
• **Detailed drawings and documents**			
• Detailed foundation drawings	I	4	12

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Document	Purpose	Weeks after Contract Award	
		Preliminary	Final
for all buildings and structures (A. E., turbine, boiler and stack foundations etc.)			
• Detailed structural drawings for all buildings and structures (concrete and steel structures).	I	8	24
• Detailed architectural drawings	I	8	24
• Room books, including external and internal finishes, windows, doors, sanitaries, wall cladding, roof etc.	A	8	24
• Detailed drawings for all internal services and installation works (HVAC; water, sewage, drainage, lighting	I	8	24
• Detailed drawings with embedded parts, anchors, plates, fixings etc.	I	8	24
• Detailed drawings for outdoor installations and services (sewage, drainage; water, ducts, trenches, culverts, pipes, cable routes, manholes, pits etc.	A	8	24
• Detailed drawings for roads including accesses, footpaths, fencing/gates, landscaping, bridges, pipe racks	A	8	24
• Checked and approved statical and dynamical analysis prepared/for all buildings and structures of the Plant	I	8	24
• Detailed constructive description of individual buildings with regard to the structural design (structural systems, foundations etc.)	I	8	24
• Sectional elevations and roof plan	I	4	24
• Underground services and ducts with equipment appertaining to the services	I	8	24
• Principal details and Sections for traffic areas, especially for ramps and retaining walls	I	8	24
• Structural drawings pertaining to river water outfall and intake facilities	A	8	24
• Foundation drawings and other underground concrete works	I	4	24

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Document	Purpose	Weeks after Contract Award: Preliminary	Weeks after Contract Award: Final
• **Permit application documents**			
• Documentation for operating permits	A	4	12
• Documentation for other permits	A	4	12
• **Other documentation**			
• Schedules of workshop tests	I	-	1 month ahead of test
• Quality assurance manuals	I	16	24
• Manual of Codes and Standards	I	16	24
• **Operating manual** • operating procedures and instructions of the Plant with description of all systems, processes and functional groups • as built documentation • general and individual control concept description • Plant and equipment protection and signal processing description with all alarm and trip signal settings • all operating conditions including electrical grid supply and connection conditions	A	6 months ahead of pre-commissioning	1 month after COD of the 1st Unit
• Service and maintenance manual • maintenance procedures and instructions with description of all equipment and facilities • Equipment data sheets	A	6 months ahead of pre-commissioning	1 month after COD of the 1st Unit

Purpose: A : for Approval
I : for Information

B0.3.9.3 Data and simulation models

The Tenderer shall submit the data of the Plant for transmission simulation to PGCB according to the Bangladesh Grid Code however minimum following data:

Components	Data	Value of data
Generator step-up transformer	Rating	MVA
	High voltage	kV
	High voltage connection	
	Low voltage	kV
	Low voltage connection	

Components	Data	Value of data
	Positive seq. Impedance	%
	Positive seq Resistance	%
	Positive seq. Reactance	%
	Zero seq. Impedance	%
	Zero seq. Resistance	%
	Zero seq. Reactance	%
	MVA for base impedance	MVA
	Maximum tap	kV
	Maximum tap position	
	Minimum tap	kV
	Minimum tap position	
	Nominal tap position	
	Value of tap step	
	Core loss	kW
	Copper loss at full load	kW
	Auxiliary power	kW
Generator	Type	
	Manufacturer	
	Rated output	MVA
	Rated voltage	kV
	Connection	
	Inertia constant	
	Xd	%
	X'd	%
	X"d	%
	X2 (Negative sequence)	%
	X0 (Zero sequence)	%
	MVA for base impedance	
Turbine	Type	
	Rating	MW
	Inertia constant	
	HP natural frequency and vibration band	Hz
	IP natural frequency and vibration band	Hz
	LP natural frequency and vibration band	Hz
Exciter	Type	
	Range ± % of rated voltage	%
Governor	Type	
	Model No.	
	Droop	%
	Deadband	Hz
Unit auxiliary power consumption	Real power auxiliary load	MW
	Reactive power auxiliary load	MVAR

The Tenderer shall also submit models for simulation studies which are compatible with the software used by PGCB. PGCB is using PSS®E software).

The simulation studies include, but are not limited to:

a. power flow
b. short circuit
c. transient stability.

All characteristics and models shall operate in stable and accurate manner under all frequency range stipulated in this Part B0, including consideration on the following:

a. large frequency variations upwards (increasing) up to 52Hz,
b. large frequency variations downwards (decreasing) up to 47.0Hz,
c. grid system faults,
d. splitting of the grid system into islands.

All simulation models submitted for stability studies must be in the form of fully validated models for the software used by PGCB simulation. The models shall be provided complete with the following documentations:

a. imodel software source codes (flecs) as well as object (binary) codes,
b. description of the models including the engineering of model derivations,
c. user operation manuals
d. user application guides
e. model block diagrams
f. values of parameters
g. input data format
h. criteria for acceptable operation (threshold parameter values such as minimum steam pressure, maximum hydrogen pressure, etc).

The models shall represent closely the on-site response and setting.

Generator and excitation systems

The fully validated control block diagram representation of the software used by PGCB simulation model (including all limiters and power system stabilisers), shall be submitted to PGCB together with:

1. Explanation of all the symbols used
2. Clearly labelled sub-systems of control and protection, such as, Volt/Hz limiter, maximum field current limiter, stator current limiter, minimum field current limiter etc.
3. Input-output relationships, by giving:
   a) Equations
   b) Characteristics/Chart/look-up table
   c) Other input/output relationship (if any).
4. Indication whether the parameters in the block diagram can be measured on the actual system.

Governor

The fully validated control block diagram representation of the software used by PGCB simulation model for the governor systems shall be submitted to PGCB together with:

1. Explanation of all the symbols used
2. Clearly labelled sub-systems of control and protection, such as, additional corrective control against frequency deviations (if any) and other controls (if any).
3. The following variables, states, and limits:
   a) mechanical output
   b) generator output
   c) turbine speed
   d) mechanical output of steam turbine (ST)
   e) MW output of ST
   f) shaft speed of ST
   g) turbine steam pressure of ST
   h) turbine steam pressure deviation of ST
   i) turbine steam temperature of ST
   j) main control valve position of ST
   k) intercept valve position of ST
   l) load limiter signal.
4. Tenderer shall inform values of limits and acceptability (or violation) criteria on the following:
   a) reverse power (cause reverse power trip when violated)
   b) Power Load Unbalance (PLU) (or similar) relay trip (if any which cause trip when set criteria is violated)
   c) operational limits and criteria
   d) others (if any which cause trip when violated).
5. Tenderer shall inform input-output relationships, by giving:
   a) Equations
   b) characteristics/chart/look-up tables
   c) other input/output relationship (if any).
6. Tenderer to inform whether the parameters in the block diagram which exist and can be measured on the actual system.

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The above models and documentation shall be submitted in CD-ROM media (read only). One hardcopy of the same is also required to be submitted.

Due dates and versions for data submission and simulation models are as follows:

Due dates	Type of data to be submitted
90 days after signing of this Agreement	Committed Project Data Contracted Project Data
90 days prior to the Initial Operation Date of the First Unit	Estimated Registered Data

Due dates	Type of data to be submitted
30 days after the Commercial Operation Date of the First Unit	Registered Data

B0.3.9.4 Requirements for documentation

Unless agreed otherwise, five (5) hard copies and three (3) sets of electronic copies of all documents are to be submitted in the English language. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files.

The Contractor shall provide, install, operate and maintain a web based electronic data room / data server. The format and filing system shall be mutually agreed between Employer and Contractor.

All documentation shall comply with uniform documentation instructions according to Employer's requirements. Detailed requirements for documentation will be determined during contract execution by the Employer.

Contractor shall comply with Employer's directive concerning documentation requirements for implementation in an automated plant operation system.

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The final documentation including but not limited to operating manuals, maintenance and service manuals, component documentation, assembly documentation, drawings and listing, etc. shall be submitted in the English language. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format.

Contractor shall also integrate and submit all the above data for each Unit into the PSS®E load flow raw data file ("raw data") and PSS®E dynamic raw data file ("dyr data") which are ready to be used for studies on operation and planning of the Grid System by PGCB using PSS®E (to be confirm by PGCB/BIFPCL)
Data for each Unit shall also include reactive power capability curve of the Facility, written in the format compatible to PSS®E activity GCAP. For this purpose, at least 10 (ten) pairs of data on the generator reactive power capability curve shall be provided for each Unit.

The final requirements for Transmission lines and Interconnecting Facilities documentation will be subjected to PGCB's approval which will be made known during execution stage.

B0.3.9.5 Approval procedure for drawings and documents

The Employer reserves the right to ask the Contractor to submit drawings and other documents for approval to the Employer or to its representative.

Before submittal of any such drawing or other document, the Contractor shall submit a detailed list comprising all drawings or other documents the Contractor will produce. Based on this list the Employer will decide which drawings or other documents will have to be submitted for approval, information or other purpose.

The documents for approval are primarily basic documents and all documents that are required to check that Contractual and operational requirements are met. It is expected that in total approximately 600 to 800 documents will be for approval.

When submitting drawings or other documents for approval, including any prepared by subcontractors, the Contractor shall certify in each case that he has examined such drawings or documents and that they comply with the requirements of the Contract.

The Contractor is requested to provide Third Party Verification of structural documents, e.g. structural analysis, drawings and connecting details prior to submission for approval. These documents must contain all information necessary for the execution of the works.

Approval of a drawing or other document will imply that:

- They have been examined and appear to be in accordance with the basic design concept of the project and meet the requirements of the specification.
- They have been examined in relation to compatibility of the items and equipment with the specification and respect of interconnections with other items, equipment or systems.
- The Contractor is not relieved of his responsibility under the Contract.

The Contractor is to arrange for the revision history of drawings and other documents as follows. The first revision shall be indexed by the letter "A" followed up by the respective letter in alphabetical order. Once the drawing or document is approved for construction by the Employer or its representative the document shall be indexed with the number "0" followed up by the respective number in chronological order. Hence, the sequence of the revision index of a design document shall be as follows: A - B - C - [...] - 0 - 1 - 2 - [...]. Each revision is to be listed in the revision history with the respective date and a short description of the modification(s). In addition, all modification(s) shall be highlighted and/or marked up as specific and detailed as possible.

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Furthermore, each drawing/document shall be indicated with a unique document number according to the following standard:

Maitree – Unit – KKS – DCC - 12345 – XYZ - REV

Where:

Maitree		Project-Denomination
Unit	-	00 (for common), 01 (for unit 1), 02 (for unit 2)
KKS	-	Function Key as per KKS system (1 to 3 letters)
DCC	-	DCC code according to EN/IEC 61355
12345	-	Document number
XYZ	-	Sub-/Contractor number
REV	-	Revision index

For each comment, the Employer will allocate a priority in the TCS (Technical Comment Sheet). The priorities range from 1 to 3 as follows:

1	-	High Priority
2	-	Medium Priority
3	-	Low Priority

The TCSs are to be named with the above described identification key and the supplementary ending "... - RI" ("Revision Income") for TCSs being sent from the Contractor to the Employer and "... - RO" ("Revision Outcome") vice versa.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other documents supplied by him, whether such drawings or other documents have been approved or not.

B0.3.9.5.1 Documents which require Approval from Grid Operator/BPDB

Documents especially test procedures and protocols, which are due to approval by the grid operator or BPDB required following specific times for submittal and approval.

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B0.3.9.5.1.1 Testing Procedure and Protocols

At least one hundred and twenty (120) Days before the scheduled commencement of the testing and Commissioning of the Plant, the Contractor shall, upon request from BPDB, submit to BPDB detailed procedures and protocols to be used during the corresponding testing. BPDB shall have the opportunity to provide written comments, if any, on the proposed procedure and protocols within thirty (30) Days of receipt from the Contractor of said documentation. If BPDB fails to submit written comments to the Contractor within the thirty (30) Days stipulated above, it shall be deemed to have accepted the detailed procedure and protocols provided by the Contractor.

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On receipt of such comments, if any, the Contractor shall review and submit the final procedure and protocols, to be used for testing not later than sixty (60) Days prior to the scheduled commencement of the respective testing and Commissioning:

a. if BPDB fails to submit written comments to the Contractor within the thirty (30) Days stipulated above, it shall be deemed to have accepted the detailed procedure and protocols provided by the Contractor; and 35

b. if the Parties fail to reach agreement on the procedures and protocols within sixty (60) Days prior to the scheduled commencement of the respective testing and Commissioning,

the matter may be referred to the Engineer by either Party, and the Engineer shall make the decision on the protocol and procedures within the five (5) Days of the matter being referred to it, and such decision shall be binding on the Parties.

B0.3.9.5.1.2 Start-up and Test Schedules

At least ninety (90) Days before the scheduled commencement of testing and commissioning of the First Generating Unit or the Plant, as the case may be, the intended Start-Up and test schedule for such unit.

B0.3.9.5.1.3 Operating Procedures

a. Not later than one hundred and twenty (120) Days before the then prevailing Scheduled Initial Operations Date, the Contractor shall, upon request from BPDB, provide BPDB with draft operating procedures dealing with all operation interfaces between BPDB and the Contractor including, but not limited to:

- method of Day-to-Day communication
- key personnel list
- clearances and switching practices
- outage scheduling
- capacity and energy reporting
- operating log; and
- reactive power support

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which shall be consistent with this Agreement, the designs of the Facility (including the Metering System), the Technical Limits and Prudent Utility Practices (together, the "Operating Procedures").

b. Within thirty (30) Days after BPDB's receipt of the draft Operating Procedures, BPDB shall notify the Company of any requested deletions, amendments or additions.

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c. The Company shall make any deletions, amendments or additions that BPDB reasonably requests unless they would be inconsistent with this Agreement, the Technical Limits, the designs of the Facility (including the Metering System), or Prudent Utility Practices and provide such revised draft to BPDB, which shall be treated as final Operating Procedure, not later than thirty (30) Days before the then prevailing Scheduled Commercial Operations Date.

d. Not Used

e. Either Party may, from time to time, request revisions to the Operating Procedures subject to agreement from the other Party.

B0.3.9.6 Quality control procedure

A comprehensive **quality control procedure / quality assurance programme** for all aspects of the works shall be prepared by the Contractor and shall be submitted to the Employer for approval.

The Contractor shall adopt suitable quality assurance programme (QAP) to ensure that the equipments and services under the scope of Contract whether manufactured or performed within Contractor's works or at his subcontractor's premises or at the site or at any other place of work are in accordance with the specifications. Such QAP shall be outlined by the Contractor and shall be finally accepted by the Employer or his authorized representative after discussions before the start of work. The QAP shall be generally in line with ISO Systems.

The quality assurance program shall consist at least of the following:

- testing during manufacturing
  - workshop inspections and testing
  - factory acceptance tests (FAT)
- testing at site
  - construction inspections and testing
  - erection / mechanical completion
  - pre-commissioning and commissioning tests (cold and hot commissioning)
  - optimization of overall Plant
  - final inspection and testing
  - Bench mark testing
- completion test
  - performance tests
  - reliability test run.

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An outline of the proposed comprehensive quality assurance programme is to be provided with the Tender and is subject to review by the Employer.

The Contractor shall provide complete laboratory facilities and staff to perform the required tests. The facilities could be fully or partially on site. Arrangements could be made with an experienced testing laboratory to support the site laboratory, all subject to the approval of the Employer.

Only approved fully qualified and experienced staff shall carry out the quality control all in accordance with the approved quality control procedure.

The Contractor shall appoint a dedicated, experienced and competent QA&QC in-charge at site, preferably directly reporting to the project manager, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP. An indicative structure of Contractors QA&QC manpower required to be deployed at site shall be submitted with the Tender.

The results of the tests shall be made available to the Employer within 24 hours of obtaining the relevant test results. Acceptance of the relevant part of the work shall be subject to the performed tests showing satisfactory results. Individual construction completion certificates shall be issued by the Contractor to certify the readiness for equipment erection (see **Section B0**).

The Employer may instruct tests at no cost provided either the overall frequency governed by the specification is not exceeded and the notification given to the Contractor is equal to that currently being provided by the Contractor for his normal testing in formality and warning, or the Employer has due cause to suspect a change in the quality, such concern having been advised to the Contractor. The Employer may instruct sampling, testing or both which satisfy only some or none of the above criteria.

The Employer shall have the right to carry out independent inspections and testing either using his own resources or those of a third party. Should the Employer require the results to determine the conformance with the specification then he shall notify and inform the Contractor.

As far as is practicable the Employer shall have free access to the site, fabrication areas and suppliers work at all times without notice. Should he discover unsatisfactory work then he will invite a formal joint inspection. Either after such an inspection or if the Contractor declines the invitation the Employer shall issue instructions with regard to the faults and their reparation.

Should any materials, items or complete parts of the works fail to comply with the requirements of this specification when tested in accordance with this Section the Employer may reject such materials or items, or condemn complete parts of the works, and demand of the Contractor such replacement or modification as may be necessary to ensure their compliance.

Should modification or adjustment be deemed a satisfactory alternative to demolition and /or removal, the Contractor shall submit full details in writing such modifications to the Employer for approval, and should such approval be forthcoming carry them out without undue delay.

If however, the Contractor is required to demolish and /or remove any such items or materials this shall be carried out quickly and with as little disruption to the works as possible.

No claims of any sort whatsoever will be entertained arising from the rejection of any part of the works through failure to meet this specification, and repairs, demolitions, removals, additional testing etc. Such modifications, removal, demolitions etc, shall be entirely at the expense of the Contractor. No extension of the Contract period shall be granted for such a reason.

If for any reason materials or other items are received or made on site before approval of them has been granted, these shall be transported, handled and stored separately or labelled in such a way in order to, wherever possible, prevent them being incorporated into the works or, should such prevention not be possible, to accurately define the part(s) of the works in which such materials or items were used.

Approvals previously granted for any materials etc. shall be withdrawn if they are not properly transported, handled or stored and otherwise protected against weather or contaminants which may adversely affect their properties and subsequent performance. The Contractor has the option of removing such materials or having them retested for approval.

The Contractor shall submit to Employer, the quality plans and field welding schedules (for field weld of pressure parts only), along with test procedures and WPS endorsed by designer wherever applicable, for checks to be done during manufacturing and erection, for review and approval by Employer.

B0.3.10 Options and Alternatives

B0.3.10.1 Option 3.1: Absorber made of concrete (Optional Offer)

Refer to Amendment No. 1, B3.

B0.3.10.2 Option 3.2: Combined Limestone System for Both Units (Optional Offer)

Refer to Amendment No. 1, B3.

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B0.3.10.3 Option 4.1: Open coal stock yard (Optional Offer)

Refer to Amendment No. 1, B4.

B0.3.10.4 Option 4.2: Screw unloader (Optional Offer)

Refer to Amendment No. 1, B4.

B0.3.10.5 Option 4.3: Open limestone yard (Optional Offer)

Refer to Amendment No. 1, B4.

B0.4 Interfaces

The Contractor shall actively clarify all interfaces with the Employer, the Operator, PGCB and all companies, authorities and any other entity participating in the project.

B0.4.1 Battery limits of the plant

The interfaces for the Plant shall be as follows.

The Contractor shall actively clarify all details of the interfaces with the Employer, the grid operator (NLDC), the coal supplier, the fuel oil supplier, the limestone supplier and all other interfacing companies.

All mentioned equipment, connections, connection materials, counter flanges, shut-off valves, safety valves, seal up material and works are included in the scope of supply:

Designation	Category	Interface / Terminal Points
TP1	HV overhead transmission line (OHL)	• 400 kV and 230 kV OHL conductors on the gantries for connection of the related GIS bushings. • OHL conductors for connection of the Line Traps. The Connection from the generator transformer to the 400/230 kV GIS shall be included in the Bidder's/Contractor's scope of supply. The 400 kV and 230 kV transmission OHL for power evacuation will be provided by PGCB. The limit of supply is at the take-off gantries (to be supplies by the Bidder/Contractor) for the 230/400 kV OHL For detailed scope refer to Section B10.3.3 and B10.3.5.
TP2	OHL Protection	• None

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Designation	Category	Interface / Terminal Points
		Remark: The 400 kV and 230 kV OHL protection on the Power Plant end (not on the remote end) shall be included in the scope of supply of the Maitree-STPP Project.
TP3	OHL Telecommunication	• Terminals on the line traps for connection of the telecommunication equipment provided by PGCB on the related gantries • Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for the signal exchange with the PGCB/NLDC and for the teleprotection. • Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for auxiliary/control power supply (240V AC, 220 VDC and 48VDC). The cabling between Contractor's cubicles and the telecommunication equipment provided by BPDB in the Control Building of the 400/132 kV GIS shall be in the scope of the Bidder/Contractor.
TP4	Earthing and	• Terminals on the gantries for connection of the OPGW • Earthing bars in the control building of the 400/230 kV GIS for connection the protection and telecommunication panels
TP5	Plant water intake	Intake from Possur river, all required supplies and services in scope
TP6	Plant water discharge	Discharge to Possur river, all required supplies and services in scope
TP7	Coal supply	Coal unloader at jetty (all coal vessel berthing, mooring and unloading facilities within scope of supplies and services)
TP8	Fuel oil supply	At and including Fuel Oil Truck Unloading Station near the Power Plant. All supplies and services in scope The road truck unlading station shall be positioned in the vicinity of the storage tank. Accordingly TP8 is located at the near of HSD oil storage tank. However, the unloading station is included in the scope of the Bidder
TP9	Limestone supply	Coal unloader at jetty (all coal vessel berthing, mooring and unloading facilities within scope of supplies and services) (common equipment with coal supply)

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Designation	Category	Interface / Terminal Points
TP10	Fly ash	Outlet connection at: • ship loading from fly ash storage silos • Truck loading from fly ash storage silos • Truck loading from intermediate fly ash silos • ash pond All supplies and services in scope Complete ship loading system from silo with all accessories shall be in Bidder's/Contractor's scope
TP11	Bottom ash	Outlet connection at: • Truck loading from bottom ash storage silos • Truck loading from intermediate bottom ash silos • ash pond All supplies and services in scope Complete ship loading system from silo with all accessories shall be in Bidder's/Contractor's scope.
TP12	Gypsum	Outlet connection at: • ship loading from gypsum storage silos • Truck loading from gypsum storage silos • Truck loading from intermediate gypsum silos All supplies and services in scope Complete ship loading system from silo with all accessories shall be in Bidder's/Contractor's scope
TP13	Raw water supply	Pipeline 1 m outside Plant boundary; interface with raw water supplier
TP14	Sewage water	Discharge to Passur river
TP15	Storm water	Discharge to Passur river, outside the Plant area; all required supplies and services in scope
TP16	Waste water for discharge	Discharge to Passur river There shall be no spill water from ash dyke to be discharged to Possur River without treatment. Seepage water from the ash dyke shall be recirculated to overflow lagoon with suitable drainge and pumping system.
TP17	Waste water and scheduled waste for disposal	Interconnection to facility external disposal
TP18	Chemicals supply	Chemicals receiving facility
TP19	Township 11 kV Power supply	Terminals in the 11 kV unit board of the Power Plant For the supply of the township redundant 11 kV feeders (2 x 100%), one from the 11 kV unit boards of each unit, shall be provided as

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Designation	Category	Interface / Terminal Points
		per section B7.1.1. Cables and raceways are out of Bidder's/Contractor's scope of supply, however, sufficient free space to be considered by the Bidder/Contractor for later installation of associated cables and raceways towards township area.
TP20	Construction Power	2 terminals at 33 KV line at the border of the Power Plant Site Construction Power (Please refer to Section V TS, B9, B9.4.2.1) Power supply for construction purposes will be provided at 33 KV voltage (2 no. of lines). The same will be extended to the Contractor for him to develop 33/11 kV sub-stations and construction power supply comprising of • Two (2) 5 MVA 33/11kV step-down transformers • Two (2) 11 KV switchgears • 11 KV main ring, design according to plant layout, construction requirement and schedule • 11KV/415 V step-down transformers (number and sizes as required according to plant layout, construction requirement) • Two (2) 11 kV feeders (minimum 630 A) for usage of the Employer For improved reliability these feeders shall be connected to separate 11 kV bus systems at 33/11 kV sub-stations. The electricity prices/power tariffs for the case of 33 kV voltage level are defined in the Annex C Further preliminary details regarding provided construction power system are shown in Annex C

Construction Water:
As described under Section B9 the supply of construction water is in the scope of Bidder/Contractor. It is not allowed to use ground water. For construction water shall be used only river water suitably treated for his purposes.

B0.4.2 Interfaces to electricity dispatcher

Communication, control, monitoring and voice channels will be provided between the Facility and BPDB's National/ Regional Control Center by BPDB. The Contractor shall provide interconnection within the Facility for all such communication circuits/ channels.

B0.4.2.1 Interface between the Power Plant and the NLDC

In order to link the Plant to the 400 kV PGCB National Load Dispatch Center (NLDC) the Contractor shall make available all analogue and digital signals in accordance with the requirements of the Bangladeshi Grid Code and as requested by PGCB and the Employer. These will include command signals from the NLDC to the Plant's automatic load control systems (AGC, see **Part B8**).

The Contractor shall liaise with NLDC to facilitate necessary interfacing with the SCADA System in NLDC. All necessary firmware and software with suitable communication link through serial interface (to match the protocol of the existing system) shall be provided by the Contractor. Necessary reconfiguration is to be done by the Contractor to establish logical link with the existing SCADA system in NLDC.
Further, reconfiguration of the database and various display builder functions of the SCADA system in NLDC to accommodate additional signals are under the scope of work of the Contractor.

The following reserve requirements shall be taken into account:

- Min. 10% of the equipment installed shall be a reserve to enable handling of an additional 10% of signals without the need for equipment extensions.
- Min. 15% of the equipment installed shall be a reserve to enable handling of an additional 15% of signals by extending the equipment but without the need to modify the existing structure of any of the interface marshalling cubicles installed.

B0.4.2.2 Signal interface to NLDC for automatic generation control

The power plant shall be equipped with terminals to receive command from the BPDB load dispatch center to allow control from NLDC.

The NLDC shall be able to link to the Automatic Generation Control (AGC) via telecontrol facilities so as to act on the turbine load control, adjusting the latter by decrease/increase load commands. All measurement data to indicate if the target load has been matched shall be transmitted by the telecontrol system to NLDC. Type and initial number of signals are defined in **Section B8**.

B0.4.2.3 Interfaces between the 400/230kV substation and the NLDC

The Contractor (in consultation with BPDB) shall provide suitable interface unit for communication links to the PGCB's SCADA system for communication, control, monitoring and voice channels to accommodate the PGCB and the National/ Regional Control Center requirements.

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The communication interface unit shall be adequate to fulfil the PGCB/ NLDC information requirement. Communication to the National Load Dispatch Center shall be provided by data communication, utilizing both, the IEC 60870-5- 104 and the IEC 60870-5-101 protocols. Settings shall ensure interoperability with the remote National Load Dispatch Center.

For possible future extensions, it shall be possible to interface with two remote control centers simultaneously by using dual port capability.

From the National Load Dispatch Center, all related high voltage apparatus of the substations shall be remote controlled and monitored. Necessary interface shall be provided within the substation automation system for receiving the signals from PGCB grid control.

All signals of the substation required for the control and monitoring from the remote National Load Dispatch Center shall be made available for data transmission via the gateway.

The scope of supply includes all required equipment and installations to enable the substation for the proper connection of the required control and monitoring signals. Communication, telemetry, fiber optical terminal and tele-protection equipment (PLCC) will be supplied and installed by PGCB at Company substation end matching with PGCB's remote substation end requirements. However, line trap and capacitive voltage transformer of required rating along with 48 VDC/AC auxiliary supply at Company substation end shall be provided by the Contractor. The Contractor shall supply and install the necessary cabling and cubicles. Cabling between these cubicles and the telecommunication equipment provided by PGCB shall be provided and installed by the Contractor.

The cabling between Contractor's cubicles and the telecommunication equipment provided by PGCB in the Control Building of the 400/230 kV GIS shall be in the scope of the Bidder/Contractor.

B0.4.2.4 Interfaces between the 400/230kV substation and the Power Plant

The Contractor is responsible for the construction of the interconnections between the substation and the Power Plant. Provision and installation of all control and signal cables between the substation and the Power Plant is within the responsibility of the Contractor.

The Power Plant shall be able to supervise and control the substation via an OPC client workstation installed in the Power Plant's CCR. The Contractor shall provide and install the OPC Server/Client architecture as well as all necessary equipment required for the proper translation of the native data (either acquired directly from the IEDs or from connectivity with the station bus) in OPC-format and the data provision at the OPC-client in the Power Plant control room via a TCP/IP communication link.

In addition the SCMS may communicate with the DCS either by serial communication link or by hardwired connection. In the former, dual redundant links and communication apparatus must be provided. However, the watchdog signalling logic must be hardwired so that this will continue to operate effectively even during SCMS failure.

B0.4.2.5 Interface to power transmission system (PGCB - Power Grid Company of Bangladesh)

The interface between the power transmission system of PGCB and Maitree-STPP will be the following points of the 400/230 kV GIS:

- 400 kV and 230 kV Interconnection:
  - 400 kV and 230 kV OHL conductors on the gantries for connection of the GIS bushings. The gantries shall be provided under the Maitree-STPP project.

- 400 kV and 230 kV OHL Protection, Control and Synchronization:
  - None.

Remark: *The 400 kV and 230 kV OHL protection on the Power Plant end (not on the remote end) shall be included in the scope of supply of the Maitree-STPP Project.*

- Telecommunication:
  - Terminals on the line traps for connection of the telecommunication equipment provided by PGCB on the related gantries
  - Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for the signal exchange with the LDC and for the teleprotection.
  - Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for auxiliary/control power supply (240V AC, 220 VDC and 48VDC).
- Earthing:
  - Terminals on the gantries for connection of the OPGW.
  - Earthing bars in the control building of the 400/230 kV GIS for connection the protection and telecommunication panels.

B0.4.3 Metering

Sufficient metering devices shall be provided to enable an energetic balancing of the power unit, all fuel consumers and additionally the Plant comprising gross and net electric power, coal flow, fuel oil flow, calorific value of fuels, fuels heat energy, electric power, specific heat consumption, etc. for tariff metering and internal balancing purposes.

Metering devices of electrical signals such as frequency, voltage, active power, reactive power, and energy shall be provided:

i for the power unit for tariff metering at the switchyard
ii for the power unit and additional the Plant for internal balancing purposes at all switchgears and all generators.

The final number and type of metering device, their accuracy and signal interface requirements shall be according to the Employer's requirements (see **Part B10** and **Annex E**) and the requirements of the relevant grid code.

B0.5 Technical Schedules

B0/TS Design Conditions
Design Data
List of Major Equipment and Service Suppliers
Guarantees

B0.6 General Technical Requirements

B0.6.1 General requirements

The following directions, information and technical requirements for design, engineering, manufacturing, procurement, construction, commissioning, start-up and testing shall be observed as far as they are applicable for the equipment to be delivered. The requirements stated in this Section of General Technical Requirements are valid for all sections of the specification, except only where additional and/or special requirements are specified.

In case of a contradiction between different Sections of this specification or mentioned standards, the more stringent requirements shall be applicable to Contractor.

Any changes on the design of any part of the Plant, which may become necessary after signing of the Contract, have to be submitted by the Contractor in writing to the Employer for approval, being sufficiently substantiated and justified.

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The Plant shall be new and clean, and designed, manufactured and arranged so that it will have a functional design and a pleasant appearance. All parts of the Plant shall be arranged in such a manner as to facilitate surveillance by the operator and to ease maintenance, operation and control.

The parts of the Plant shall be designed and arranged so that they can be easily inspected, cleaned, erected and dismantled without necessitating large scale dismantling of other parts of the Plant. They shall be designed,

manufactured and put into operation in accordance with the latest recognized rules of workmanship, modern engineering practice and with good standards of prudence applicable to the international electricity generation industry which would have been expected to accomplish the desired result at the lowest reasonable cost consistent with reliability, safety and expedition.

The regulations, standards and guidelines listed in the Specification as well as all applicable laws and governmental decrees, regulations, orders, etc. shall be observed in the design, calculation, manufacture, erection, installation, testing, commissioning and start-up of all parts of the Plant.

The following shall be considered in the design and engineering of the Plant facilities:

- All parts of the Plant shall be suitable in every respect for continuous operation at maximum output as well as part loads and expected transient operating conditions peculiar to the site and shall be able to safely withstand the stresses arising from the operating conditions without any reduction in its planned life.
- The Contractor shall familiarize himself with the conditions on site.
- Suitable and automatically acting protection and safety measures shall be provided for automatic load reduction or shut down of equipment in case of abnormal operating conditions.
- Switchover to stand-by units shall be automatically, as far as required for continuous Plant operation without interruption of Plant operation.
- In case of equipment and/or system shut down process conditioned drainage of components (such as pipelines, tanks, etc.) shall be performed automatically from the control room.
- Minor equipment which, in case of failure would cause a failure of a power generation unit and/or the Plant is to be provided with a stand-by facility in order to ensure further operation of the power generation unit or the Plant.
- All live, moving and rotating parts shall be provided with appropriate effective protection in order to avoid danger to the operating staff. All metal parts shall be electrically grounded.
- All equipment shall be designed to ensure start-up from any condition, i.e. from long term shut-down, cold, warm or hot condition without necessitating special or preparatory measures.
- The project language shall be English.

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B0.6.2 Standards and codes

The work must be performed according to the most recent relevant codes, standards, accident prevention regulations and local rules and legal regulations.

All materials and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of goods, methods of inspection, specific design features of equipment and parts and acceptances of partial plants shall comply in every respect with the applicable standards, codes and regulations to be chosen from the following:

• American Association of State Highway and transportation Officials	AASHTO
• American Concrete Institute	ACI
• American Gear Manufacturers Association	AGMA
• American Institute of Steel Construction	AISC
• American Iron & Steel Institute	AISI
• American Moving and Conditioning Association	AMCA
• American National Standards Institute	ANSI
• American Petroleum Institute	API
• American Public Health Association	APHA
• American Society for Testing and Materials	ASTM
• American Society of Civil Engineers	ASCE
• American Society of Heating, Refrigeration & Air Conditioning Engineers	ASHRAE
• American Society of Mechanical Engineers	ASME
• American Water Works Association	AWWA
• American Welding Society	AWS
• American Wire Gauge	AWG
• Anti-Friction Bearing Manufactures Association	AFBMA
• Architectural Institute of Japan	AIJ
• Association Francaise de Normalisation	AFNOR
• British Standards Institute	BS
• Chlorine Institute	CI
• Crane Manufacturers Association of America	CMAA
• Deutsches Institut für Normung	DIN
• Diesel Engine Manufacturers Association	DEMA
• European Norm	EN
• Expansion Joint Manufacturer Association	EJMA
• Fédération Européene de Manutention	FEM
• Heat Exchanger Institute	HEI
• Hydraulic Institute	HI
• Illuminated Engineers Society	IES
• Institute of Electrical and Electronics Engineers	IEEE
• Instrument Society of America	ISA
• Insulated Power Cable Engineers Association	IPCEA
• International Electrotechnical Commission	IEC
• International Standards Organization	ISO
• Japanese Architectural Standard Specification	JASS

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• Japanese Electrical Manufacturers Association	JEMA
• Japanese Electrotechnical Institute	JEC
• Japanese Industrial Standards	JIS
• Manufacturers Standardization Society	MSS
• National Association of Corrosion Engineers	NACE
• National Electrical Code (USA)	NEC
• National Electrical Manufacturer's Association (USA)	NEMA
• National Electrical Safety Code	NESC
• National Fire Protection Association	NFPA
• National Structural Code for Building	NSCB
• Occupation Safety and Health Administration	OSHA
• Portland Cement Association	PCA
• Properties of Water and Steam	IFC
• Scientific Apparatus Manufacturers Association	SAMA
• Society of Automotive Engineers	ASE
• Standards of Japanese Electrotechnical Committee	JEC
• Steel Structures Painting Council	SSPC
• Technische Vereinigung der Grosskraftwerksbetreiber	VGB
• Tubular Exchanger Manufacturers Association	TEMA
• Underwriters Laboratory	UL
• Uniform Building Code	UBC
• Verband Deutscher Elektrotechniker	VDE
• Verein Deutscher Ingenieure	VDI
• Vereinigung Deutscher Elektrizitätswerke (Association of German Power Plants)	VDEW
• Water Pollution Control Federation	WPCF

Generally, all internationally and nationally recognized standards as above will be applied, except if specific standards called for by:

a) Occupational Safety Board of Bangladesh
b) Department of Inspection for Factories and Establishments, Bangladesh
c) Department of Environment, Bangladesh
d) Bangladesh Power Development Board
e) Bangladesh Energy Regulatory Commission
f) Ministry of Power, Energy and Mineral Resources
g) Bangladesh Fire Service and Civil Defence Ministry
h) All relevant Bangladesh National Statutory Regulations
i) Bangladesh National Building Code
j) Bangladesh Standards
k) Local Authorities.

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All steam boilers and unfired pressure vessels together with associated pipework and fittings shall comply with the Bangladesh Boiler Act, 1923 with amendments.

All pressure parts shall be designed in accordance with applicable ASME codes.

All services, supplies and works shall comply with the requirements of the relevant laws of Bangladesh and the IFC/World Bank Group Standards and Guidelines in their latest edition, including but not limited to:

- Environmental Conservation Rules
- Bangladesh Energy Regulatory Commission Act;
- BERC Licensing Regulation
- BERC Technical Quality Standards;
- Bangladesh National Building Code;
- other applicable laws in Bangladesh;
- IFC Performance Standards on Environmental and Social Sustainability;
- IFC / World Bank Group Environmental, Health and Safety (EHS) General Guidelines ;
- IFC / World Bank Group EHS Guidelines for Thermal Power Plants;
- IFC / World Bank Group EHS Guidelines for Electric Power Transmission and Distribution.

It is the Contractor's responsibility to provide sufficient evidence that any national or other standard the Contractor proposes (other than those mentioned above) will ensure an equivalent or higher standard.

Immediately after effective date of the Contract the Contractor shall supply an indexed list of all standards, codes and associated standards referred to, to which the work is to be performed. A copy of all applied standards shall be forwarded to the Employer. The Contractor shall supply preferably two (2) searchable softcopies, else two (2) hardcopies each.

B0.6.3 Plant and equipment identification

The Contractor shall apply a plant identification system showing the name and number of each item of Plant and its respective arrangement drawing number and add any additional items necessary to fully identify the Plant.

All design submissions shall include a detailed labelling list indicating the label text, size of the lettering and fixing details for the approval of the Employer or its representative.

The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with

the VGB guideline RDS-PP (Reference Designation System for Power Plants - KKS system).

There is to be only one approved description for any one item of Plant and this must be used consistently for Plant, electrical and instrumentation designations throughout.

The Contractor shall supply all labels (Plant and Equipment Identification Plates), nameplates, manufacturer's equipment nameplate, instruction and warning plates necessary for the identification and safe operation of the Plant, and all inscriptions shall be in the English language and Bangla language.

All labels, nameplates, instruction and warning plates shall be securely fixed to items of Plant and equipment with stainless steel rivets, plated self-tapping screws or other approved means. The use of adhesives will not be permitted.

Nameplates for Plant and equipment identification and record purposes shall be manufactured from stainless steel or aluminium with a mat or satin finish, and engraved with black lettering of a size which is legible from the working position.

Warning plates shall be manufactured from stainless steel or aluminium, engraved red lettering on a white background and sited in the position where they afford maximum safety of personnel.

All equipment within panels and desks shall be individually identified by satin or mat finish stainless steel or aluminium labels.

Each circuit breaker panel, electrical control panel, relay panel, etc. shall have a circuit designation label on the front as well as on the rear panels engraved with black lettering in accordance with the circuit designation system. Circuit designations must be precise and convey complete information. There should be no doubt whatsoever for the operation as to which area of the Plant a particular feeder is supplying with power. Labels such as interconnector 1 or feeder 2 are not acceptable. Corridor type panels shall in addition have circuit designation labels within the panels.

Pipework systems shall be identified with a colour identification systems in conformity with the colours according to the Employer's specification, with colours at the nameplates and, if necessary by colour bands and with KKS numbering and plain language. The direction of flow shall be shown.

Each valve/instrument shall be fitted with a stainless steel or aluminium nameplate indicating the valve/instrument service and reference number in accordance with the approved equipment coding system.

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Where possible valve nameplates shall be circular and shall be fitted under the handwheel captive nut. They have to be of such a diameter that there is no danger for persons operating the valve or that they do not prevent lock-off of this valve; on check valves and small valves the Contractor may provide rectangular nameplates fitted to brackets on the valve or attached to a wall or steelwork in a convenient position adjacent to the valve.

B0.6.4 Marking and labelling

Each crate or package is to contain a packing list in a waterproof envelope. All items of material are to be clearly marked for easy identification against the packing list.

All cases, packages, etc. are to be clearly marked on the outside to indicate the total weight, where the weight is bearing and the correct position of the slings and are to bear an identification mark relating them to the appropriate shipping documents.

All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.

B0.6.5 Corrosion protection, coating and galvanizing

This specification shall be used for the corrosion protection of steel structures, components, pipings and equipment in general which are installed in confined areas (indoors) or outdoors.

Surface preparation, as well as protective coatings and coating systems are based on this specification in order to assure that structural parts of different suppliers will get a corrosion protection of similar and high quality.

Coating material shall only be supplied by manufacturers with international experience and their products can be obtained internationally.

Regarding maintenance work (storage), application and supervision of coating work, choice of coating suppliers should be minimized. At any rate, similar parts of structures/components (such as structural steel, containers, piping, etc.) shall only be coated with products of one individual manufacturer.

The materials and equipment used, the methods of application and the quality of work shall at all times be subject to the inspection and approval of the Employer or his Representative.

To mitigate crevice corrosion, the designs and construction of structures and equipment shall ensure that no collection of water occurs in crevices which could lead to crevice corrosion.

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It is the responsibility of the Contractor to ensure that, for all supplied equipment (including that from sub suppliers):

- The protection system is perfectly suitable for the Site conditions and for the specific purpose.
- The shop paints provide a sufficient protection during transport, storage and erection.
- The shop paints are suitable for handling and erection conditions (slinging, Site welding works etc.) and are compatible with the Site finishing coats
- All necessary precautions are taken in order to prevent damage to paints during storage, handling, welding.
- The necessary repairs are carefully executed as soon as possible.
- The colour RAL number of the finishing coat has been approved by the Employer, including identification code for piping.
- Standardised equipment will be painted according to the manufacturer's standard.
- All corrosion protection and coating on site shall be done in a workshop specifically for the purpose of the application of corrosion protection and coating.

Codes and standards
Applicable standards are:

- Product data of coating manufacturer
- DIN 2403 Indication of pipe-lines according to flowing material
- DIN 4762 Surface roughness
- ISO 8503 Surface roughness
- DIN 8201 Part 1-9 tight blasting agents
- DIN 50976 Corrosion protection, hot dip batch galvanizing of single parts, requirements and testing
- DIN 55928 Part 1-9 corrosion protection of structural steel work through protective coatings and topcoats
- ISO 8501 Preparation of steel substrates before application of paints and associated products
- ISO 12944 Paints and varnishes – corrosion protection of steel structures by protective paint systems
- RAL Colour card
- ISO 8501-1 Preparation of steel substrates before application of paints and related products
- SSPC Vol. 1 and 2 Steel structure painting council

Surface preparation and cleaning of surfaces in the shop
Prior to blasting, areas have to be cleaned from oil, grease, paint residues, splatters, welding splashes and welding slag using a suitable aqueous degreaser, or solvent for more severe grease contamination. The cleaning should be to provide a "water break free surface".

Sharp edges have to be rounded off.

Contaminations caused by salts, acids and alkali solutions shall be eliminated by rinsing with water up to a pH value of 6-8. Soluble salt contamination is to be tested using the Weber Reilly test method (or similar approved) and pH is to be tested using universal indicator paper strips prior to continuation with the blasting.

The preparation of substrates shall be carried out on the basis of the specifications of ISO 12944 part 4 and ISO 8501. The preparation of steel before application of paint and related products shall be in line with ISO 11124 for metallic blast cleaning abrasives and ISO 11126 for non-metallic blast cleaning abrasives. No recycled blast grit may be utilised.

After blasting, an anchor profile of 25 - 50 µm shall be achieved. Blasted surfaces have to be provided with a prime coat of the approved coating system immediately within 4 hours of blasting. All blasting and priming must take place outside of the high humidity periods of the day (i.e. maximum relative humidity of 80%).

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

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming, , unless the specific coating system allows for coating onto damp concrete, in which case only with approval from the Employer.

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

Transport and erection damages, as well as damages which result out of additional welding have to be repaired as soon as possible. The damaged areas have to be derusted with rotating or steel brushes, abrasive wheels, and abrasive blasting according to DIN ISO 8501-1.

Cleaning of prime and intermediate coats (if required)
To prevent contamination by mineral oil products, areas with prime and intermediate coat have to be treated with suitable cleaning agent. Cleaning has to be done free of residues, e.g. with alkaline detergents and thorough washing done with fresh water. Rusty spots have to be removed according to required purity. Metallic areas which are provided with temporary corrosion protection have to be cleaned. No oxidation products shall remain on the surface. Further care shall be taken that on hot components, no destructive or reaction products will be released when heating which could injure insulation.

Application procedure
When using the provided coating material, strict adherence to all application instructions given in product data of coating manufacturer is necessary. To obtain the maximum performance, technical data as well as application instructions for the individual coating material have to be strictly followed.
For a multi-layer coating system each layer has to have a different colour shade in order to clearly identify number of coats applied.
The last finish coat has to be applied in the specified colour shade.

All paintings shall be performed according to ISO 12944. The durability of all paintings shall be "high" which corresponds to 15 years.

The interval between applying the different coats has to follow according to supplier's precautions. Each layer has to be cleaned and released from spray dust before the next layer will be applied. Prior to applying a further layer, the last one has to be repaired. All coatings have to be applied without retarding.

Following application procedures are allowed:

- prime coats by airless spray
  areas like disconnections, angles, corners, etc. which are difficult to be reached can be applied by brush or roller
- repair of prime coat by brush
- finish coats
  - at works by airless spray, roller or brush
  - at site by roller or brush or airless spray.

When applying coating systems by roller, rollers have to be of kind and quality which make an appropriate application possible.

Control areas in accordance with the coating supplier's instructions have to be applied. For this procedure, a schedule for control areas has to be prepared by the Contractor and coating supplier which corresponds with the requirements of the warranty agreement.

Number and performance of the control areas have to be done in accordance with ISO 12944 part 7 and have to be documented in writing.

No application shall take place either in the condition of the relative humidity not within the given limit or in case of poor weather conditions such as fog, dust, rain, snow, hail or when it can be assumed that such conditions of poor weather will arise within 2 hours after application.

Temperature of the coated parts has always to be above 5 °C and 3 K above dew point.

All specified dry film thicknesses (DFT) are minimum thicknesses.

Welding seams executed at site have to be taped with an adhesive tape of about 30-50 mm after surface preparation (blasting or manual derusting) and prior to application in the manufacturing plant and to be coated with stripping coat.

Chequered plates, nap plates, etc. have not to be covered with adhesive tape, but have to be coated with stripping coat in a dry film thickness of at least 150 µm.

Edging lines on steel structure have to be taped prior to application and after blasting in sufficient width or have to be protected with varnish before application. Thickness of prime coat may be 50 µm maximum.

During repairing works at site on shop-primed structures, it is important that different coats will have different colour shades. Numbers of layers have to be the same as the original coating system to be used.

Application of temporary primer on structures which have to be insulated has to be in accordance with a sufficient corrosion protection for the period of storage respectively erection time.

Galvanizing

Galvanizing work shall conform in all respects to ISO 1461 or equivalent standards and shall be performed by the hot dip process unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed to suit the requirements of the process. They should be in accordance with ISO 12944.

Vent holes and drain holes shall be provided to avoid high internal pressures and air locks during immersion and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with BS 4360. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized.

The minimum coating thickness shall be as specified in Table 1 of BS 729. Structural steel items shall be first grit-blasted to BS 4232, second quality, (Sa 2 1/2) or pickled in a bath, and the minimum average coating weight on steel Sections 5 mm thick and over shall be 900 g/m^2, on steel Sections 2 - 5 mm thick 600 g/m^2.

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Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.

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

Small areas of the galvanized coating damaged in any way shall be restored by:

- cleaning the area of any weld slag and thorough wire brushing to give a clean surface
- The application of two coats of zinc-rich paint, or the application of a low melting point zinc alloy repair rod or powder to the damaged area, which is heated to 300 °C or the treatment with suitable cold galvanizing paint, such as ORAPI n.z.a.b 706. All zinc rich paint used for such repairs must contain a minimum of 81% by mass of zinc in the dry film.

Connections between galvanized surfaces and copper, copper alloy or aluminium surfaces shall be protected by suitable tape wrapping.

Coating Systems

System-No.	Surface location	Temp. °C	Surface preparation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat µm	Total DFT µm
1	Structural steel works, piping, vessels, tanks INDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Finish	1	Epoxy High Solid	80	80 **160**
2	Structural steel works, piping, vessels tanks OUTDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Intermediate	1 – 2	Epoxy High Solid	160	160
				Finish	1	2-Comp Polyurethane	50	50 **290**
3	Piping, tanks, etc. INDOOR and OUTDOOR Insulated	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	Pumps, motors, other equipment OUTDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Intermediate	1	Epoxy High Solid	110	110
				Finish	1	2-Comp.Polyurethane	50	50 **240**
5	Pumps, motors, other equipment INDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Finish	2	Epoxy High Solid	50	100 **180**
6	Piping, reactors OUTDOOR Insulated	> 120	SA 2.5	Primer	1	Zinc Ethysilicate	75	75
7	Stacks OUTDOOR	< 120	SA 2.5	Primer	1	Zinc Ethysilicate	75	75
		< 200		Finish	2	Silicone Acrylic	50	100 **175**

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THIS IS THE PART OF TECHNICAL SPECIFICATION NO. PE-TS-421-177-A001

Coating Systems

System-No.	Surface location	Temp. °C	Surface preparation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat µm	Total DFT µm
8	Steel surfaces Uninsulated	200 - 450	SA 2 ½	Primer Finish	1 1 or 2	Zinc Ethyl Silicate Silicone Aluminium	75 25	75 50 125
9	Galvanized surfaces	up to 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine sand	When Finish Coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid*	125	125
10	Steel surfaces permanently in contact with water, also river water splash zone	Medium temp. °C up to 60	SA 2 ½	Prime and Finish Coat in One	1	Glassflake reinforced High Solid Epoxy	500	500
11	Plant / Cooling water pipes	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						

* Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 µm, when exposed to UV or weathering conditions and colour retention is required.

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B0.6.6 Vibration

Steam turbine generator

The steam turbine and generator have to be statically and dynamically balanced in the workshop such that the following levels of vibrations can be achieved:

- For the steam turbine and the generator the vibration level, measured on the rotating parts at each main bearing shall not exceed the upper limit of the zone "A" as defined in ISO 7919 at steady conditions.
- For the steam turbine and the generator, the vibration level, measured on the rotating parts at each main bearing shall not exceed the upper limit of zone "B" as defined in ISO 7919 for transient operation at rated speed.
- In no case (except alarm condition), the vibrations measured on the rotating parts shall exceed 0.5 of the minimal clearance of the bearings, for the measurements installed near the bearings. This requirement is valid for all speed ranges and load conditions. If conflicts exist between the different specifications, the more restrictive value shall be applied.

The location of sensor element shall be according established standards and generally recognised codes of practice.

Other rotating equipment

Unless otherwise stated or agreed by the Employer all rotating equipment must have statically and dynamically balanced in the workshop such that the following levels of vibrations can be achieved:

- For large rotating equipment (boiler feedwater pumps, main cooling water pumps, fans (PAFs, FDFs, IDFs), condensate pumps, etc.) the vibration levels, measured on the non-rotating parts, shall not exceed the upper limit of zone "A" as defined in ISO 10816 at steady conditions. For other areas e.g. min flow or run out flow, zone limit "B" shall be maintained.
- For standard pumps, other rotating equipment and reciprocating pumps, the vibration levels, measured on the non-rotating parts, shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions. For equipment which is not covered by ISO 10816, the manufacturer's standard shall be applied.
- For all rotating equipment at transient conditions, the vibration levels, measured on the non-rotating parts, shall not exceed the zone limit "C" as defined in ISO 10816.
- For all motors, the vibration levels, measured on the non-rotating parts, shall not exceed the limit as described in the relevant Sections for MV and LV motors.
- The vibrations measured on the rotating parts may not exceed 0.5 of the minimal clearance of the bearings. This requirement is valid for all speed ranges and load conditions. If conflicts exist between the different specifications, the more restrictive value must be applied.

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Whenever necessary, equipment shall be put on vibration dampers.

Vibration Monitoring System

Vibration shall be measured at large rotating or reciprocating machinery for protection and predictive maintenance. This includes the turbine, the generator, large rotating equipment (boiler feedwater pumps, main cooling water pumps, fans (PAFs, FDFs, IDFs), condensate pumps, etc.).

Suitable indications shall be provided in the control room for each measurement point and the measurement shall be suitably alarmed where high vibration levels may cause possible damage or affect the safety of the Plant. All the vibration signals, unprocessed, which are present on the machine as well the result of the VMS shall be available in the PADO as well as in DCS.

The vibration monitoring system (VMS) shall be reliable, accurate, easy to maintain, and suitable for use in such ambient conditions appertaining to the intended plant installation. Vibration monitoring signals for trip commands, protection functions or process interlocks shall be hardwired. The VMS shall comprise all the necessary hardware and software modules and shall be configured according the design and the needs of the specific installation and technology.

Standardization and interchangeability of components shall be implemented where feasible.

The following features and requirements shall be considered for the vibration and displacement monitoring system:

- self-checking and single fault tolerant system
- modular and reliable system
- 2 out of 3 voting, if signals shall be used for trips (shaft vibration measurement shall be as per ISO 7919-2)
- hardwired or redundant serial communication have to be foreseen
- All buffered outputs signals shall be passed through to the analysis system as unprocessed (raw) input signals.

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The following criteria shall be used as a guideline for rotating machinery such as steam turbine, generator, blowers and fans, mills and main feed water pumps as well as other main pumps, in order to ascertain the monitoring points, principles of what signal shall be measured, what is displayed, and what mechanical conditions entail alarm and/or trip status:

- non-contacting proximity probes shall be provided unless otherwise specified for measuring rotor shaft vibration and axial position,
- vibration measurements shall be in displacement microns peak to peak,

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- in cases which, because of process conditions, accessibility or non-critical service, may entail the use of machine casing mounted vibration transmitters, the transmitters shall be of the "acceleration" type incorporating a filter network, if necessary along with integration in the monitor unit for vibration read-out in velocity mm/sec RMS. For alarm only, one transducer may be used. For alarm and trip conditions 3 transmitters shall be used with a voting system (i.e. one high reading out of three = alarm, two out of three = trip). Contacting type of equipment shall meet the requirements of ISO 2954,
- velocity type transmitters shall be used as an alternative to velocimeters when machine rotational speed and generated vibration frequency conditions dictate,
- individual read-out of all channels shall be provided in HMI as well as in the vibration monitoring module. Display shall be by means of a multi-point indicator and digital selector,
- facilities for trend monitoring using trend functions of the DCS shall be provided on the turbo-generator bearings as an aid for predictive maintenance purposes,
- vibration parameters of the turbine shall also be fed in the turbine control system
- buffered signals at the monitor shall be a requirement to enable external data acquisition, if such is necessary,
- facilities shall be provided for the calibration of the instrumentation system.

Further requirements on the analysis functions of the VMS are given in **Section B8**.

B0.6.7 Standardization of makes

The works shall be designed to facilitate access and facility for inspection, cleaning, maintenance and repair. Continuity of supply is a prime concern. The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the works. The Plant shall be designed to operate satisfactorily under all variations of load, pressure, and temperature.

Corresponding parts throughout shall be made to gauge and be interchangeable wherever possible.

No prototype will be permitted. Continuity of operation and lowest maintenance requirements are of prime concern. The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment and plant.

The equipment must be standardized as much as possible.

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All equipment performing similar duties shall be of the same type and manufacture in order to limit the stock of spare parts required and maintain. uniformity of plant and equipment to be installed. Especially the number of types and manufacturers of actuators, valves and instruments shall be reduced to a minimum.

If a piece of equipment is present several times, then all of these pieces shall be identical. All their constituting parts must be exchangeable between them.

The Employer reserves the right to advise the Contractor of preferred type and manufacture to secure the above-mentioned requirements.

Bidder's/Contractor's sub-suppliers and vendors shall comply with Provennes Criteria as stipulated elsewhere in the biding document.

Throughout the Power Plant metric units, scales and measures shall be used; this applies especially to all fittings.

B0.6.8 Accessibility

The Contractor shall supply and erect sufficiently large safe platforms, galleries, stairways or ladders and access ways necessary for providing safe and easy access to all the plant items for operation and maintenance. The Contractor shall ensure that the whole of the access ways is of uniform design and pattern throughout the works.

The design of all stairways, access ways etc. shall conform to the requirements of the relevant chapters is **Section B0**.

B0.6.9 Signs & colour code

General

Safety colours, safety symbols and safety signs must comply in construction, geometrical form, colour and meaning with the ISO 3864.

Signs for plant identification during the erection period must be to Employer's approval.

The signs should be of a material which is weather-resistant and of sufficient durability for the conditions prevailing on site.

Mounting and installation

The positions for the signs must be chosen so that they are within the field of vision of the persons to whom they apply. The signs should be permanently attached. Temporarily dangerous areas (e.g. construction sites, assembly areas) may also be marked by movable signs. The safety signs

must be mounted or installed in such a manner that there is no possibility of misunderstanding.

Information signs

Information signs should supply the necessary information to acquaint personnel with the physical arrangement and structure of site, buildings and equipment, e.g. floor numbers, load-carrying capacities including marking of floor areas, working loads of cranes, lifting gear and lifts, room identification, etc. The routing of underground pipes and cables is to be indicated by substantial marker blocks showing the relevant identification numbers.

In the choice of information signs in situations not covered by ISO Draft Recommendation 507 the possibility of using pictograms should be considered. Pictograms are particularly suitable for the identification of rooms, areas and buildings in the non-technical areas of the Plant, sanitary and amenities buildings, etc.

Emergency signs

In the event of accidents, all necessary information should be available immediately to those affected. Thus, a sufficient number of signs of appropriate size should be installed, e.g. escape routes (including marking of floor areas), emergency exits, fire alarms, fire extinguishers, instructions for special fire-extinguishing agents, warnings against fire-extinguishing agents (CO_2), first aid equipment, first aid points, accident reporting points, telephones, etc.

Mandatory signs

Signs indicating obligatory actions must be provided installed wherever certain action is necessary, e.g. do not obstruct the entrance; keep right, etc. Signs should also indicate when the wearing of protective clothing and equipment is necessary and obligatory, e.g., protective goggles, protective clothing, helmets, head guards, breathing equipment, ear muffs, etc.

Warning Signs

Warning signs should refer to the existence or possible existence of danger, e.g., flammable substances, explosive substances, corrosive or noxious substances, suspended loads, general danger, width/height restriction, steps, risk of trapping, slipping, falling, etc.

In addition to warning signs, appropriate black-yellow strip markings should also be used where necessary.

Equipment and Piping Colour Code

For colour code for all equipment and piping see table below, for any other items Employer's approval shall be obtained. For safety issues relevant standards and regulations shall prevail in case of discrepancy. Final colour selection is to be discussed and approved by Employer.

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Colour Code (based on DIN 2403:2007-05 & DIN 5381)

Medium	Base	RAL	Band/ Ring	RAL	Let-tering	RAL
Flammable liquids and solids e.g. high speed diesel, lube oil, seal oil, hydraulic oil, coal	Signal Brown	8002	Signal Red	3001	Signal White	9003
Flammable gases e.g. hydrogen	Signal Yellow	1003	Signal Red	3001	Signal Black	9004
Non-flammable liquids and solids e.g. ash	Signal Brown	8002	Signal Black	9004	Signal White	9003
Non-flammable gases e.g. nitrogen, carbon dioxide	Signal Yellow	1003	Signal Black	9004	Signal Black	9004
Fire fighting, e.g. fire fighting water	Signal Red	3001			Signal White	9003
Water, e.g. service-demin., condensate feed-, river-, cooling-closed cooling water except fire fighting water	Signal Green	6032			Signal White	9003
Steam e.g. main steam, HRH, CRH, aux. steam	Signal Red	3001			Signal White	9003
Acids e.g. HCl, ferrous sulphate	Signal Orange	2010			Signal Black	9004
Alkali, e.g. ammonia, caustic	Signal Violet	4008			Signal White	9003
Air e.g. station air, service air, instrument air	Signal White	9003			Signal Black	9004
Oxygen	Signal Blue	5005			Signal White	9003
Driven machines (e.g. fans and pumps) including motor; Vents, drains, vacuum	Follow medium color					
Structural steel, steel skids for equipment	Window Grey RAL 7040					
Safety caution, e.g. fall or trip hazards, handrails, head room clearance	Alternating stripes Signal Yellow RAL 1003 / Signal Black RAL 9004					
Panels, cubicles, junction boxes	Light Grey RAL 7035					

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B0.6.10 Units of measurement

The Contract shall be conducted in the Systems International d'Units (SI) system of units in accordance with the provisions of ISO 31 and ISO 1000.

In all correspondence, technical schedules, drawings and instrument scales, the following units shall be used:

Quantity	Name of Unit	Symbol
Length	Millimeter	mm
Mass	Kilogram	kg
Time	Second	s
Temperature	Degree Celsius	°C
Temperature Difference	Kelvin	K
Electric Current	Ampere	A
Luminous Intensity	Candela	cd
Area	Square meter	m^2
Volume	Cubic meter Liter	m^3 l
Force	Newton	N
Pressure	Bar	bar
Pressure below 1 bar	Millibar	mbar
Stress	Newton per square millimeter	N/mm^2
Velocity	Meter per second	m/s
Rotational speed	Revolutions per minute	rpm
Flow	Cubic meter per day Cubic meter per hour Kilogram per hour Liter per second metric ton per hour	m^3/d m^3/h kg/h l/s t/h
	For gaseous substance: standard cubic meter per hour	Nm^3/h
Density	Kilogram per cubic meter	kg/m^3
	Kilogram per standard cubic meter	kg/Nm^3
Torque, moment of force	Newton meter	Nm
Moment of inertia (mr^2)	Kilogram square meter	kgm^2
Work, energy or heat	Joule	J
Heat capacity, entropy	Joule per Kelvin	J/K
Specific heat capacity, specific entropy	Joule per kilogram Kelvin	J/kgK
Calorific value	Joule per cubic meter Joule per gram	J/m^3 J/g

Quantity	Name of Unit	Symbol
Power, radiant flux	Watt	W
Heat release rate	Watt per square meter	W/m^2
Thermal conductivity	Watt per meter Kelvin	W/mK
Dynamic viscosity	Newton second per square meter	Ns/m^2
Kinematic viscosity	Meter squared per second	m^2/s
Surface tension	Newton per meter	N/m
Concentration	Parts per million	ppm
Electrical conductivity	Microsiemens per meter at 25 °C	µS/m
Frequency	Hertz	Hz
Electric charge	Coulomb	C
Electric potential	Volt	V
Electric field strength	Volt per meter	V/m
Electric capacitance	Farad	F
Electric resistance	Ohm	Ω
Conductance	Siemens	S
Magnetic flux	Weber	Wb
Magnetic flux density	Tesla	T
Magnetic field strength	Ampere per meter	A/m
Luminous flux	Lumen	lm
Illuminance	Lux	lx
Thermal resistivity	Kelvin meter per Watt	Km/W
Energy	Kilowatt hour	kWh

For the thermodynamic properties of steam and water, "The IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam" or the latest version thereof shall be used.

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B0.6.11 Ways, stairs, ladders, balustrades

The Contractor shall supply all platforms, galleries and stairways necessary for providing safe and proper access to the Plant for operation and efficient maintenance. The Contractor shall ensure that the type of flooring, stair treads and handrails conform to a uniform pattern throughout the whole Project.

The loads for the design of platforms, galleries etc. shall be in accordance with the Section 'Design Loads' of the special civil part of these specifications.

All platforms, galleries, stairways and hand railing shall be of galvanized steel unless otherwise specified.

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All platforms and galleries shall be designed with a minimum headroom clearance of 2200 mm and shall have a minimum width of 1500 mm clear passageway and shall be enclosed by hand-railing on both sides. Ladders are only to be provided as an extra means of escape.

All aspects of platforms, stairways, ladders and other access ways shall comply with the requirements of applicable DIN standards, BNBC or equivalent.

B0.6.12 Hazardous areas, fire fighting & prevention systems

Hazardous areas

The Contractor shall take full account of any special requirements concerning the nature, handling and storage of all fuels, flammable gases and chemicals etc., and provide plant, equipment, buildings and other services accordingly, including all facilities to ensure the safety of the operating and maintenance personnel.

The Contractor shall provide drawings to define all the hazardous zones taking account of all sources of hazards under normal and abnormal operating conditions (regardless of whether or not these areas are specifically listed in the specification). The zoning philosophy shall be subject to the approval of the Employer. All equipment necessary for mounting in these areas shall meet the requirements of BS 5345 or equivalent.

In particular, equipment directly concerned with Plant which may give rise to a hazardous situation shall be designed to IEC 60079 Zone 1 or 2 requirements with electrical connection safety barriers or intrinsically safe equipment equivalent to VDE 0171 Type Exi. Where required by the Employer/Engineer, certification shall be provided to confirm the suitability of the equipment and devices.

The Contractor shall be responsible for ensuring that all electrical equipment installed in any hazardous zone is designed and tested to suit the relevant zone classification and shall be to the approval of the Employer. Cables shall not be laid in trenches etc. with fuel pipe work.

All electrical equipment part of a following system installed in hazardous areas shall be of flame/explosion proof type:

- fuel oil handling systems
- burner operating floors
- turbine lubrication oil tank area
- generator sealing oil tank area
- diesel generator area
- hydrogen bottle house
- others required by the above standards.

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All equipment offered for use in the above areas shall have the necessary certification by the appropriate National Certification Bureau and its proposed application shall fully comply with all conditions of the certificate.

At least all electrical equipment part of the systems in hazardous area as stipluated in the specification shall be of flame/explosion proof type.
For other systems the approach as described by the Bidder/Contractor can be applicable.

All electrical equipment associated with any part of a system within the following areas shall be of dust explosion proof type:

- station bunker rooms,
- conveyor transfer towers,
- 3 meters radius from coal feeders, pulverizers and the center point of pulverized fuel pipes.

Fire Fighting & Prevention Systems
See **Section B12**.

B0.6.13 Maintenance isolation

All major equipment shall be arranged to facilitate safe isolation from all hazards for maintenance purposes. In addition all valves must be capable of being locked either in the open or closed position by means of a chain and padlock.

Non return valves are not acceptable as a means of isolation.

B0.6.14 Materials

B0.6.14.1 General material requirements

All materials shall be new and of the best quality for use in the conditions and the variations in river water quality (refer to **Part C Annexes**), the temperature and pressure that will be encountered in service without undue distortion or deterioration or the setting up of undue strains in any part that might affect the efficiency and reliability of the Plant.

All materials shall correspond either to the approved standards and the respective code number or to exact analysis data, and full information concerning properties and applied heat, chemical and mechanical treatment shall be submitted.

Special attention must be paid to eliminating the possibility of corrosion resulting from galvanic effects. Design, selection of materials and all methods of erection shall be such as to keep these effects to a minimum.

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Materials complying with codes and standards listed below shall be used for the design and construction work.

Unless the materials meet these codes and standards the equivalent ASME/ASTM standard shall be used.

Materials and standards

(A)	a.	Structural Steel Built-up Members	DIN EN 10 027-1	all steel brands S235 and S355
			Formerly DIN 17 100 and EN 10 025	Formerly St, USt & RSt37-2, St37-3, St52-3 or Fe360B, BFU, BFN, C & D1, and Fe 510
	b.	Structural Steel Hot Rolled Members	DIN 1024 Series DIN 1025 Series	all steel brands S235 and S355,
			DIN 1026 Series DIN 1027 Series DIN 1028 Series	Formerly St, USt & RSt37-2, St37-3 and St52-3, or Fe360B, BFU, BFN, C & D1, and Fe 510
			DIN 1029 Series	
	c	Structural Steel Tubes	DIN EN 10 210-1,2	S235 and S355
	d.	Crane rail	DIN 4132	
(B)	a.	Bolts and Anchor Bolts	DIN ISO 898, DIN 18 800-1	4.6 (fy ≥240 N/mm²) 5.6 (fy ≥300 N/mm²)
	b.	High Strength Bolts	DIN ISO 898, DIN 18 800-1	8.8 (fy ≥640 N/mm²) 10.9 (fy ≥900 N/mm²)
	c	Stud Bolts	DIN 32 500 Part 1 & DIN 18 800-1	4.8 (fy ≥320 N/mm²)
			DIN 32 500, Part 3 & DIN 18 800-1	St 37-3 per DIN 17 100, (fy ≥350 N/mm²)
(C)		Electrodes for Arc Welding	DIN 1913/ DIN EN 499	
(D)		Ordinary Portland Cement	DIN 1164-1 / 1164-2 EN 197-1	
(E)		Reinforcing Bars	DIN 488-2 / 488-4	

Material properties and allowable strengths

- **Concrete steel reinforcement**
  High yield steel deformed bars, types as per DIN 488-2
  The max. bar length shall be 12 m.

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- **Concrete steel fabric reinforcement**
  Reinforcement quality
  Wire of grade 500 (fy = 500 N/mm²) as per DIN 488
  Welding of reinforcement as per DIN 4099.

- **Fabric types**
  Preferred range of designated fabric types: see part 4 of DIN 488.

- **Concrete grade and specified strength**
  Concrete for blinding grade C12/15 as per DIN 1045. Min. thickness of blinding = 75 mm.
  Concrete for all other structures grade 25/30 as per DIN 1045.
  All concrete grade 30/37 or higher as well as special qualities, like waterproofed concrete, have to be mixed in accordance with a special design concept, approved by a third party assessment.

- **Concrete cover to reinforcement bars**
  The minimum concrete cover for durability to any reinforcing bar shall be in accordance with ZTV-K, **Section 6.**

  Concrete grade 25/30 as per DIN 1045 are minimum requirements, if not mentioned otherwise.

  Note:

  a) Cover noted is to the outside bar regardless of whether it is main or secondary reinforcement.
  b) For concrete exposed to brackish water, brine and seawater splashing a special design concept is required.
  c) For water or liquid retaining structures, the cover should be reviewed in conjunction with design, to limit the allowable crack widths. Linings could also need to be applied.

Structural steel
DIN 18800 / DIN 18801 / DIN 18807 shall be followed.

For all above mentioned material standards, the equivalent standards as per BS, ASME/ASTM are also accepted.

B0.6.14.2 Specific requirements for high temp./high pressure part materials

The purpose of this part is to provide the additional requirements for the purchase, manufacturing and fabrication of:

- austenitic stainless steels used for high temperature superheater and reheater tubing,
- ferritic/ martensitic steels used for high temperature pressure parts.

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All manufacturers and suppliers of the base metals, from raw materials until finished products, shall be ISO 9001:2000 certified for the duration of the contract or being renewed during the duration of the contract as appropriate.

Only seamless tubes and pipes are acceptable for power piping. For low pressure systems (< 6 bar (g) welded pipes will be accepted. Welded pipes may be used for sizes above DN500 if the design pressure and design temperature are such that it calls for pressure rating of ASME 300 class or below. The fittings shall correspond to ASTM A234 with Grade corresponding to the pipe material. The welded pipes provided shall be of certified source.

All materials and manufacturing procedures shall be certified by an independent 3rd party. The approval shall be part of the quality documentation.

The use of SA213-T24 material for membrane walls is not accepted.

The material SA213-T23 is known for cracking sensitivity. It shall be demonstrated and documented in the final data package that all such materials are free from any cracks and that all hardness values are within the required limits.

For SA213-T23 the Contractor must provide a detailed procedure for the calculation, design, purchase, manufacturing, erection, cleaning and pressure testing of this material. The relevant ASME code cases must be respected.

For SA213 T91 and SA335 P91 the latest stress values and the latest information according to ASME code cases must be used. Also the EPRI „Guidelines and Specifications for High-Reliability Fossil Power Plants Best Practice Guideline for Manufacturing and Construction of Grade 91 Steel Components“ shall be respected.

Bidder/Contractor at his sole discretion may use ASME SA-335, P-92 or approved equivalent material for superheater/reheater headers and interconnecting piping, i.e. for the components which are outside the flue gas path. However, use of T92 material for boiler tubes is not permitted.

In case it is proposed by the Bidder/Contractor to use ASTM-A-335, P-92 or equivalent material, Bidder/Contractor shall furnish a certificate of provenness of the material certifying the usage and satisfactory performance of the proposed material in main steam/hot reheat piping for a reference plant (or applicable unit of reference plant) having rated main steam and/or hot reheat steam temperature at turbine inlet at least equal to or higher than the rated main steam and/or hot reheat steam temperature at turbine inlet envisaged by the Bidder/Contractor. Such reference plant(s) (or unit) should have been executed by the Bidder/Contractor himself or by others and should have been under operation for at least 50,000 hours or 6 years from date of commissioning of the applicable unit (of the reference plant).

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Maximum allowable stress values for ASME SA-335: P-92 or approved equivalent material as per code shall be reduced by 10% for calculating the thickness of pressure parts.

For SA335 P92 the Contractor shall provide a detailed procedure for the calculation, design, purchase, manufacturing, erection, cleaning and pressure testing of this material. The relevant ASME code cases must be respected. SA213-T92 may be used for header nipples outside of the flue gas pass, while meeting the above mentioned requirements for quality control.

The details on preheating for welding and PWHT shall be stated in detail. Special consideration shall be given to record the metal temperatures during manufacturing, erection and operation.

In case of any repair of any of such materials at site the 3rd party engineer must be involved concerning the proposed repair method.

B0.6.15 Pre-service cleaning and protection of plant equipment

This clause covers mechanical and pre-service cleaning and protection of the plant items and equipment at the Manufacturer's workshop and at site that are not subsequently to be painted.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturers' works or at site, as appropriate.

In the event of the surfaces not being cleaned to the Employer's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the Contractor's sole expense.
Mechanical cleaning as opposed to alternative chemical cleaning is the preferred method for workshop cleaning except where this is precluded by design or access considerations.

Machined surfaces shall be protected during the cleaning operations. For recleaning small areas, hand cleaning by wire brushing may be permitted. Wire brushes used on austenitic materials shall have austenitic steel bristles.

Austenitic stainless steels, copper and aluminium alloys, cast iron, bimetallic and metallic/plastic items, and components fabricated by spot welding or riveting shall not be chemically cleaned. All weld areas shall be suitably stress-relieved before chemical cleaning.

At an appropriate time, the Contractor shall submit drawings of temporary pipework necessary to carry out the pre-service cleaning simultaneously with a list of works to be carried out on the pipelines, heaters, feedwater

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tanks, vessels etc. to connect the temporary pipework with the parts of equipment to be cleaned.

Further, the Contractor shall submit at the same time the basic draft of the cleaning procedure and of the treatment of wastes.

Not less than six months prior to the commencement of any site cleaning, the Contractor has to submit programs covering all procedures, lists of chemicals, calculations which quote the velocities, temperatures hand-pipework forces and movements imposed during site cleaning.

All necessary equipment, provisions, chemicals etc. are to be provided by the Contractor.

All tests, analyses, etc. as required are to be performed by the Contractor.

Besides this, the Contractor shall take over all responsibility for the treatment and disposal of wastes according to the local law and to the satisfaction of the Employer.

The date at which cleaning of plant equipment will be carried out at site shall be notified to the Employer at least 20 days in advance.

The Contractor shall take all necessary precautions to ensure that the internal surfaces of all plant are kept clean and free from injurious matter during erection.

When all plant has been erected and lagged or at such other time as may be agreed with the Employer for sub-assemblies, the installation shall undergo a procedure for site cleaning proposed by the Contractor and subject to the approval of the Employer.

B0.6.16 Welding

All pressure part welding must follow the requirements of ASME and connected standards.

Welding work and related heat treatment as well as inspections and test shall be performed in accordance with the specific and approved welding procedure specifications (WPS) and the respective material specifications.

WPS shall be prepared in accordance with relevant ASME standards, endorsed by 3rd party / inspector and submitted to the Employer.

Welding plans have to be prepared by every manufacturer for his scope of work.

No welding shall be undertaken until the applicable WPS and Procedure Qualification Record (PQR) are approved by the Employer.

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The PQR shall be qualified in accordance with relevant ASME standard. Welding procedures must be qualified by a qualified independent testing authority engaged by the manufacturer.

Welding procedures shall be qualified in accordance with the requirements of the construction code/specification for the Item of plant concerned and in the case of critical plant items the tests shall be witnessed by an internationally recognized inspection authority.

Welders shall be qualified in accordance with the requirements of the construction code/specification for the Item of plant concerned for all types/positions of welding he may perform.

Welder tests shall be carried out in accordance with the approved standards within Contractor's scope. Test results are available for review in the work-shops.

If at any time in the opinion of the Employer the work of any welder appears questionable, such welder is required to pass additional qualification tests to determine his ability to perform the type of work on which he is engaged. Any welder failing the retest may, at the discretion of the Employer be dis-qualified from further welding on items under this Contract.

The 2 first production welds of every welder shall be 100% examined by volumetric NDE and only when the results are acceptable, shall the welder be released for production welding.

A system of positively identifying the work of each welder shall be maintained and any welder whose work is the subject of multiple rejections shall be required to undergo a requalification test. Any welder failing the retest may, at the discretion of the Employer's Representative be disqualified from further welding on items under this contract.

Welded fabrications shall be stress relieved when specified by the applicable standard or for dimensional stabilization prior to machining.

Copies of temperature charts referenced with load items shall be included in the test certification supplied for the relevant items.

All welds shall be visually examined and shall be of smooth contour, free from cracks, undercut and other significant defects. Wherever possible the interior of tubes etc. shall be examined using a suitable optical device where necessary. The manufacturer shall make every effort to avoid any contamination of the tube interior during the manufacturing process. To ensure the tubes are free from obstruction and debris the tubes shall be cleared with a sponge being blown through.

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Fillet welds shall be checked for size using suitable gauges which shall be available for use on request by the Employer's Representative during an inspection visit.

For single side butt welds, all root passes shall be welded using a TIG welding process.

Preheating shall be in accordance with the applicable WPS and the respective material specification. The preheat temperature shall be in function of welding process, wall thickness, type of welding consumables, ambient temperature and climatic conditions

Welding performed outside a workshop is authorised if an approved wind and rain protection (welding bay) is installed around the working place. Anyway, when ambient temperatures falls below 5°C, preheat is required for all ferritic materials and thicknesses. Gas burners or oxy-fuel torches can be used for pre-heating. Preheat shall be maintained over a distance of not less than 4 times the nominal thickness with a minimum of 75mm on either side of the weld. If the material required pre-heating, the same pre-heating shall be done for oxy-fuel or plasma cutting.

Welding consumables such as TIG-rods, electrodes, wires shall be clearly marked in order to avoid any mix-up of material grades. Positive Material Identification to be carried out on where a doubt for mix-up exists.

Any post welding heat treatment (PWHT) shall be performed in accordance with an approved procedure. The procedure shall describe the method, the heat treatment parameters (e.g. holding temperature and time, heating/cooling rates, heated/insulated band...), the number and location of thermocouples, records and calibration. The procedure shall be available on Site and or in the workshops.

Before welding and/or heat treating valves, valve-manufacturer instructions shall be taken into consideration.

In the case of sensitive materials, grinding of the welds or other grinding work may only be carried out with special grinding wheels so as to avoid overheating or an increase in the hardness of the material.

Welding defects of all kinds must be documented and be available to the Employer on Site or in the workshop.

The Contractor maintains and makes available to the Employer or his representative, both at works and Site, adequately indexed records of all welds, weld inspections, weld controls and repair.

Please refer also to **Section B0** for "Manufacturing tests".

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

B0.6.17 Mechanical equipment

B0.6.17.1 Pumps

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Bearings

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

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

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

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

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

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

Fittings
All pumps shall be installed with isolating valves, a non-return valve and suction and discharge pressure gauges unless otherwise stated. Accessible couplings shall be supplied with removable type guards.
Coupling halves shall be machine matched to ensure accurate alignment.
Couplings as well as gears must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
All pumps other than submersible pumps shall have temporary strainers fitted in the suction pipework during all initial running and commissioning phases. Permanent strainers shall be provided where specified.

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

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

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B0.6.17.2 Piping and accessories

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

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

outside. For steel underground piping where cathodic protection is not feasible coal tar epoxy coating shall be applied. For painting and coating see chapter painting specification. A sufficient corrosion allowance shall be considered.

Plant water and cooling water piping system: If these pipes are buried cathodic protection system shall be employed for inside and outside. Further communicating lines (from above ground to underground and vice versa) will have to be provided with respective insulation joints. In any case protection against corrosion must be provided. GRP or other appropriate material is required.

Screening channel in the plant water pumping station as well as other equipment installed in pumping stations: In case all piping of mild steel is used require cathodic protection.

GRP piping shall be laid under the responsibility and supervision of the GRP pipe manufacturer.

The maximum flow velocities for the individual media must not be exceeded at maximum throughput (unless expressly specified in the documents or proven by the Contractor):

Type of Pipework	Max. Velocity
Steam lines:	
High-pressure live steam lines (PN ≥ 63)	60 m/s
HP / LP turbine bypass lines	100 m/s
Intermediate-pressure steam lines (PN 25/40)	40 m/s
Low-pressure steam lines above 5 bar	35 m/s
Low-pressure steam lines < 5 bar	25 m/s
Vacuum lines	80 m/s
Saturated steam lines	20 m/s
BFP drive turbine exhaust	80 m/s
Water lines (Feedwater, Plant water / cooling water, condensate etc.):	
Feedwater suction lines	0.5-2.5 m/s**
Feedwater discharge lines	3-5 m/s
Other suction lines	1.5 m/s
Other discharge lines	3.0 m/s
River water lines	3.0 m/s
Fuel lines:	
Fuel oil / LDO suction lines	1.0 m/s

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Type of Pipework	Max. Velocity
Fuel oil / LDO discharge	2 0 m/s
Air Lines:	
Compressed air lines	15.0 m/s
Combustion air lines	20 m/s
flue gas lines	18 m/s

** The design and routing of the feedwater suction lines must be optimized considering the allowable velocity of depressurization caused by load changes.

The maximum velocity for the LP extraction shall not exceed 60 m/s. For those media/sytems where no maximum velocity is given in the specification, the maximum velocity shall be proposed by the Contractor and is subject to approval by BIFPCL during the basic/detailed engineering.

In addition pressure drop criteria shall govern the sizing of the key lines.

Nominal diameters (DN), nominal pressure (PN) and wall thicknesses shall be standardized.

Nominal diameters of < DN 25 shall not be used for pipe lines except for instrument lines, chemical dosing and analysis lines.

For the design of safety valves installed downstream of reducing stations, high pressure bypass valves or equivalent control valves, the maximum throughput of the fully open reducing or bypass valve including injection water quantity is to be taken as the basis for calculation. All cross Sections and lines for safety devices that protect against excess pressure (safety valves, rupture discs and similar items) must be designed to ensure the necessary blow-off rate and fault free functioning.

The design pressure is equal to the response pressure of the devices protecting the piping. In the case of pump discharge lines a pressure corresponding to 1.1 times of the shut-off head of the pump at the ambient temperature is to be taken as the minimum design pressure. The plant water and cooling water systems must be designed according to the water hammer calculation.

The design temperature is the highest possible fluid temperature occurring in the length of line concerned. Possible tolerances of the temperature control system and any temperature allowances provided by the requirements of the standards shall be considered.
For live steam lines the design pressure of the boiler shall be taken as the design pressure of these lines up to the inlet of the turbine main stop valves.
In addition to the required wall thickness in accordance with calculations, a corrosion allowance of 3 mm shall be added for unprotected carbon steel, 1.5 mm for alloy steel and 0.5 mm by stainless steel.

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For the cold reheat piping downstream of the connection to the HP bypass exhaust, the selection of the design temperature shall also consider the case that the HP bypass station is operated for limited period without spray injection. The Contractor shall prove both operating cases: Operation of HP bypass with spray attemperation and without spray attemperation (limited time period). Both cases shall not lead to any damage to the cold reheat piping and downstream pressure part.

For the piping systems with a nominal pressure specified as PN > 40 as in DIN 2401 or equivalent and for vacuum systems, the drainage and ventilation facilities shall be fitted with double valves.

All vents, drains or dump points with more than 10 bar/100 °C operating pressure/temperature shall lead to the flash tanks and into funnels at visible points with covers.

Guidelines for the design and construction of pipework and accessories

- Design and construction of all parts of the power piping shall be according ASME B31.1 (Power Piping).
- Other piping and accessories should correspond to the present state of the art and shall be based on the latest standards and medium properties.
- The pipework and its accessories shall be designed and arranged so that all parts subject to operation and maintenance can be operated, inspected, maintained and replaced without difficulty and with a minimum of effort. All important parts must be accessible.
- Provisions to allow for isolation and for access must be foreseen on all parts subject to acceptance by the local authorities.
- None of the forces and moments transmitted by the pipes to connected machines, apparatus and other components must exceed the maximum permissible values, given by the manufacturers of these items. Attachments to turbine foundations shall be carried out only as agreed with the turbine manufacturer.
- All steam traps shall be provided with a bypass and lines which open to a funnel.
- As far as expansion joints and other parts of pipework are concerned it shall be borne in mind that differential settlement can occur. The reaction forces and moments of the piping system to be withstood by fixed points, walls, foundations and other civil structures shall be reduced to the utmost minimum by suitable means (e.g. expansion joints shall be provided where required).
- The pipe support structures shall be designed to minimize heat transfer.
- The installed pipework with its supports and other components shall not obstruct gangways (min. 1500 mm wide), maintenance, escape routes etc. Overhead piping shall have a minimum vertical clearance of 2.3 meters, 8 meters above main access roads and 6 meters above any other roadways.
- Pipe spools for HP steam, feedwater piping and all steel pipes ≥ DN 400 shall be cleaned internally prior to delivery by shot blasting at the

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workshop with iron particles to SA2 1/2 or by acid cleaning, and shall be properly protected against corrosion.

- Pipe ends and branch connections of underground piping shall be sealed temporarily during installation if the connecting pipe is not immediately installed.
- The Contractor shall submit a detailed description of proposed steam blowing and other cleaning procedures for all pipelines, and no part of this work shall be started until these procedures have been approved by the Employer. Temporary silencers shall be provided for this.
- The cleaning of water - steam system shall comply toVGB R513e „Internal Cleaning of Water-Tube Steam Generating Plants and Associated Pipework"
- The Employer reserves the right to require the Contractor to modify any of his cleaning procedures if found necessary to obtain acceptable results. The Contractor shall furnish, install and dismantle all temporary pipes, hangers, anchors, etc. required for cleaning all piping systems.
- To the extent that hot fluids can accumulate in pipe Sections isolated for maintenance purposes (including control valves with injection water), drains with hand-operated shut-off valves are to be provided for the safety of the personnel (block and bleed systems). Furthermore the Contractor shall safeguard the piping systems against over-pressurization caused by thermal expansion of blocked-in fluids by adequate means.

Welding

- All welding shall be carried out according to relevant standards. The welding procedures of the Contractor shall be supplied before execution of welding works to the Employer for approval. For quality reasons as many welds as possible are to be carried out in the workshop.
- Welding ends of all piping must be carefully prepared before welding. The type of butt welding ends of valves, control devices, orifices, etc. shall be specified by the Contractor and must be given to the manufacturers of these components in due time prior to their start of work if necessary/postweld heating treatment. If there are differences in the wall thickness and/or different materials of piping and valves with butt-welding ends, the necessary transition pieces must be provided by the manufacturer of the valves.
- Socket welds are not permitted for lines above DN 50, for corrosive media lines or for lubricating oil lines.
- After completion of the weld joint, the welder must mark with indelible crayon his identity number and the last two digits of the year in which the work was completed on the pipes. The Contractor shall keep a record of welders.
- Testing of piping and welding shall be as per ASME standard. Minimum requirements for testing of welds are specified in Section **B0.7.2.2 Welding tests**.

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Piping

- The Contractor shall provide suitable thimbles and flashing where pipelines pass through floors and walls. Floor thimbles shall be installed to provide 90 mm projection above the finished floor surface.
- A stress analysis shall be performed for all piping systems DN ≥ 50 with an operating temperature ≥ 100 °C.
- For cross country low pressure piping with a straight length of more than 200 m a stress analysis shall also be conducted.
- The piping stress and flexibility analysis shall be based on the relevant standards. Recalculation must be taken into consideration as built condition, actual weight and dimensions.
- Tubes, pipes, bends and fittings shall be produced and tested in accordance with the applicable international standards (ASME/ASTM, EN, etc.).
- All pipe lengths under this package, including piping where alloy steel is used shall be subjected to 100 % ultrasonic examination as per material specification standard with acceptable notch depth of 5% of the selected wall thickness (1.5mm maximum) except for the following piping system: LP piping not under "ASME B31.1 Power Piping" for not dangerous and not explosive media.

Noise abatement measures

The Contractor shall take all necessary measures to limit noise in accordance with the requirements. On no account shall the sound level exceed the values as mentioned under the relevant subsection.

If this requirement cannot be met by adequate construction of the pipework and valves concerned, sound absorbing housing or insulation have to be provided. Where pipework and valves are installed outdoors, the above mentioned requirement may be fulfilled, if necessary, by providing silencers at the safety valve outlets and at the blowing out lines.

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Pipe supporting elements

As used herein, the term "hangers and supports" shall include all hanger assemblies, support assemblies, constant support hangers, anchors, guides, sway braces, vibration dampers, trays, brackets, attachments, miscellaneous structural steel and other items required to support the piping in a proper manner.

For supporting points up to 25% variation and 40 mm movement variable spring supports shall be selected.

Constant support type spring assemblies shall be provided at all locations where it is necessary to avoid transfer of stress from that support to another support or to an equipment terminal, and at other support locations where vertical movements of the piping are too large to be properly handled by variable support springs. Constant support spring assemblies shall be of a design that will compensate for the normal variation in the supporting force of the helical coil springs, thus providing constant supporting force through-

out a total travel range which shall be at least 20 mm greater than the actual maximum movement of the piping.

Constant support assemblies shall be equipped with a means of locking the spring(s) against movement during erection, hydrostatic testing etc. The use of counterweights in substitution for support spring assemblies will not be permitted.

Support spring assemblies shall be of the enclosed spring type, and shall have an embossed on factory load indication scale showing the hot (operating) and cold (ambient) positions. Each spring assembly shall incorporate an adjustable hanger rod coupling to permit load adjustment. All support springs shall be designed to permit at least ±10% field load deviation from the factory calibrated load.

The supporting force provided by variable support type spring assemblies shall not change by more than 20% between the cold and hot positions, and supports of this type shall not be used at any point where such a change in supporting force cannot be safely permitted. Variable support spring assemblies shall incorporate springs with maximum working range length in order to reduce the overall length of the assembly.

All pipe hangers and support stands shall be attached to the piping and structural supports such that they will be vertical when the piping is at hot operating condition. So far as practicable, hangers and supports shall be of the same type and component assembly.

All hangers shall be carefully adjusted. After Plant start-up checks shall confirm that all hangers and supports are in the correct position.

The Contractor shall prepare a complete documentation of all pipe hangers and supporting elements. These documents shall contain the following information:

- loads, forces and moments, and their directions at all supports, hangers at normal operating conditions, etc.
- magnitude and directions of the movements at the loading points
- measurements of the loading points referred to the axes of the buildings
- item No. of the supports, hangers etc. according to the piping group
- material specification for the supporting parts.

Trace heating

Trace heating shall be provided for fuel oil pipes and other pipes as required. Electric type trace heating is preferred. The referenced Site Conditions as well as media properties shall be base for the design.

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Protection of buried pipework systems

All buried pipework of steel or cast iron or other materials prone to corrosion shall be protected from corrosion by cathodic protection.

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The design of the cathodic protection system(s) shall be executed by a specialist and authorized company. The designed cathodic protection shall be a completely functioning system in all respects according to the state of the art and shall also include the appropriate equipment for measurements.

For the plant water and cooling water piping system only: If these pipes are buried cathodic protection system shall be employed for inside and outside. Further communicating lines (from above ground to underground and vice versa) will have to be provided with respective insulation joints
In any case protection against corrosion must be provided. GRP or other appropriate material is required.

B0.6.17.3 Valves, steam traps, condensate drainers, safety valves

The Contractor shall design and supply all valves and their accessories required for the safe, efficient and sound operation and maintenance of the Plant based on the appropriate standards. They shall comply as a minimum with the design criteria of the relevant piping.

For reasons of Plant standardization, the Contractor shall co-ordinate types and makes of all valves in his supply and that of his subsuppliers.

Design, construction, fabrication and testing of the valves shall be in accordance with the ASME B16.34. The stipulations of this Section will take precedence if these are more stringent than the approved standards.

All valves shall be suitable for the media and for the service conditions and those performing similar duties shall be interchangeable.

Acceptance certificates for valves shall follow EN 10204 or approved equivalent codes.

The following types of valves are recommended:

• globe valves	up to and including DN 50
• gate valves	DN 65 and above
• butterfly valves	DN 400 and above as metal seated type for LP steam and exhaust steam (DN 65 and above as soft seated type for waterlines (cooling water, process water etc., operating temp. max. 180 °C)
• lift check valves	up to and including DN 50
• swing check valves	DN 65 and above
• Ball valves (fuel oil, natural gas, compressed air)	DN 25 and above.

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DN means 'diameter nominal'.

In vacuum service and wherever otherwise necessary to prevent the entry of air, valves shall be provided with suitable sealing facilities. Where applicable, the valves must be suitable for outdoor installation under consideration of the special climatic and environmental conditions of the site.

Unless otherwise agreed, all valves shall be fitted with the spindle in upright position.

All valves shall be positioned so as to be readily accessible for operation and maintenance from permanent floors, catwalks or platforms. Where required, valve spindles shall be lengthened to have the hand-wheel at a height approximately 1 meter above the operation level. All underground valves shall be installed in concrete culverts.

All valves shall be closed in a clockwise direction when looking at the face of the handwheel. The valves shall have rising spindles and non rising handwheels. Plastic valve handwheels will not be accepted.

HP- and large size gate valves to be opened under differential pressure shall be equipped with pressure equalizing valves (globe valves).

All valves shall be fitted with indicators to determine the valve position. In the case of valves fitted with extended spindles, indicators shall be fitted both to the extended spindle and to the valve spindle.

All globe valves shall be equipped with throttling cones with parabolic characteristic.

In general, LP safety valves, butterfly valves, ball valves and orifices as well as all control valves shall be flanged. All valves including valves as mentioned above for steam, feedwater and condensate, HP safety valves (inlet side) shall have welded ends, corresponding to the connected pipes. Also all valves on heater drains and vents and in vacuum systems shall be welded.

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Design of valves and materials used must comply with the relevant standards. They must be chosen in accordance with the requirements to be met and to corresponding pipework.

For limiting handwheel forces, for control and operation purposes it may be necessary to install gears and drives.

The maximum handwheel force of 500 N must not be exceeded.
The Contractor shall furnish and install steam traps at each low point. Each steam trap installation shall include a permanent strainer of 20 x 20 mesh

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size, upstream and downstream globe valves and a globe valve as free drain.
Steam traps shall be supplied with weld ends.
Steam traps shall preferably be of the thermodynamic, thermostatic or bimetallic type with multistage nozzles and selected to suit the service conditions.

Traps which incorporate internal screens or check valves will also be accepted.

Each trap shall be sized to provide ample capacity at the minimum working differential pressure, and to open the orifice at maximum working differential pressure.

Condensate drainers such as used on LP saturated steam or compressed air lines shall be of the ball-float type.

HP gate valves shall be equipped with self sealing lid covers. The self-sealing lid covers shall be equipped with a safety device at the body with shut-off valve and interlocking system. This system must be approved by the authorities.

All valves of the HP/IP piping systems shall be suitable for pickling/acid cleaning (special temporary inserts).

The valves for live steam, HP feedwater and HP injection water shall be made of forged steel. Forged steel or cast steel bodies shall be used for the remaining systems. Valves made of gray cast iron are not acceptable.

Acceptance certificates for piping components and valves shall follow EN 10204.

At the economizer inlet a non-return valve shall be installed, but not shut-off valve.

Technical requirements of Butterfly Valve:

Applicable standard:

- ASME B16.10 2009 Face-to-Face and End-to-End Dimensions Valves
- ASME B16.34 2009 Valves - Flanged, Threaded, and Welding End
- ASME B31.1 2012 Power Piping
- API 609 2009 Butterfly Valves: Double Flanged, Lug- and Wafer-Type
- API 609 2009 Butterfly Valves: Double Flanged, Lug- and Wafer-Type
- ISO 5752 1982 Metal valves for use in flanged pipe systems - face to face and centre to face dimensions
- ISO 80000-1 2009 Quantities and units
- EN 10204 2004 Materials Testing Certificates

Valves assemblies shall be designed for the pressure and temperature rating of the class specified in the Piping Material Classes and Valve List.

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Hydrostatic testing for valves shall be in accordance with ASME B16.34 and API 598.

Carbon steel having carbon contents of more than 0.25% shall not be used in Welded construction valves.

Lug type valves shall not be used.

Valve stem packing, trim and bonnet gasket material shall be manufacturer's standards, unless otherwise specified.

The maximum force requested at the hand wheel shall not exceed 300N (30kgf).

The manually operated valves in the sizes and pressure classes shall be provided with a gear operator as minimum.

- Class Butterfly
- 150 DN 200 & larger
- 300 DN 150 & larger

Gear operator type: Worm-gear type

All valve actuators shall have local indicators fitted to show whether the valves are in an open or shut position. Where extended spindles are used, indicators shall be fitted to both the extended spindle and to the valve spindle.

Plastic or bakelite valve hand-wheels are not permitted.

The stops limiting the travel of any valve in the "open" or "shut" position shall be arranged externally to the valve body.

All valves shall be closed by turning the hand-wheel in the clockwise direction when looking on top of the hand-wheel.

The face of each hand-wheel shall be clearly marked with the words "open" and "shut" in English, with adjacent arrows to indicate the direction of rotation to which each refers.

Each valve hand-wheel shall be fitted with a name-plate of an approved material, indicating in English the valve reference number and function. The name-plate shall incorporate the colour code corresponding to the particular service of the piping.

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B0.6.17.4 Thermal insulation

General

The thermal insulation shall be designed and installed in accordance with AGI, VDI and DIN or equivalent standards, considering the following minimum requirements:

Insulation shall be provided for personnel protection, heat conservation, noise reduction and for prevention of the formation of condensation on all pipework and equipment whose external surface temperature exceeds 60 °C.

For personnel protection all surfaces with a temperature above 50 °C and which are within the reach of personnel shall be provided with protection insulation and the maximum insulation surface temperature shall be 60 °C.

- All insulation material has to be made from non-asbestos materials.

Following design criteria for insulation shall apply: Design ambient temperature:

- Inside buildings: Ambient temperature of 40°C and wind speed of 0.5 m/s
- Outside buildings: Ambient temperature of 45°C and wind speed of 0.25 m/s

Thickness of the insulation shall be calculated according to ASTM C-680. The Emissivity of the cladding shall be 0.2.

Type of insulation materials

The mats shall be stable in shape, chemically inert, free of sulfur and alkali, resistant to water and steam, non-flammable and capable of withstanding continuous exposure to the pipe design temperature. The mats used for insulation of stainless steel equipment shall have a chloride content of less than 0.15%. Under no circumstances may asbestos or asbestos containing materials be used.

The material will have the following physical/chemical properties (± 10% allowance):

- service temperature up to 650 °C
- density 120 kg/m^3
- water adsorption 0.5% weight
- specific heat capacity 0.84 kJ/kg °C
- compressive strength 20 kPa
- conductivity versus temperature:

Average temperature	Blanket (W/m °C)
0	0.034
50	0.040
100	0.048

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Average temperature	Blanket (W/m °C)
150	0.058
200	0.070
250	0.083
300	0.100

For temperatures above 300°C the conductivity required shall be determined by linearly extrapolation of the values presented in the above table.

- conductivity allowance is limited to + 5%.

For special purposes such as for turbines, boilers, etc. spray type insulation or insulation brickwork (for example calcium silicate) may also be applied. The special insulation materials shall be stated by the Contractor and their design shall match the overall design and guarantee the requirements stated in the specifications.

Type of insulation setting materials
The surface cladding shall be made of aluminium sheets, manufactured in sheets with the following minimum thickness:

- Outer insulation diameter up to 150 mm Sheet thickness 0.7 mm
- Outer insulation diameter up to 450 mm Sheet thickness 0.9 mm
- Tanks and other large equipment Sheet thickness 1.2 mm

Tank tops shall be provided with insulation strong enough to support a man's weight.

The sheets shall be secured and connected at the longitudinal seams with at least five stainless steel self-tapping screws per meter run.

Plain sheets for flat surfaces shall not exceed 1 meter square and shall be stiffened by crimping.

At the longitudinal and circumferential joints, the sheets shall overlap by at least 50 mm so as to drain off the liquid and not to trap the liquid in the insulation.

Places at which the metal sheets are penetrated for pipe hangers, thermometer sockets, etc. shall be sealed with funnel-shaped recesses or sheet metal rims.

The seams and penetrations of any sheet metal insulating jacket installed outdoors as well as in the boiler and turbine house in areas with risk of water spray etc., shall be sealed against penetration of water by means of a suitable silicon based sealant.

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In the case of pipe insulation thicknesses greater than 60 mm, where insulation blankets are used spacers shall be provided at maximum intervals of 950 mm to ensure a uniform insulating thickness on all sides and a perfectly circular shape of the sheet metal jacket. The sheet metal jacket shall be supported by support webs (for pipe diameters below 100 mm) and enclosed support rings (for pipe diameters 100 mm and above). If the enclosed support rings are not provided with ceramic spacers, the spacers made of steel shall be insulated with one heat insulation strip in the case of operating temperatures of up to 200 °C, and with two heat insulation strips where the operating temperature exceeds 200 °C.

To provide protection against contact corrosion, the external circumference of the support ring shall be fitted with heat insulation tape 1 mm thick with two woven edges.

Insulation of flanges, valves and fittings

All flanges, valves and fittings shall be provided with two-piece or multi-part caps made of aluminium sheet of the specified thickness. Each piece or part shall be double jacketed and the various parts shall be held together by quick release clamps or lever hooks to facilitate assembly and disassembly.

All caps of the welded-in fittings shall be made longer by approximately twice the insulation thickness so that the welding seams will be exposed after removal of the cap.

All manholes shall be provided with heavy duty hinged covers which are to be protected from overheating and corrosion. Such covers shall be secured with easily accessible clamps. In addition, metallic stand-offs shall be provided for personnel protection.

Insulation of tanks and process equipment

Tanks and process equipment shall be insulated in the same way as pipes, except that the insulating material shall not be attached by wire but by using strong galvanized steel bands.

Spacers shall be welded to process equipment only if this is essential for satisfactory retention of the insulation. Welding of spacers to process equipment is subject to approval by its manufacturer in writing.

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Insulation for personnel protection

Wherever insulation is necessary only for the protection of personnel, it shall be applied around that portion of the pipeline length or to that surface of the equipment that is located within 2.50 m above the passage way floor, or within 1.20 m horizontally to the side or at the end of any floor, platform, walkway, stair or ladder.

Where necessary, drain lines and valves shall be provided with a contact guard of minimum 30 mm thickness against accidental contact, and this shall be installed in the same way as the other insulation.

Where insulation is provided for heat conservation it shall reduce the heat loss to an economic minimum. The maximum heat loss shall be 200 W/m^2 at an ambient temperature acceptable at 30 °C and a wind speed of 2 m/s. For personnel protection all surfaces with a temperature above 50 °C and which are within the reach of personnel shall be provided with protection insulation. The maximum insulation surface temperature shall be 60 °C.

B0.6.17.5 Vessels

All vessels shall be designed in accordance with the applicable standards and regulations.

The Contractor is held responsible for the correct design and dimensioning of the apparatus.

Connections shall be provided for all pipework, together with connection and tapping points for instrumentation. Manholes, vents, drains, safety devices and any platforms necessary for safe operation and easy maintenance have to be included in design and supply.

If under any operation conditions vacuum can occur in the vessels, they shall be designed for max. pressure and full (= 100%) vacuum.

The welding factor for all vessels is fixed to v = 1.0. The minimum wall thickness should not be less than 10 mm, and an appropriate corrosion allowance based upon the particular material, but not less than 1 mm.

Instrumentation and control equipment shall be provided according to the safe service requirements. A minimum requirement is to equip each vessel with a local level indicator, a temperature and a pressure indicator.

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Manholes shall be provided as follows:

1. manholes (minimum nominal bore 600 mm) for vessels of 1.0 meter diameter and above
2. handholes (minimum size 200 mm) for vessels below 1.0 meter diameter

All nozzles shall be provided with flanges and shall be so arranged that practical pipe connections are possible. The stub length for all stub pipes shall be at least 200 mm, measured from the tank wall to the flange sealing surface. In the case of insulated vessels, the length shall be chosen so that there will be a clear space of at least 100 mm between the cover of the insulation and the underside of the flange. Nozzles below DN 25 are not acceptable.

For insulated vessels, provisions must be made for fixing and supporting the insulation.

All tank internals must be replaceable through the manhole unless by approval of the Employer. Prefabricated vessels must as a minimum have a coat of primer applied before transport. They shall be cleaned and internally dry. All openings must be secured closed before transport.

Tank and vessel capacities given for process relevant documents and for basic design calculations shall be *usable net* volumes and shall be in the relevant documents clearly referred as such.

B0.6.17.6 Heat exchangers

Heat exchangers are to be designed, manufactured and erected in accordance with the applicable standards.

Only proven products shall be delivered. No cast iron components are permitted.

It must be possible to install and remove the heat exchangers without undue difficulty. Lifting lugs and eyes and other special tackle shall be provided to permit easy handling.

Tubular heat exchangers or plate and frame type heat exchangers are acceptable where no specific requirements expressed. Where necessary the tubes are to be protected by impact shields. An adequate number of visual inspection ports are to be provided in critical areas to facilitate condition monitoring.

Unless otherwise specified, all heat exchanger tubes and casings must be designed to withstand 1.2 times the zero flow pressure of the relevant pump at cold conditions, or 1.2 times of the maximum positive operating pressure, as applicable. The test pressure must be 1.5 times the design pressure.

The heat exchangers shall be designed for the maximum temperature incurred plus 20 K.

Heat exchangers must be capable of continuous unrestricted operation with up to 10% of plugged tubes, and a corresponding factor of conservatism on at least this amount must be used in the design of the heat transfer areas.

Considerable importance will be attached to the ease of cleaning the heat exchangers.

Where any heat exchanger part in contact with liquid can be isolated, and there is a possibility of being heated from the other side, safety valves are to be provided for pressure relief.

Pipes from drains, vents and safety valves are to be grouped together, and routed to easily observable points equipped with covered funnels or to the flash tanks.

The overall design and conception of the heat exchangers and accessories is to be such that they are suitable for the degree of automation envisaged for the individual system.

B0.6.17.7 Instrument and service air

To meet the compressed air requirements of the Plant two different compressed air systems, - instrument air and service air, will be provided.

The service and instrument air system shall produce and deliver compressed air for the following main consumer of the Power Plant and desalination plant:

- Service air for atomization of HSD (High Speed Diesel) and for operation of mechanical air tools, wrenches and other consumers during all operation modes of both units and for maintenance purposes.
- Instrument air for all pneumatically operated plant instrumentation and control devices and other consumers. The instrument air quality shall meet ISO 8573-1 Class 2".

For detail instruction on compressed air see **B12 Part 7**.

B0.6.17.8 Cranes, hoists and lifts

B0.6.17.9 Cranes

For erection and maintenance works, overhead travelling crane per unit shall be installed in:

- One EOT Crane for each turbine hall (Refer the below note)
- One EOT crane for the compressed air station building.

Note: If Bidder/Contractor intends to provide one EOT crane then turbine generator stator shall be moved by special device (to be handed over with special tools).

For handling of the generator stator the following alternative is also acceptable: Tandem/combined operation of two turbine hall EOT cranes for which the necessary arrangements shall be provided. In such case the combined capacity of two EOT cranes shall not be less than the 105% of weight of generator stator, including the weight of lifting beam with swiveling equipment and slings.

HP heater shall be moved by turbine hall crane.

For erection and maintenence works in the plant water screening and pumping station two (2) travelling bridge cranes shall be installed, one for pump and header bay area and one for screening plant area. The cranes shall

be calculated and designed in accordance with the principles of DIN or equivalent standards.

EOT crane shall only be used in closed pumphouses.

For installation and repair works in the cooling water pumping station one (1) gantry crane shall be installed.

Additional overhead travelling cranes are to be installed in pump houses, central work shop and all other locations and buildings for equipment of this Contract where cranes are needed. Refer also to the individual technical sub-sections of this specification.

The nominal carrying capacity of the cranes must be such that the heaviest object to be lifted including the spreader bar and other necessary auxiliary lifting devices can be transported with safety.

Cranes with a span of more than 8 m and/or a nominal carrying capacity of more than 5 t shall be in the form of double-girder cranes with the crab running on top.

Smaller cranes shall be in the form of single-girder cranes with the crab running on the lower flange or in the form of suspension cranes.

Cranes with a nominal carrying capacity of 30 t and above shall be fitted with an auxiliary hoist.

The overhead travelling cranes shall be fitted with gangways on the crane bridges or with gangways fitted to the sides of the crane.

The end-carriages of all cranes shall generally be of welded box-girder construction. Buffers shall be provided at the faces on the end-carriages. The end-carriages shall also be fitted with wheel-breakage supports designed to prevent derailment as well.

The deflection of the crane bridges at nominal load shall not exceed 1/1000 of the span for cranes with capacity of 50 t or more, or 1/900 of the span for cranes below 50 t capacities.

The crab assemblies shall be of rigid steel construction. Buffers shall be provided at the faces of the crabs.

The crabs shall as far as possible be covered with smooth sheet-metal and fitted with handrails.

The crane switchgear shall be accommodated in switchgear cabinets to be arranged on the crane bridge.

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The crane and crab running wheels shall be made of cast or forged steel and shall have double flanges. The wheels should have rolling bearings lubricated for life.

For cranes used for the removal and installation of pump rotors in vertical pumps (e.g. cooling water pumps), it is important to ensure that there is no lateral drift of the hook during lifting and lowering.

All cranes shall be equipped with pendant control units. The pendant control units shall be suspended on the bridge so that they can travel along it independently of the crab.

All pendant control panels shall be fitted with rocker-type or push-button switches for the crane functions. A key switch and an emergency stop switch shall also be provided on each panel. Additional switches or push buttons shall be provided as required.

The crane and crab drives are to be designed as two-corner drives with electric gear motors. 2 (two) motors are to be provided for the crane drives. The crab drives may consist of one motor and universal joint shaft.

All travelling and traversing drives are to incorporate pole-reversible squirrel-cage gear motors with sliding armature and brake.

The lifting gear may consist of standard electric hoists with sliding armature motor and cone brake or disc brake.

The precision speed control shall be provided for all crane and lifting gears.

Speeds for cranes shall be as below:-

- For TG hall crane-
  - Main hoist - 1.6 m/min (creep speed 0.16 m/min thro VFD)
  - Aux hoist - 7.5 m/min (creep speed 0.75 m/min thro VFD)
  - CT - 15 m/min (creep speed 1.5 m/min thro VFD)
  - LT - 30 m/min (creep speed 3.0 m/min thro VFD)
- For other cranes-
  - Main hoist - 3 m/min
  - CT - 10 m/min
  - LT - 10 m/min.

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B0.6.17.10 Hoists

Hoists shall be provided throughout the entire installation where machines or other components provided under this contract are to be installed, removed, repaired, serviced or transported and these parts are not in the working area of a crane (refer also to the individual technical subsections of this specification).

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The final number of hoists to be supplied will be proposed by the Contractor, according to the requirements of the equipment. The Contractor has to include in his offer the number of hoists for the whole Plant. Any necessary change of hoists must not lead to any price change of the contract price.

The hoists used shall be standard production hoists.

The hoists shall be designed and calculated in accordance to applicable standards.

The nominal carrying capacity of the hoists and of their attachment points shall be such that the heaviest object to be lifted can be transported with safety.

For electric hoist, trolley travel speed and hoist speed shall be 15 m/min and 6 m/min respectively.

Manual hoists shall take the form of chain tackle blocks with load and drive chains. The crabs shall be fitted with a drive also operated by a chain. The runways shall be designed according to approved standards.

Electrically driven hoists and crabs shall be equipped with squirrel-cage motors. An inching control shall be provided on all electrically driven hoists and crabs.

The crab power supplies shall be in the form of sheet-steel-enclosed safety power tracks, which can be easily bent to follow the form of the hoist runways.

Electrical switchgear and control gear shall be mounted directly on the hoists in cabinets.

The electric hoists shall be operated by pendant control units fitted with pushbutton or rocker-type switches, which shall be fixed to the hoists in such a way that safe operation is guaranteed.

The control panels shall be equipped also with a key-operated switch and a mushroom-shaped emergency "off" switch.

Limit switches shall be fitted to all lifting and travel gear.

The electrically operated hoists shall be installed in a permanent location.

Where hoists are not easily accessible by simple means such as ladders or mobile scaffolds, maintenance platforms with means of access shall be provided.

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B0.6.17.11 Lifts

One (1) lift in each steam generator building for goods transport (minimum capacity 3,000 kg) and one (1) no. conventional passenger elevator in each the steam generator building for personnel transport (minimum capacity 16 persons and minimum 1,100 kg) shall be installed, reaching the highest accessible platform. Outdoor hoisting arrangements shall be included at one side of each boiler house for lifting long items of up to 4,000 kg.

Further Elevators shall be provided in the following building, reaching the highest floor of these buildings:

- 2 x elevators TG building
- 1 x elevator for service building
- 1 x elevator for crusher house
- 1 x elevator for highest transfer point before main plant.

For administration building 2 x nos. of 16 person capacity (minimum 1,100kg), panoramic type elevator shall be provided.

Lift for light material store shall be provided as follows:

- Quantity = 1
- Type = Goods lift
- Capcity = 1,000 kg.
- Speed=0.5 m/s.

The basic requirements for conventional passenger elevators are:

- Capacity: 16 person (minimum 1,100 kg)
- Speed: 1 m/s

The lift installations shall be designed as cable-operated lifts with traction machine. The car shall be provided with automatic telescope sliding doors.

The lifts shall be designed, manufactured, erected and tested according to OSHA (Operational Safety and Health Administration) and applicable standards.

During the construction period, the sides of the cars (without doors) and the floor of the cars shall be provided with protective coverings (hardboard panels or similar). The protective coverings shall be removed by the Contractor after the construction period.

The motors and switchgear must be designed for at least 180 starts/stops per hour. The type of enclosure of the switchboards and motors shall comply with the relevant requirements of **Section B0**.

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B0.6.18 Electrical equipment and works

B0.6.18.1 Standards

The design and manufacture of all electrical equipment shall comply with the latest editions of the IEC Recommendations if not specified otherwise elsewhere in the specification. Compliance with ANSI/IEEE/NEMA, BS, EN or VDE standards will only be accepted in case no applicable IEC standards are available and subject to approval by the Employer/Engineer.

The Plant shall comply with:

a. the Essential Electrical Requirements of the PPA
b. the latest edition of the Electricity Grid Code of the Bangladesh Energy Regulatory Commission; and
c. the Great Britain Grid Code.

In case of contradictions the order of precedence shall be as follows:

a. Essential Electrical Requirements of the PPA;
b. Electricity Grid Code of the Bangladesh Energy Regulatory Commission;
c. Great Britain Grid Code.

Any other requirements of BPDB/PGCB shall also be considered (if available).

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B0.6.18.2 Voltage levels

The following voltage levels shall apply:

• 400 kV and 230 kV, 50 Hz	connection voltage to the public grid
• 18 to 27 kV, 50 Hz	generator voltage, depending on manufacturer's standard
• 11 kV ± 6%, 50 Hz	voltage for motors equal to/bigger than 1500 kW and for power distribution within the Plant
• 3.3 kV ± 6%, 50 Hz	voltage for motors equal to/bigger than160 kW and for power distribution within the Plant
• 240/415 V (+/-) 10%, 50 Hz	standard voltage for power supplies to small electric power consumers and motors below 160 kW lighting and domestic power outlets
• 240/415 V (+/-) 10%, 50 Hz	voltage for power supply of essential electric power consumers - the system shall be operated with ungrouded neutral
• 220 V DC + 10%/-15%	voltage for emergency users of electricity, like turbine emergency oil pumps, circuit breaker control, inverters

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• 240/415 V ± 10%, 50 Hz	uninterrupted voltage supplies to consumers, which require uninterrupted infeed like DDCMIS components, control actuators, burner control panels, VDUs.
• 24 V DC ± 15%	for power supplies to the DDCMIS system components
• 24 V ± 10%, 50 Hz	for erection work in enclosed plant items of metal

The general arrangement of the particular voltage level for each part of the Plant within the scope of the Contract and the connections of the power supply systems can be seen from the Key Single Line Diagram (Annex E).

B0.6.18.3 Insulation levels

- The 400 kV system shall be designed to limit the switching surge overvoltage to 2.3 p.u. and the power frequency over-voltage for the 400 kV system and the 230 kV system to 1.5 p.u. The lightning arrestors associated with the 400 kV reactors shall be of 336 kV.
- Following insulation levels shall be considered:

	Description	400 kV	230 kV	Generator *	11 kV	3.3 kV
1.	Highest voltage for equipment	420	245	24 or 36	12	3.6
2.	Power frequency withstand voltage	650*/630	460	50 or 70	28	10
3.	Lightning impulse withstand voltage	1425	1050	145 or 170	75	40
4	Switching impulse withstand voltage (phase to earth)	1050	-	–	-	-

* According to manufacturer standard

The creepage distance of the outdoor insulators shall be minimum 31 mm/kV.

- 400 kV level:
  - rated switching impulse withstand voltage 1050 kV
  - (phase-to-earth);
  - rated lightning impulse withstand voltage 1425 kV;
    *rated power frequency withstand voltage for GIS 650 kVand for transformers 630 kV.
- 230 kV level:
  - rated short duration power-frequency withstand voltage 460 kV;
  - rated lightning impulse withstand voltage 1050 kV.
  - Remark: The insulation coordination study shall be carried out by the Contractor.

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B0.6.18.4 Installation conditions and protection class for electrical operational equipment and control and monitoring equipment

If not specified otherwise the electrical operational equipment must be designed to meet protection classes stated below.

Switchgear, housings for electrical equipment and electrical equipment itself must be designed according to IEC 60529 at least to:

- Class IP 41 if located indoors in air-conditioned/ventilated areas
- Class IP 42 for ventilated enclosure of DDCMIS equipment if located indoors in air-conditioned/ventilated areas with suitable cannope ontop to prevent ingress of dripping water
- Class IP 22 for non-ventilated enclosure of DDCMIS equipment if located indoors in air-conditioned/ventilated areas with suitable cannope ontop to prevent ingress of dripping water
- Class IP 54 if located indoors
- Class IP 65 for all I&C field devices
- Class IP 55 for motors located outdoors and in indoor areas with high dust and humidity
- Class IP 65 for other outdoor electrical and control system equipment such as cubicles or panels with additional measures) if located outdoors in accordance with IEC 60529 (degrees of protection provided by enclosures (IP Code) or equivalent). The additional measures shall consist of sunshades, protection covers against splashing water, additional sealing, special acid resistive coating etc., depending upon the particular site conditions at the place of installation, subject to the approval of the Employer.
- Class IP 21 if located indoors with open doors.

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The lamps for external lightning and internal lighting of not completely closed buildings must have protection class IP 55W. Furthermore for dust prone areas the lamps shall have protection class IP 65.

Electrical operational equipment which must be installed in areas exposed to danger from explosions must have the required explosion-proof design appropriate to the flash-point group classification of the explosive mixture as laid down in IEC 60079. Attention must be paid with respect to the use of electrical operational equipment in workshops and storage premises exposed to the risk of explosions.

In all rooms and areas where the local and operational conditions and surroundings can lead to the accumulation of gases, vapors, mists or dusts which, in combination with air, form explosive mixtures, the operational equipment and installations to be used in these circumstances must be of explosion-proof design. All operational equipment must be designed to comply with the class of protection dictated by the ignitable mixture (e.g. compression-proof casing, external ventilation, inherent safety, etc.).

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Electrical operational equipment should be located indoors in adjoining buildings rather than inside buildings or other structures exposed to the risk of explosion. Whenever operational equipment has to be installed within areas liable to the risk of explosion, protection against explosion must, in general, be applied wherever explosive mixtures can arise. In this connection, the ignition of explosive mixtures must be reliably prevented by adopting the correct choice of design and construction of the operational equipment and the incorporation of supplementary safeguards where applicable.

Electrical, chemical, thermal and mechanical influences must on no account impair, in any way, the protection afforded against explosion. In particular the high ambient temperatures and the influence of nearby heat sources at the installation point must be taken fully into account.

B0.6.18.5 Protective measures, earthing and lightning protection

In view of the potential dangers of electrical power, the following measures are required for the protection of life, equipment and materials. Basically, all 'live' parts, i.e. all parts of electrical, operational equipment at an electrical potential above or below earth potential when in operation, and with a rated voltage over 24 V, must be insulated or covered so that they cannot be touched accidentally.

In addition, measures must be taken by the Contractor to prevent the occurrence or persistence of excessively high contact potentials on conductive parts of electrical operational equipment (frames etc.) brought about by faults in insulation.

For installations up to 1000 V, voltages over 50 V are considered to be excessive contact voltages. Within enclosed electrical installations, with voltages over 1000 V, the contact potential shall be according to the values given in EN 50522 (VDE 0101-2) Earthing of power installations exceeding 1 kV: enclosure B.

The following rules and regulations are to be observed in carrying out protective measures and in earthing procedure:

- IEC 60079 and 60364 for installations up to 1000 V,
- EN 50522 (VDE 0101-2) Earthing of power installations exceeding 1 kV.

In areas exposed to the hazard of explosion, the protective measures outlined in IEC 60079 and IEC 61241are to be adhered to in the erection and installation of electrical plant and equipment.

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B0.6.18.5.1 Protective measures for installations up to 1000 V

Protection against direct contact
All 'live' parts of electrical operational equipment that can be reached by hand must be protected against direct contact either by means of insulation or through constructional design, position or arrangement, or by means of special devices. If, in the case of enclosed switchgear or control cabinets, access is required in the course of normal operation (e.g. for replacing fuses), protection against direct contact must still be ensured when the switchgear or control cabinet has been opened up.

Protective insulation
Protective insulation is to be provided by means of additional insulation over and above the insulation provided for operational purposes. This measure must prevent the occurrence of a dangerous contact potential.

Use of low voltages as a safety measure
This safeguard applies to all equipment, which is required to operate in metal enclosures, boilers, tanks etc. The operational voltage of tools and lighting equipment must not exceed 24 V AC.

Isolating transformers shall be provided by the Contractor for the purpose of producing the protective low voltage. A separate 24 V system will not be provided.

Connection of the neutral
The LV network shall be of the TN type, i.e. the LV neutrals of the auxiliary transformers are earthed directly.

Neutralization (protective multiple earthing) is intended to prevent the persistence of an excessively high contact potential on conductive parts of the installation which do not form part of the actual operating circuit.

Protective multiple earthing as a protective measure requires the neutral to be earthed close to the transformer. However, wherever possible the neutral shall be earthed at the main LV board. In this case the connection transformer to LV main board shall be carried out as TN-C type, i.e. three phases plus PEN:

The LV system for symmetrically as well as unsymmetrical connected power consumers shall generally be of the TN-S type, i.e. a five wire system. The separation of N and PE shall be carried out at the main LV board. Because of the clear demarcation between the neutral conductor N, carrying operational current, and the protective earthing conductor PE, which - under non-fault conditions - carries no current, NO connection between either N and PEN or N and PE is permissible beyond the point of separation of the PEN conductor into PE and N.

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The LV system for supply of essential consumers (emergency diesel supply) shall be of IT type. All required isolating transformers shall be included in the scope of supply.

The neutral conductor is to be insulated in the same manner as the phase conductors. The use of constructional parts of the switchgear as a neutral conductor is not permitted.

All earthing conductors have to be rated depending on the value of earth-fault current (see EN 50522 (VDE 0101-2) enclosure D). Separate installed earth conductors must be at least 16 mm² for copper and 100 mm² for galvanized flat-iron.

The earth electrode resistance shall ensure that potential contact will not be higher than 50V (see IEC 60364 - 4 -41).

B0.6.18.5.2 Protective measures for installations over 1000 V

Protection against contact
At least the following measures are to be taken for all parts that are 'live' when in operation:

- Protection outside of closed electrical operating areas:
  - complete protection from all sides against contact, the degree of protection shall be at least IP23D according IEC 62271-202 and IEC 60529
  - protective devices may only be removed by means of tools.
- Protection inside closed electrical operating areas:
  - protection against contact with 'live' parts within reach of personnel,
  - protection against accidental contact outside the reach of personnel.

The above-mentioned measures for protection against contact are also to be applied to 'dead' parts of the Plant where, in the case of a fault, a dangerous contact potential might arise, however, where the parts must not be connected to the protective earthing system for operational reasons.

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Protection against contact voltages
Protective earthing is to be used as a safeguard against excessively high contact potentials for conductive parts of the installation, which do not form part of the operational circuit. Here, all normally 'dead' parts equipment and apparatus shall be earthed if it is possible for them to come into contact with 'live' parts as a result of faults due to the occurrence of surface leakage paths, arcs or direct connections to a 'live' part of the equipment.

In considering the dimensioning of the protective earthing system, the thermal loading and voltages on the earthing equipment are decisive factors and these should be based on the maximum possible earthing current, which can arise.

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Connection of the neutrals

- 400 kV system: neutrals of the 400 kV windings of the transformers shall be directly grounded
- 230 kV system: neutrals of the 230 kV windings of the transformers shall be directly grounded
- 11 kV system: neutrals of the 11 kV windings of the transformers shall be grounded by means of 400A resistors
- 3.3 kV system: neutrals of the 3.3 kV windings of the transformers shall be grounded by means of 400A resistors.

B0.6.18.6 Earthing and lightning protection

B0.6.18.6.1 Earthing and potential equalization system

The earthing system and potential equalization shall comply with the following standards:

- IEC 60364-4-41: Electrical Installation of Buildings – Protection for Safety: Chapter 41: Protection Against Electric Shock
- IEC 60364-5-54: Electrical Installation of Buildings – Part 5-54: Selection and Erection of Electrical Equipment - Earthing Arrangements, Protective Conductors and Protective Bonding Conductors
- EN 50522 (VDE 0101-2) : Earthing of power installations exceeding 1 kV
- VDE 0845, Part 1: Protection of Telecommunication Systems Against Lightning, Electrostatic Discharges and Over-voltages from Electric Power Installations; Provisions Against Over-voltages
- IEC 61643: Low-voltage Surge Protective Devices

For earthing, protective earthing, functional earthing, potential equalization and lightning protection-potential equalization, a common system shall be established.

Within all buildings, internal earthing rings shall be installed. These shall be linked by way of connection tags to the foundation ground and outdoor earthing system.

All system and plant components which are to be earthed as well as electrical components, like protection and control cubicles, sub-distribution boards, control systems, motors and transformers, shall be connected to the earthing rings/bars. All steel structures within a welded Section shall be connected to the main earthing system.

At pipelines for flammable liquids or gases, earthing tags shall be provided at each flange. All bolted flanges shall be bridged using a flexible braided copper conductor. Each pipe shall be connected at least once to the main earthing system.

No framework parts or other structural components shall be used for the ground bus.

An earthing cable shall be included in all main cable runs.
Protective earthing and potential equalization of electronics cubicles, frameworks, racks etc. shall be executed as follows:

- Earthing rings shall be installed in the I&C rooms as buses, to be connected at several locations – at least two – to the earthing network.
- For each row of cubicles, at least two connections shall be made to the earthing ring. Cubicles in a row shall all be connected by conductors to each other.
- If cubicles are attached to a raised platform flooring of steel structural parts, it shall be ensured that these are electrically connected to each other throughout the area. The raised floor shall be connected to the earthing ring at several locations, and as a minimum at two corners of the room.

Foundation earthing
All buildings, including those with a steel skeleton, shall be equipped with foundation earthing. The foundation earthing shall be installed in addition to reinforcement that is likewise connected together with braided conductors.

The foundation earthing shall be used in connection with the other earthing systems like protective, operational, functional and lightning protection earthing.

In the case of pile foundations, earthing rods of the same length as the piles shall be installed along with the foundation piles at intervals of around 10 m and connected at around every 2 m to the pile reinforcement using braided conductors. The earthing rods shall project beyond the top of the piles and then be connected to the earthing system of the ring foundation.

In addition to the closed ring of the foundation earthing system, a net of mesh size around 10 x 20 m shall be embedded in the bottommost concrete layer. The foundation earthing shall be connected to the reinforcement by a braided conductor at intervals of about 2 m.

At intervals not exceeding 20 m, and with at least two in every room, connection tags from the foundation earthing shall be foreseen for connecting the internal earthing ring. Connection tags shall likewise be foreseen for connection to the external earthing system and to the lightning rods. Optionally, lighting rods can be connected to the external ring

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earthing, with connections then made from this ring earthing to the foundation ground by way of the internal earthing ring at intervals not exceeding 20 m.

Earthing material

- Refer to Part B7.

Screening

The measures described in the following serve for screening and potential control within (see EN 50522 (VDE 0101-2) Annexes E and F) and for lessening overvoltages.

- For reinforced concrete buildings, at each corner of the building including the bottom slab, an additional mesh of rebars, of approximate mesh size 10 x 10 m, shall be provided at the topmost reinforcement. The meshes shall be produced by welding. This additional reinforcement, connected so that it is electrically conducting, may be dispensed with if it is ensured that the existing reinforcement is so connected by welding at appropriate points that it is electrically conducting.
- At intervals corresponding to the mesh-width, earthing wires from the reinforcement shall be incorporated into the building pillars, rising from the foundations to the roof, and so welded that they are continuous. These earthing wires shall terminate at the roof parapet. The meshes and earthing wires shall be welded to each other.
- For steel skeleton buildings, equivalent measures shall be taken. Framework Sections shall be welded to make up a defined, electrically conducting connection or shall be bolted together so that they are electrically conducting.
- Metal façades and coverings shall be preferred over non-conducting materials and at their topmost and bottommost points shall be connected at an adequate frequency to the lightning protection system.
- Reinforcement of cable ducts of reinforced concrete shall be connected to parallel running earthing cables. These earthing cables shall be connected to the screen of the building earthing system or to the foundation earthing system.

B0.6.18.6.2 Lightning protection

All buildings and structures shall be equipped with a lightning protection system. Lightning protection level I (LPL) according to IEC 62305 shall be considered.

The **building lightning protection system** is to be executed according to:

- IEC 62305-1
- IEC 62305-3 and
- IEC 62305-4

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and alongside protection of human life to prevent damage not only to buildings, but also to electrical and electronic installations.

All buildings and structures are to be protected against lightning strikes by means of lightning collectors and conductors. The collectors are to be arranged in such a way that, as far as possible they collect all lightning strokes without these directly striking the parts to be protected. This condition is considered to have been fulfilled if no point on the roof surface is more than 5 m away from a collector. Collector lines suffice as collectors, e.g. along the ridge and at gables and eaves.

Ridge conductors must be taken right to the end of the ridge. Moreover roof conductors should run as natural continuations of all main conductors. Conductors at the gable extremities or eaves must be laid in the closest possible proximity thereto. In the case of steel-framed structures the ridge conductors must be connected to the roof supporting structure at least every 20 m. Lower level annexes are also to be provided with collectors.

Roof lines and other conductors are to be laid and fixed in such a way that they can withstand the stresses expected from storms, lightning strokes, roof work, etc.

One main conductor between the lightning collectors mounted on the top of the building and the potential grading ring laid in the ground is to be provided every 20 m of the before-mentioned lightning collector. The maximum spacing between conductor fixings may not exceed 1 m for horizontal runs and 1.2 m for vertical runs.

Lightning protection material
In case of buildings with steel structures and sheet steel cladding, the steel columns and the sheet steel cladding shall be used as lightning conductor. In case of masonry buildings or buildings with concrete structure, external lightning conductors made of copper or stainless steel shall be used. Lightning arrestors (arrestor tips and roof conductors) or Lightning air terminal shall also be made of copper or stainless steel rods. The conductor supports of the lightning protection system must be copper or bronze. Nuts and bolts at isolating or other points which are to remain detachable must be made of copper-nickel-silicon-bronze.

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B0.6.18.7 Technical conditions for high voltage motors

If not specified otherwise all electric motors must be designed to meet iP 54 enclosures.

All motors with rated power (referred to 40° C ambient temp.) of 160 kW and above must be designed as HV motors.

B0.6.18.7.1 Constructive features

The following constructive features shall apply:

a. Climatic protection provisions for mounting in the open in a humid and hot climate. Insulation class F. During operation at rated power of the driven machine, the motor insulation must only be stressed in accordance with the requirements of class B insulation.
b. Motor parts made of iron internally and externally sandblasted and surface-protected.
c. Paint finish resistant to chemicals and seawater.
d. Bolts with adequate corrosion protection.
e. All joint faces and gaps sealed.
f. Anti-condensation heating to be switched into operation when the motor feed circuit is in the 'off' position. Heater supply power 'on' indicating lamp is to be provided.
g. Special treatment of windings with resin impregnation plus immersion in varnish.
h. Varnish-insulated laminations.
i. Pressboard material protected by varnishing.
j. . For motor ratings the cooling air available at the specific location has to be considered.

   All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) type. However, motors rated 3000 kW or above can be Closed Air Circuit Water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type.

k. Condensation outlets to be provided at the lowest point in the housing.

Design and construction of the motors shall comply with IEC 60034-1, 60034-5 or VDE 0530 and DIN 40050.

B0.6.18.7.2 Electric features

The following electric features shall apply:

a. Motor rating to be at least 110% of the maximum required electric power consumption of the driven machine.
b. Continuous delivery of rated power at voltages of 90 - 110% of the rated voltage and allowable frequency range within the limits of thermal class F.
c. Rated power output at ambient temperatures existing at the particular site of installation and under continuous running conditions.
d. All motors shall be designed as 3-phase squirrel-cage motors suitable for direct on line starting. It must be possible, with 100% residual voltage, to switch them on to a large and stable power supply network without incurring damage or deformation. The motors must still be capable of

faultless running up to speed with a voltage drop to 80% of rated voltage and rated loading.

However, 75 % starting voltage shall be allowed for motors above 4000 kW. Mill motor being high starting torque motor, is specially designed and shall be suitable to operate at 85% rated voltage for 1 minute only, provided that the mill motor is suitable for starting/running with voltage variations for which aux. power supply system is designed.

e. Motor starting current must not exceed 5.5 times rated current (referred to motor rating at 45 °C ambient temperature) for motors up to 2 MW and must not exceed 4.5 times rated current (referred to motor rating at 45°C ambient temperature) for motor ratings above 2 MW. The voltage drop at direct-on-line starting should be limited to 20% at the motor terminals except rating above 4000 kW. However starting of any motor shall not cause tripping of any other consumer.
However, Bidder/Contractor is free to design his system with starting currents up to 600% maximum.

f. From the cold state four consecutive starts up to full speed must be possible. The second start must be possible immediately after the first start, the third 20 minutes after the second, the fourth 20 minutes after the third.
g. A minimum frequency of starting cycles of 1000 per year must be guaranteed.
h. In general, motors must be capable of running without overheating when subjected to three consecutive starts within one hour after having run for an extended period on a voltage of 95% nominal voltage. Thereby the second start must be possible immediately after the first start and the third 30 minutes after the second start. In individual cases where operation depends on signals from pressure switches or other such sources, then a more severe duty with respect to the frequency of starting cycles per hour shall be necessary and the design of the motors must be carried out accordingly.

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B0.6.18.7.3 Protective features

The following protective features shall apply:

a. High voltage motors must be fitted with measuring points for the determination of slot and bearing temperatures.
b. Six Pt 100 resistance thermometers (2 per phase) are to be provided for slot temperature measurement, and a double thermocouple or resistance thermometer per bearing must be provided for bearing temperature measurement. Type of temperature elements shall be finalized by the manufacturer.
c. Each Pt 100 shall be connected, potential free, to a terminal strip. The connections to the thermometer as well as the associated over-voltage cutouts shall be brought into separate terminal boxes.

d. Where motors have closed-cycle cooling, temperature-measuring points must be fitted in the cold air stream.
e. The winding temperatures have to be detected with RTD's at high temperature and alarm to be produced, at extra high temperature the motor to be tripped.
f. All motor gaps and joints between it and other units must be sealed.
g. Earthing clamps at both sides of the stator have to be provided.
h. All HV motors bearings shall be equipped with vibration sensors for vibration monitoring.

Considering the rating of CHP HT motors vibation monitoring is not required. For Coal Crushers vibation isolation & monitoring shall be provided.

i. Temperature transmitter to be provided for all temperature measuring devices.

B0.6.18.7.4 Other features

Terminal Boxes
The main terminal boxes on the high voltage side shall be provided with a pressure relief joint for the purpose of reducing the danger of an accident as a result of short-circuits, and shall be fitted with a terminal block suitable for any desired type of connection.

Cable connecting boxes must be longitudinally divided to facilitate fitting of cable sleeves and end caps. Protection class shall be IP 55.

Inside the terminal box an earthing clamp for connection of the cable shield must be foreseen.

The opened terminal boxes must have provision for local earthing to be carried out.

All terminal boxes shall be provided with a removable undrilled gland plate. The gland plates shall be of non-magnetic material if single core cables are to be installed.

Connections, star-point terminal boxes etc.
All motors must have the star-point connection brought out separately to terminals.

For all motors with a rating of 2000 kW or above a differential relay for winding protection shall be provided and installed in the associated switch-gear. In that case the star-point connection shall be brought out separately to terminals. The differential current transformers are to be designed to class 5 P10 with a rating matched to the protection system. The CT's shall be accommodated in the star-point terminal box.

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

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

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

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

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

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

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

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

B0.6.18.8 Technical conditions for low voltage motors

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

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

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

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

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B0.6.18.8.1 Constructive features

The same features as for high voltage motors shall apply.

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

B0.6.18.8.2 Electric features

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

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

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

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

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

B0.6.18.8.3 Protective features

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

B0.6.18.8.4 Other features

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

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

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

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

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B0.6.18.9 DC motors

The use of DC motors is to be avoided and must be agreed by the Employer. The maximum starting current must not exceed 1.8 of the rated motor current (referred to the motor rating at 45 °C ambient temperature). However any other value of starting current proposed by Bidder/Contractor during basic/detailed engineering shall be subject to Employer's approval

B0.6.18.10 . Actuator drives

As far as applicable the above "Technical conditions for low voltage motors" shall apply.

In addition, all actuators for valves, dampers etc are to be fitted with socket and plug of well-established make to IEC 60309 or equivalent for the power cable connection. For the control cable connection separate socket and plug shall be provided.

Self-cooling at respective ambient temperature conditions is mandatory. Fan cooling is not accepted.

Actuators shall have integrated starters. Regulation type shall be continuous modulation type (min. 3000 starts per minutes).

B0.6.18.11 Frequency converters

General
On the basis of the requirements of the driven equipment, the Contractor shall design, supply, install and commission a complete, fully operative, variable-speed converter drive (frequency converter and motor, for motors up to 400 kW, for motors 400 kW and above in addition to the converter a converter transformer shall be provided).

Converters made by reputable manufacturers are to be used.

Technical requirements
The design of the converter (maximum continuous rating) is to be based on the maximum shaft output required by the equipment assembly.

Maintenance work and cable connections must always be possible from the front of the converter cubicles

The terminals on the input and output sides are to be rated such that parallel cables can be connected.

The converter allows the speed of three-phase asynchronous motors to be adjusted steplessly. It must be fully equipped for remote control and monitoring in the control room.

An on-load disconnector and a power contactor are to be provided at the power input of the converter.

For motors with a rating up to 400 kW the frequency converter shall be designed in at least a six-pulse circuit on both the line and motor sides.

Frequency converters using Insulated Gate Bipolar Transistors (IGBTs) should preferably be provided on both the line and the motor sides.

For motors with a rating above 400 kW the converter should be designed in a 12 pulse circuit supplied via converter transformer.

The converter is to be disconnected if the voltage drops to less than 80% of the rated voltage or if one or more phases of the line voltages are missed. When the line voltage is restored, the converter is to be connected again automatically, providing the break in the power supply did not last longer preferably than 5 seconds. The Plant check back signals (floating change-over contacts) must continue to be received during this period, while alarms are to be suppressed. It must be possible for the converter to be connected at any coasting-down drive speed and with in-phase voltages. The specified frequency set point is to be resumed automatically.

If the voltage reduction or the power failure lasts for a long time, the drive must remain switched off; in this case, it must subsequently only be possible to switch it on again either manually or by means of the higher order control.

The converters are to be designed for 10% more than the maximum power output required by the system. The purpose of regulating the converter is to ensure that the indirect current and voltage remain within the permissible limits during all control processes. This should apply both when the motor is started up and when the speed is adjusted during operation.

Forced ventilated converters are to be equipped with redundant fans (two double fans).

Flow monitors (not air vanes) are to be used to monitor the fans. Positive control is to be provided for fan drives with a master drive.

Converter transformers

The transformer shall meet the requirements in the IEC standards 60076-11 and 60146-1-3, shall be of cast-resin type and are to be installed in protective casings made of sheet steel, cooling method AN, thermal insulation class F (utilized according to class B only), type of protection at least IP 21.

The transformer output shall correspond to the power requirement of the frequency converters.

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It should be possible to vary the high-voltage side within a range of 2 x ± 2.5%, by means of reversible clamp connectors.
The connections on the high-voltage side have to be carried out using cables.

Busbar connections with short-circuit protection are to be provided to the current converters on the low-voltage side.

Suitable earthing studs are to be provided for maintenance purposes (earthing and short-circuiting).

All accessories - especially sensors and terminal connections - must be arranged so that they are readily accessible.

The windings must be flame-retardant and self-extinguishing. The cast-resin mixture must not contain any flame-inhibiting additives which develop toxic vapors or gases either under the influence of secondary fires or in the electric arc. A report on this subject has to be enclosed with the bid.

Moisture-proof design:
It must not be necessary to dry the winding after shut-off periods. The protection against voltage surges and short circuits, the noise levels and the freedom from partial discharges up to twice the rated voltage must be verified by means of type tests.

The windings are to be protected by means of a temperature monitoring system, comprising the following minimum components:

- 3 PTC resistors (1 for each phase)
- 1 tripping unit with isolated change-over contacts for remote signalling (alarms).

Temperature transmitter to be provided for all temperature measuring devices

Instrumentation and control
The instrumentation is subdivided into a local Section in the converter cubicle and into a "remote" Section in the control room. All the measures necessary to enable the drive to be remote-controlled and remote-monitored must be implemented, i.e. all the 24 V DC interposing relays which are required to convert the on/off commands from the instrumentation and control system, signal transducers, etc (see also "remote control and remote indications" below).

A suitable automatic compensation facility is to be provided, to ensure that the transfer between LOCAL mode and REMOTE mode is bumpless in both directions. The emergency shutdown function of the equipment must act on the converter directly, regardless of whether 'local' or 'remote' mode is set.

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Local instrumentation and control
The following are to be provided as a minimum in the converter cubicle:

Controls
a) Local/remote converter control (key-operated switch)
b) "On" and "off" converter controls
c) Set point adjuster (speed)
d) Incoming master switch, "on-off"
e) All the controls necessary for internal converter settings and adjustments, as specified by the manufacturer

Indications, signals, monitoring
a) Line voltage indicator
b) Output frequency
c) Output current
d) Operating status signals, in accordance with the specifications of the instrumentation and control supplier, though at least "Ready", "Drive running" and "Zero and set speed reached"
e) Motor temperature monitor - alarm Motor temperature monitor - shut-down
f) Signals concerning internal operating states of the converter, in accordance with the manufacturer's standards, though at least:
   - Overtemperature
   - Line voltage monitoring
   - Line undervoltage
   - Overcurrent
   - Control voltage monitoring
   - Converter protection
   - Fan monitoring
   - Incoming air temperature
   - Motor feeder interruption
   - Motor feeder short circuit
   - Earth fault
   - Motor blocked
   - Other faults.

Remote control and remote indications
Account must be taken of the following types of remote control and indication in the control room, and suitable interposing relays, transducers and switchgears are to be provided in the cubicle:

a) Converter "on/off" and "local/remote"
b) Set point adjuster for speed (4 - 20 mA)
c) Remote indication for speed as 0/4 - 20 mA standard signal
d) Motor current as 4 - 20 mA standard signal
e) Combined fault
f) Remote indication of the set speed potentiometer as a 0/4 - 20 mA standard signal
g) All Switchgear faults and "Racked-Out" events

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h) Other controls and indications

All event signals and check back signals must be made available on the terminal strip as floating change-over contacts.

System perturbation
The perturbation caused by the voltage harmonics in the feeding three-phase system, which are a result of the converter drives, must not exceed the specified limit values, i.e. 5% for the 5th harmonic voltage, 4% for the 7th and 2% for each of the 11th and 13th. IEC 60801.1 - 60801.4 are also to be observed in this connection. The system perturbations are to be curbed by means of suitable measures if necessary. The contractor is responsible for demonstrating conformance with the above-mentioned limit values.

B0.6.18.12 Cable and cable trays

B0.6.18.12.1 Cable laying and routing requirements

The Contractor responsible for cable routing and laying has to observe a strict unit separation. The cables must be routed in different cable channels or, as the minimum requirement, on different cable trays, so that in case of a fire or any accident in a cable channel or tray two units will not be affected. Further in case of two critical drives of the same unit with both drives operating in normal conditions cable for the same shall be routed through two completely redundant routes.

On vertical cable risers, walls and ceilings the cables must be secured with corrosion-resistant cable clips (e.g. cable clamps with cable protecting cable sleeves).

Cable risers near gangways or in electrical rooms that are exposed to possible mechanical damage are to be protected up to 1 meter from ground by suitable metal cover.

All holes in ceilings, floors and wall made for cable routing must be sealed fire-resistant, when the cables have been laid. This also applies to switchgear panels and cubicles, passages between cable ducts, at vertical risers etc. As there is an increased danger of fire during the construction period the holes shall be fire-resistant sealed at that stage already. This applies especially to vertical runs.

When the cables are no longer supported on cable trays or risers etc. the power, DC and instrument transformer cables must generally be run singly in galvanized steel conduit. With lighting cables, measuring and control cables and telephone cables, several similar cables can be run in one conduit. Surface-mounted conduits must be secured every 1.5 m.

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The control and communication cables must be laid sufficiently apart from the power cables so that no interference will occur and the transmission of fault signals is excluded. For this purpose the following minimum separations are to be observed:

- 300 mm between low voltage power cables and measuring and control cables at voltages of 60 V and below,
- 300 mm between power cables and measuring and control cables at voltages above 60 V,
- 600 mm between medium voltage power cables and measuring and control cables at voltages of 60 V and below.

The laying of cables outside of buildings should be preferably on cable bridges that preferably are to be naturally ventilated.
If the cables are laid in the ground, after excavating the trench a layer of sand must be introduced. On the sand the cables are laid separately from each other according to voltage systems. The cables must be laid at a depth of 0.8 m at least. The trench is filled with sand and covered with concrete covers or bricks. The thermal resistance of the backfilling shall not exceed 150 Kcm/W. A ground temperature of 28 °C has to be considered. Where cables have to pass under streets cable duct blocks with a suitable bore(s) should be provided. The marking of cable routes by cable warning tapes must be provided.

When laying the cables on cable trays, cable risers, cable channels, etc. and when choosing the size of the cables care must be taken that sufficient ventilation is available and that there is no possibility of thermal overheating, or strain on the cables.

Cables that must move with connected apparatus owing to thermal expansion (e.g. boilers) must be provided in a flexible form or they must have sufficient slack at the location.

All the ends of the cables must be prepared according to the particular requirements of the manufacturers and connected to existing terminal strips, terminal screws, apparatus terminals, etc.

The necessary cable sealing ends and the stripped and fanned-out cable ends, where no sealing ends are provided, must be fixed to the appropriate supporting structures.

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B0.6.18.12.2 General cable construction requirements

The medium and low voltage cables shall be of Fire Retardant Low Smoke (FRLS) with XLPE insulation. For cables that are exposed to ambient temperatures above 60°C, teflon or silicone cables are to be provided.

For safety related equipment fire surval cables shall be provided.

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The cables must be suitable for laying indoors, in the open (direct or indirect sunlight), in ducts, on trays, in the ground and in water. The cables must be resistant to solar radiation, the effect of oil, seawater, bacterial action, insects and rodents. Outer sheaths are to be manufactured from non-combustible or flame retardant low smoke material.

Manufacturers testing standard related to resistance to solar radiation, effect of oil, seawater, bacterial infection, insects and rodents, will be accepted.

All cables must be provided at both ends, at every 20 m and every bend with identification in the form of numbered labels corresponding to the coding system. The individual cores will be numbered or identified by colour-coding.

The cables must be laid to ensure that they can be replaced or renewed in a simple manner.

B0.6.18.12.3 Medium voltage (MV) power cables

The design of the MV cables shall be screened, stranded, single-core or three-core copper conductor cables of FRLS with XLPE insulation. The cable shall be sealed with a red, non-fading PVC outer sheath. Three-core cables shall be designed with individually screened cores.

The MV power cables must be designed for the thermal and short-circuit characteristics of the electrical systems, taking into consideration the following minimum short circuit duration:

- for incoming cables and cables to sub-distribution: fault clearing time of the back-up protection.
- for all other cables: the fault clearing time of the main protection.

The cables must be terminated and connected to the indoor metal-clad switchgear or the sealing ends are installed in cable connection hoods mounted on the power transformers.

In the event of outage of the air-conditioning plants of the switchgear buildings the internal and external conditions will become the same. Therefore, sealing ends are to be used which shall be suitable for the maximum conditions at site.

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B0.6.18.12.4 Low voltage (LV) power cables

The low voltage power cables shall be standard single and multi-core cables of FRLS with copper conductor and XLPE insulation.

To ensure the elimination of excessive contact potentials on any object, effective earthing must be carried out as a safety measure and suitable 3-core, 4-core and 5-core low voltage power cables must be provided. The minimum conductor cross-section of the low voltage power cables is 2.5 mm^2. If 3 1/2-core cables are used, the reduced conductor for protective neutral must have a cross-section of at least 16 mm^2. In lighting systems (especially discharge lighting circuits) the use of a reduced conductor for the protective neutral is to be avoided.

Depending on the site conditions the DC cables must be single-core, 2-core or 4-core. Between batteries or rectifiers and the DC switchgear single-core power cables should in general be used.

The LV power cables must be designed for the dynamic and thermal characteristics of the electrical system and for continuous operation.

B0.6.18.12.5 Current carrying capacity of power cables

The ratings for continuous loading of the cables shall be calculated according to the relevant IEC regulations. The Contractor must submit corresponding tabulations for all cables to be used.

The maximum voltage drop under normal conditions shall not exceed 2.5%.

Voltage drop during starting shall be considered as 15% & during running 3%.

The voltage drop between the the MCC and the terminal of the load shall not exceed 2.5%. It is asumed that the switchgear and the MCC are connected by bus-bars/- ducts means the voltage drop is very low.

The voltage drop for MV Cable Shall be limited to 3% and for LV Cables:

- The voltage drop on the LV cabless from Main Distribution to subdistribution shall not exceed 2.5%
- The voltage drop up to the LV motor terminals shall not exceed 5% at normal operation and 15% during starting.

B0.6.18.12.6 Measuring and control cables above 60 V/ instrument transformer cables

For voltages above 60 V the cables shall be of Fire Retardant Low Smoke (FRLS) with PVC insulation and a mini-mum conductor cross-section of

1.5 mm^2. If they lead to outlying buildings, cables with a common core screen and protection against induction must generally be used.

For instrument transformer cables inside buildings the minimum conductor cross-section must be 2.5 mm^2.

Instrument transformer cables leading to outlying buildings must have a minimum size of 4 mm^2 and must generally have a common core screen.

The maximum voltage drop shall not exceed 2%.

B0.6.18.12.7 Measuring and control cables below 60 V

For voltages up to 60 V, measuring and control cables shall be of FRLS with PVC insulation and shall have stranded or solid copper conductors of minimum 0.8 mm diameter. Multi-pair control cables with paired lay-up of the leads and lay-up of the pairs themselves shall be used.

Instrumentation cables shall be identified by colour codes and bank marking as per VDE 0815.

Wherever necessary, e.g. for all cables leading outside the relay rooms and/or control rooms, the control cables shall have a common screen (Al-foil or Cu-foil).

Cables must generally have appropriate electrical protection against inductive/resistive influences and lightning.

The required compensating wires for temperature measurements must be at least 0.5 mm^2.

The maximum voltage drop shall not exceed 2%.

The individual cores of the multi-pair control cables shall be identified by numbers or a colour coding system.

Minimum size of 0.5 sq mm shall be considered for wiring including for control cabinets.

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B0.6.18.12.8 Fiber optic cables (FOC)

All fiber optic cables as well as their deployment and the entire test procedure shall comply with IEC 60794. The cables shall be able to operate continuously in temperatures up to 70°C. The fiber optic cables shall be loose tube type with the fibers fed into tubes. The tubes shall be sufficiently strong to hold their shape and provide protection for the fibers against deformation and friction. Each fiber shall be colour coded acc. to IEC 60304.

Buried fiber optic cables shall always be laid inside adapted conduits. Installation shall ensure rodent protection and be water tight. The conduits system shall supply all equipment necessary for the deployment acc. to FOC manufacturer's specification. Occupancy shall allow future cable installation.

For out-door applications cables shall be suited for out-door deployment, longitudinally water tight, filling material standardized for all cables, yield minimum 3,000 N.

The fiber optic cables shall be complete with non metallic strain relief elements. Fiber optic cables that are installed outdoors shall be armored. Cables used indoors shall be reinforced with a steel wire braid.

Graded index fibers cables and monomode fiber cables shall comply with IEC 24702:

Graded index fibers cables shall consist of always 24 fibers

- fiber - type 50/125 µm, OM-3.

Monomode fiber cables shall consist of always 24 fibers

- fiber - type 9/125 µm, OS-1.

19" patch panels shall be used for termination, connectors shall be LC-Duplex as standardized by IEC 61076-3-106 var. 4. All fibers shall be terminated / connected.

Each fiber of all FOC shall be deployed and tested according to IEC 60794. Resulting test protocols of all single fibers of all FOC shall be handed over to the Employer, stating all details in written.

B0.6.18.12.9 Cable supporting structures

Construction requirements
Basically, pre-fabricated cable trays, cable risers, hanger rods, screws, clamps and all fixing material of corrosion-resistant finish, hot-dip galvanized, shall be used. If in certain sections the use of trays and risers is not possible, cable racks are to be provided in such places. These shall be made of corrosion-resistant, steel angle Sections, hot dip galvanized. The steel angles must be cut to size on site and exposed cut surfaces must be suitably treated on the spot to prevent corrosion before being fitted. The minimum requirement for this treatment is the application of an anti-corrosion layer of zinc coating.

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All cable tray T-junctions, cross-overs, vertical and other shelving, bends, etc. must consist of pre-fabricated tray elements so that crushing of the cables at these transition points is avoided.

The cables laid on the trays must be carefully arranged and ordered. All cable tray routings consisting of several individual cable trays that are located outside buildings and exposed to the sunlight shall be provided with sun-shades made of the material as described for the cable tray equipment. In all areas where an accumulation of coal dust must be expected, e.g. coal handling plant, conveyor belt ways, bunker area, the cable trays shall be installed vertically.

The trays and risers must be installed in such a way that in accessible manways an escape route at least 800 mm wide by 2100 mm high is available for the personnel.

For safety reasons the lower parts of the hanger rods and all other exposed parts in manways and escape routes must be fitted with plastic covers.

In indoor installations hot dip galvanized material with an average coating thickness according to ASTM A123/123M is to be used.

In all external areas, in semi closed buildings and in areas with corrosive gas or steam, Fibre Reinforced Plastic (FRP) cable trays tested according to international standards shall be provided.

The cable trays must be designed to ensure that there is 5% spare space on all trays when commissioning and handing-over is complete.

The fixing materials for the cable trays and risers must be corrosion-resistant or at least be hot-dip galvanized. The rods, brackets and risers must be fitted with appropriate support brackets to be fixed to anchor rails or fixed by dowels and screws in walls and ceilings.

Welding to steel structures and the welding together of hot-dip galvanized cable-laying accessories is not permitted.

After completion of the cable-laying work the maximum deflection of the cable trays shall not exceed 2.5 mm per 1.5 m (specified distance between two hanger rods).

B0.6.18.13 EMC measures

All EMC measures shall ensure that during subsequent operation, no impermissible malfunctions or damage to equipment occurs due to violating electromagnetic compatibility.

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The description of the measures is not limited to this chapter, but also forms a part of other chapters, in particular "Protective measures", "Earthing and lightning protection" and "Cabling".

The EMC requirements are set out in the following.

Under consideration of the conditions and constraints, the equipment used shall emit the lowest interference signals and exhibit the highest immunity to interference.
All equipment items shall operate properly when connected to networks with a power supply corresponding to the maximum permissible tolerances as laid down in EN 50160 (as regards, harmonics, voltage fluctuations etc.).

Priority is given to reducing sources of interference.

Additionally, by means of high-capacity screening, generation of overvoltages due to inductive or capacitive coupling shall be reduced. Influencing by electrical and magnetic fields shall be reduced.

Earthing and potential equalization systems designed for low-impedance shall reduce generation of overvoltages due to ohmic coupling.
If EMC resulting from the measures named above is still not adequate, further measures shall be taken within buildings, for example by isolation and suppressor circuits.

Thanks to the lightning protection and screening measures taken at the buildings, within them an EMC protection zone is formed.

All installations penetrating this protection zone, that is where they pass through the external walls of buildings, shall be incorporated into a lightning protection-potential equalization system as close as possible to the points of entry and exit of the building. This applies also for conductors carrying a potential. At entry or exit, these shall be included in the lightning protection-potential equalization system by way of suppressor circuits.

Cable runs to outdoor plant components and between buildings may also be screened by appropriate measures, and so form a part of the protection zone. If this is done, the suppressor circuit can be dispensed with.

A suppressor circuit shall be provided at all low-voltage main distribution boards.

Overvoltage protection shall be foreseen within the power supply for both central and distributed power supplies to electronic cubicles.

All conductive parts of the structures and installation within the scope of the contract must be connected to the main earthing system.

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All steel Sections or frames must be provided with at least two earthing straps for every frame or Section that is fabricated from parts welded together. The earthing straps shall be located at the ends of the beam Section or frame Section in every case.

The Contractor must provide earthing straps in front of and behind the screwed connection in every case and these straps must be interconnected, using stranded copper, and connected, at least at one point, to the main earthing system, except the Contractor verifies that the type of screwed connection applied is a permanent electrically conducting one.
Tanks and vessels containing flammable liquids or gas shall be earthed by a connection to the earthing grid or by bonding to earthed metal structures.

Each pipe shall have a minimum of one connection to the earthing system. In areas where flammable vapor-air mixtures may exist, electrically isolated Sections of metallic piping shall be connected to the earthing grid.

All flange connections in these lines shall be bridged by flexible stranded copper. Earthing tabs shall be provided at each flange.

When connecting differing materials together the required material transition plates must, in general, be inserted. All connecting materials must be corrosion-proof and suitable for the conditions prevailing at the installation point.

Railway lines, together with electrically conducting pipelines leading outside the power station place must be insulated or be fitted with intermediate insulating links or elements.

Each cable tray and cable riser of less than 20 m length have to be earthed once; structures of more than 20 m length have to be earthed twice.

B0.6.18.14 Requirements for local cubicles and local housings for e.g. switchgear, control, measurement and signalling equipment

Steel-clad cubicles and enclosures with fixed, integral switchgear and apparatus must be provided.

The switchgear cubicles must be partitioned off and incorporate a busbar system, the necessary instruments, control switches, switch panels of the individual switch and apparatus chambers. The main busbars are to be installed on the rear face, top side of the switchgear cubicle in a lockable shuttered compartment.

Connections to switching devices, MCB's fuses etc. are to be made from these busbars. The lower part of the cubicle will house the terminal strips and connecting blocks, the clamps for the cable terminals and, if required parallel connection copper straps for the connection of more than 2 cables in parallel. An adequate number of ball studs must be provided within the

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switchgear cubicle suitable for earthing the main and distribution busbars as well as the switchgear itself by means of portable earthing and short circuiting equipment (to be provided once per switchgear panel row).

The space in the interior of the cubicles must be divided into a Section with 'live' parts, 'live' switching elements etc. and a Section with control and measuring equipment. The Sections are to be separated by reinforced sheet-steel.

Care must be taken that in the event of arcing hot gases will not escape to the front of the cubicles (the operational side).

Ammeters are to be provided on the cubicle front panel for the cubicle feeders and the supply outlets for motors higher than 55 kW or motors of lower rating, but particularly important for the process. A single voltmeter with 4-position voltmeter changeover switch must be provided for measurements of busbar voltage between each phase and neutral. Measuring instruments should, in general, be square in shape.

All cubicles, cabinets, panels, etc. shall be designed for an ambient temperature of 40 °C (outside the enclosure) in non-air conditioned areas. Special precautions shall be taken in the design of electronic devices for protection and control systems housed in the cubicle in order to allow for these conditions.

Heating elements are to be provided generally in each local cubicle or cabinet and shall be humidity controlled.

It must be possible to disconnect power supplies to the cabinets by means of manually operated power circuit-breakers (MCBs).

For easy monitoring and a rapid grasp of the operational state, collared mimic diagrams with the required switch position indicators, apparatus symbols and pilot lamps must be provided in every case on main process cubicles and switchgear cubicles. Lamp test facilities for all signed lamps connected shall be provided. All cubicles shall be provided with the required earthing screws.

Plastic-insulated, stranded conductors must be used for wiring within the switchgear cabinets, which must be numbered at each end with special tabs so that change by mistake is impossible.

Preferably plug-in type auxiliary relays are to be used. Apparatus being sensitive to impact must be protected against shock and vibration.

On completion of hand-over the cubicles must contain at least 5% of fully fitted spare terminal capacity and 5% of spare space for the future installation of extra equipment. It shall be possible to replace indicating lamps on the front panels of cubicle feeders and motor-supply outlets

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without isolating the equipment concerned. Furthermore the control system must be designed in such a way that lamps operate at less than their rated voltage in order to avoid their being overheated.

Incoming and outgoing cables have to be fixed by suitable metallic cable glands.

B0.6.18.15 Local control points and level control cabinets

B0.6.18.15.1 General

Any electrical consumer unit, which is not controlled automatically or from the central control room, is to be fitted with a suitable local control cabinet. The local control cabinets are to be installed in the immediate vicinity of the motor drive to be controlled.

Pump motors, which are level controlled locally, will be given an automatic and manual control. The respective level control cabinets are to be fitted in the immediate vicinity of the pump motors, gauge glasses or level monitoring instruments.

B0.6.18.15.2 Construction requirements

In general local control cabinets and level control cabinets with plastic casings resistant to impact, sand, light and water, mounted on walls or hot-dip galvanized supporting constructions, are to be provided. Hot-dip galvanized casings will be acceptable.

Protection class must be at least IP 54 if installed indoors and IP 55W if located outdoors. The necessary earthing terminals must be provided for earthing purposes.

The cabinets must be equipped with the necessary mini circuit breakers, fuses, auxiliary relays, power contactors, terminal blocks and cable attachment components.

For motors with pre-selection control (operation/stand-by) operation hours counters are to be provided.

In hazardous areas, the necessary explosion proof control cabinets and level control equipment must be provided in accordance with IEC 60079, IEC 61241 and VDE 0165/170/171.

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B0.6.18.15.3 Local control points

The local control points are to be equipped as the minimum requirement with:

- ON button
- OFF button
- Running lamp
- FAULT LAMP
- TRIP HEALTHY indication
- Lamp test.

When two motors are installed, serving as operation and stand-by unit, then in addition to a double set of the above items, the following equipment has to be installed as the minimum requirement:

- MOTOR 1 - MOTOR 2 (running motor/stand-by motor) pre-selection switch,
- automatic transfer to the stand-by motor in case of failure of the running motor.

B0.6.18.15.4 Level controls

In the case of pump motors controlled by levels, in addition to the level control in each case the MANUAL - AUTOMATIC selector switch and the necessary local points are to be fitted. Control of individual pump motors must be effected as follows as the minimum requirement:

- MANUAL- AUTOMATIC selector switch
- level control with maximum and minimum contacts
- low level contact on motor - OFF
- bottom maximum contact on motor - ON
- top maximum contact as warning to the central control room
- low-low level contact as pump dry-running protection and alarm signal to the central control room
- local control point with ON and OFF button, running and fault lamp.

When two pump motors are installed for the same purpose the control is to be effected as follows, as a minimum requirement:

- MANUAL - AUTOMATIC selector switch
- PUMP 1 - PUMP 2 (running pump / stand-by pump) pre-selection switch
- level control with three high level contacts:
- first (1): high level contact for pre-selected ON
- second (2): high level contact for alarm signal to the central control room
- low level contacts for pumps OFF
- low-low level contacts as pump dry-running protection and alarm signal to the central control room

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

B0.6.18.16 Terminal boxes and terminal cabinets

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

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

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

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

B0.6.19 Instrumentation and control equipment

B0.6.19.1 Main design criteria

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

B0.6.19.3 Programmable logic controllers

Programmable logic controllers (PLC) shall be deployed in subsidiary installations and systems of higher complexity and shall provide a more open access for operation. Standard products of PLC manufacturers shall be used for which software developed by the process suppliers and proven for the specialized process is available.
The diversity of makes and types shall be kept to a minimum. The Employer/Engineer reserves the right to stipulate make and type following award of contract.

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The use of auxiliary packages with PLCs or local controls for ancillary plants or systems shall be limited and minimized. Only some special cases can be considered subject to the Employer/Engineer's approval.
Typical and acceptable reasons for a specialized control system can be high speed of response or special safety requirements, which may require a separate safety-related system.

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

If only few signals are to be exchanged, parallel interfacing is preferred. Binary signals shall be exchanged via volt free signals. Analogue signals (4 - 20 mA) must be suitably decoupled.
If serial interfacing is used, the interface equipment between the PLC and the DCS must be capable of communication using an industrial standard protocol. The transmission baud rate shall be selected dependent on the application (minimum 19200 baud or higher). If commands are issued from the DCS to the PLC, the time between operator command input and PLC signal output shall not be more than 1.5 seconds. The same requirement goes for answer back signals from the PLC and updating of displays of analogue values coming from the PLC on the DCS monitor displays.

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

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

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

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

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

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

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

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

B0.6.19.4 Control cubicles

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

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

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

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

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

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

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

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

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

B0.6.19.5 Racks, junction boxes

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

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

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

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

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

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

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

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

B0.6.19.6 Mimic diagrams

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

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

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

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

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

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

B0.6.19.7 Power supply and fusing

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

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

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

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

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

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

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

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

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

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

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

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

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B0.6.19.8 Transmitters

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

In general limits (for alarms or switching actions) shall be derived from the analogue measurement value in the DCS (use of switches shall be avoided). Where binary signals cannot be derived from an analog value, **binary transmitters** e.g. temperature switches, pressure switches etc. may be used. Indicators with integrated limit switches are allowed within package units. Preferably limit switches shall be of the proximity type.
All switches shall be of robust design and reliable performance.
Temperature switches, pressure switches, level switches, and etc. shall be of the snap-action and change over type. The switches shall have an adjustable switching hysteresis. Parity checks shall be supplied for switches. (Note: Parity checks refer to the supervision of switches, i.e. it shall be supervised that switches have one defined state and are not undefined e.g. neither open nor closed. Finally this means that there have to be 2 DI to be used for each switch, one for "open" detection and one for "closed" detection.)

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

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

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

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

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B0.6.19.9 Temperature measurements

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

B0.6.19.10 Pressure measurements

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

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

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

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

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

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

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

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

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

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

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

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

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

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

B0.6.19.11 Flow measurements

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

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

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

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

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

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

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

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

Orifice plates and nozzles shall be manufactured of ANSI 316 Stainless Steel unless specified otherwise. Orifice plates shall be sized according ISO 5167-2.
Orifice plates shall be sized for a d/D ratio not less than 0.20 and not greater than 0.70. Higher rather than lower d/D ratio are preferred to minimize line restrictions. All sizing calculations shall be submitted to the Employer/ Engineer for approval.

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

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

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

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

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

Special conditions may dictate the use of devices such as:

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

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

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

Electromagnetic measurements may be used for flow measurements of inhomogenous liquids with or without solids content in completely filled pipes. The limits of application of the measuring system due to the medium parameters planned on a case-by-case basis shall be observed. Inductive flow sensors shall be of alternating field or pulsating DC field type and be for inline installation with a pipe.
The tube lining material shall be as required for the fluid and its temperature and be as specified in other chapters of this **Section B0**. The accuracy shall be 1% of the calibrated span. An overpressure security shall be provided of 50% above the maximum pressure range.
Corriolis measurements shall be used for mass flow measurements of homogenous liquids and gases without solids content in completely filled pipes, in particular for natural gases, fuel oils and solvents as well as other media with fluctuating densities. The accuracy shall be typically at 0.5% of the measured value.

B0.6.19.12 Level measurements

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

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

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

For measurement of large storage tanks, the load indication and transmitting mechanism shall be located at the base of the tank.
For the measurements of boiler separator water level, feed water tank levels etc., differential pressure transmitters shall preferably be used.

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

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

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

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

All measurement transmitters for differential pressure shall be provided with:

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

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

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

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

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

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

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B0.6.19.13 Analysers and monitoring systems

B0.6.19.13.1 Analyses of steam and water (SWAS)

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

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

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

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

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

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

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

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

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

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Analyzers shall be provided as follows:

Sample Point	Analyzing Required
Condenser make up water	specific Conductivity
Condensate pump discharge water	pH, cation Conductivity, DO
Condensate at deaerator inlet water	pH, specific Conductivity
Deaerator effluent water	pH, DO
Economizer inlet water	pH, cation Conductivity, DO
Boiler blow down steam	pH, specific Conductivity
Saturated steam	cation Conductivity, SiO2, Na
Main steam	cation Conductivity
HP5 heater drain water	pH, specific Conductivity
Closed cooling water	pH, specific Conductivity

Note:

DO: Dissolved Oxygen

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

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

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

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

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

B0.6.19.13.2 Effluent Monitoring

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

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

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

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

Following kind of analyzers shall be considered at least:

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

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

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

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

B0.6.19.13.3 Potable water quality monitoring system

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

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

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

B0.6.19.13.4 Quality monitoring for fuel

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

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B0.6.19.13.5 Analysis of exhaust gas (CEMS)

The analysis of O_2, CO, CO_2, NO_X, SO_2, particulate matter (opacity) in the exhaust gas shall be performed by appropriate analyzers of proven type.

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

The reliability and response time of the O_2-analyzer shall be of the quality required for closed-loop control. The accuracy of the system shall be better

than 2.0% of the span and the drift shall be not more than 0.1% O_2 per week. A zirconium oxide measuring cell shall be used. Maintenance shall not be more than once a week.

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

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

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

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

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

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

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

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

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B0.6.19.13.6 Ambient air quality monitoring system (AAQMS)

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

The AAQMS stations shall contain at least the following:

- Analyzers for SO_x, NO_x, CO, O_3, mercury
- Multi gas calibration system
- PC based data logger
- UPS
- Suspended particulate monitors (TSP)
- Sampling inlet heads

Metrological station shall include at least:

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

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

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

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

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

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

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

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

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

Data loggers for the metrological station shall be provided with the necessary analogue and digital inputs and internal memory for all collected parameters. The data loggers shall have the capacity for future extension with additional sensors.
Location for centralized data collection PC stations shall be decided during basic/detailed design stage

B0.6.19.14 .Electrical value measurements

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

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

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

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

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

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B0.6.19.15 Control valves

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

000206

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

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

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

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

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

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

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

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

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

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

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

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

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

For normal duty globe type valves shall be used.

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

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

Angle valves shall be provided.

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

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

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

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B0.6.19.16 Actuators

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

000208

Unless otherwise specified actuators for modulating valves and dampers shall either be pneumatic or electrically operated. Self contained sealed hydraulic units may be considered where high thrusts or high speeds of operation are required.

Actuators for ON/OFF duty or manually positioned units shall generally be electrical motor and/or pneumatic driven, however the use of solenoid types on small valves shall be allowed dependent on duty.

The various types and sizes of actuators shall be rationalized and as far as possible each type shall be from a common manufacturer to facilitate interchangeability and spares.

In order to prevent the risk of fire or explosion pneumatic actuators shall be used in hazardous areas and associated equipment (e.g. positioners) must be intrinsically safe in accordance with IEC 60079-11.

Pneumatic actuators must be designed in such a way that in the event of air failure the actuator will remain in the position immediately prior to loss of power, or assume a position which is safe for the process.

With either action the failure mode shall be suitably monitored and the Plant operator informed by some form of alarm. The failure response of all actuators in the event of the loss of the prime mover (air pressure, oil pressure, electrical power) shall be indicated on the Piping and Instrumentation (P&I) diagrams, valve schedules, etc.

All pneumatic tubing to control drives or actuators shall, unless otherwise agreed to by the Employer/Engineer, be in copper which shall be sheathed in PVC or alternatively in stainless steel.

For all actuators of control valves and dampers of main systems local indicating pointer and position transmitters for remote indication and closed loop feedback shall be provided in accordance with the most severe operating conditions to be expected. The transmitters shall be designed to withstand conditions such as high temperature, vibrations and leakage of steam and of hot water wherever required. The protection class shall be IP 65 according to IEC 60529.

All actuators shall have a handwheel for direct manual operation. The diameter of the handwheel and geared effort shall be such that they can be reasonably operated by one man. A lockable mechanical clutch mechanism shall be provided to inhibit power control of the actuators when the handwheel is operated.

The speed of response of actuators used for modulating control shall be chosen to suit each particular application. Facilities shall be provided for limiting the actuator movement in each direction.

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Special attention must be paid to adequately dimensioned drives and care must be taken to avoid any unintended displacement of the actuator on sudden rises of pressure in the piping.

Actuators shall have fail safe operation and actuator locking device in the event of abnormal conditions. Any abnormality on the valve shall be transmitted to the DCS.

All electrical actuator drives necessary for the safe operation and shut-down of the Plant in the event of 0.4 kV switchgear failure shall be connected to the UPS.

B0.6.19.17 Solenoid valves

In lines with nominal diameters of up to DN 25, as well as for piloting pneumatic actuators, suitable solenoid valves shall be used. Valves with power ratings up to 30 W shall be controlled directly at 24 V DC from the DCS. For powers over 30 W, solenoid valves for 230 V AC shall be employed. Solenoid valves for 110 V, 230 V AC and above shall be secured with blade fuses. Electrical connections are made by means of plug connectors, with the mating connector forming part of the scope of supplies.

B0.6.19.18 Cabling and wiring

The general requirements for cabling are as stated under relevant chapter in **Section B0**.

In particular, wiring within desks and panels shall be supported on trays and shall be segregated according to voltage level. Wiring carrying AC and D.C. voltage shall also be segregated.

All desks, panels, cubicles and racks shall be factory-wired with regard to the internal connections. Where desks or panels will be supplied in more than one Section, electrical connections between the Sections shall be via terminal strips provided for this purpose.

All cables must be provided at both ends, at every 20 m and every bend with identification with identification in the form of numbered labels corresponding to the coding system. The individual cores will be numbered or identified by colour-coding.
Instrumentation cables will be identified by colour codes and band marking, follow VDE 0815. The cables must be laid to ensure that they can be replaced or renewed in a simple manner.
Spare cores shall be terminated at terminal strips in such a way as to give a maximum length of core and shall be ferruled in such a way as to indicate that they are spare cores.

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All instrumentation cables including both prefabricated and non-prefabricated type shall be with Fire Retardant Low Smoke (FRLS) type Poly Vinyl Chloride (PVC) overall sheath. For cables that are exposed to ambient temperatures above 60°C, teflon or silicone cables are to be provided. For safety related equipment fire surval cables shall be provided. The cables must be suitable for laying indoors, in the open (direct or indirect sunlight), in ducts, on trays, in the ground and in water. The cables must be resistant to solar radiation, the effect of oil, seawater, bacterial action, insects and rodents. Shields for individual pair and overall shield shall be provided for cables for analogue signals. Cables for binary signals shall have an overall shield. Multipair cables of 0.5 sq. mm, shall be used extensively for I&C cables, wherever required, prefabricated cables may also be used.

For thermocouple measurements compensation cable NiC r-Ni 2x0.5sq. mm or 4x0.5 sq. mm with silicone insulation and pair screen will be used. Fiber optic cables shall be provided for Remote I/O bus, CCTV, Station LAN etc.

The fiber and cable specifications shall comply with ITU-T Recommendation G652 and the relevant IEC standards. Each fiber cable shall be supplied with at least 50% spare cores. A minimum number of four spare cores are required.

Suitable fiber optic cable junction boxes, patch panels and patch leads shall be provided. These shall conform to the following:

- They shall support, organize, and protect the optical fibers and the fiber splices whilst ensuring that the optical fiber minimum-bending radius is not exceeded.
- The splice tray shall not have any sharp edges or protrusions that may damage the optical fiber cable.
- They shall provide entry for all cables.
- Include number tags for tube and fiber identification.
- They shall provide mounting positions for the bulkhead mounted connectors on which the cable will be terminated.
- They shall allow patching of fibers.
- Outdoor mounted boxes shall be rated to IP65 in accordance with IEC 60529.

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The junction boxes/ patch panels shall have a fiber capacity equal to the total number of fibers (connected and spares) for all cables to be connected. Patch panels shall be designed for 19-inch rack mounting within a standard equipment cabinet.

All unused couplings shall have protective dust covers. The patch area in patch panels shall be accessible and covered behind a door or removable cover.

000211

Sufficient factory manufactured patch cords with suitable colour coding shall be provided.

Fiber optic connectors shall be standardized for ease of maintenance.

B0.6.19.19 Instrument and measuring impulse piping

Instrument impulse piping shall be supported at intervals as defined in BS 6739. The correct size of tube clips shall be used to suit the tube outside diameter.

The Contractor shall fabricate and erect all mounting brackets for control and monitoring apparatus including all pressure switches and miscellaneous instrumentation. If it is found after commissioning that any mounting frame vibrates excessively under operating conditions, instruments within the frames shall be isolated with vibration dampers by the Contractor or moved to areas of low vibration.

Impulse lines shall have venting, draining and blowdown facilities. Impulse lines between process and sensor shall be as direct as possible and shall include allowance for vibration and vertical and horizontal movement. Joints in impulse lines shall be kept to a minimum.

All pneumatic instrument lines shall be soap tested and any leakage shall be rectified.

While process instrument lines are being pressure tested all instruments shall be completely isolated or disconnected.

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B0.7 Inspection and Testing

B0.7.1 General

This Section contains general requirements for inspection of material, parts, equipment and workmanship of the Plant during manufacture, assembling and erection and upon completion to demonstrate compliance with specification, codes and standards and to ensure overall reliability of Plant operation and performance.

Development and implementation of test procedures for the construction inspection, start-up and performance testing and capacity demonstration of the Plant shall be the responsibility of the Contractor.

The Contractor shall be responsible for providing all supplies required for carrying out such tests, except to the high speed diesel and coal used during Reliability Test Run and Performance Tests.

000212

The overall testing program for the Project shall consist of the following:

- workshop inspections and testing
- construction inspections, and testing
- mechanical completion
- pre-commissioning tests
- tests on completion
- reliability test run and performance tests.

The Employer shall have the right to have their representatives present during inspections and tests of Plant equipment and systems in the workshops and during construction. The presence of the Employer's representatives during any inspection or test shall in no way relieve the Contractor of its responsibility for supplying the equipment or systems in accordance with the milestone dates.

The Employer will be notified by the Contractor in writing at least ten (10) days prior to such testing and inspection at workshop and two (2) days for test at site.

Three (3) months after effective date of Contract, the Contractor shall submit to the Employer all relevant test documents, which shall include:

- inspection and test program
- test standards
- type of inspection and tests
- tests which are to be witnessed by third parties.

Six (6) months prior to the proposed start of commissioning the Contractor shall submit to the Employer:

- commissioning test program
- commissioning procedures
- tests on completion.

Six (6) months after effective date of Contract the Contractor shall submit to the Employer for the Performance Tests:

- test program
- test standards
- manpower and deployment schedule of the Contractor for performing the tests forms of test records and report
- description of instrumentation to be used, including accuracy, and calibration test results
- method of data recording
- method and equations/correction curves used for adjustment of recorded data to the design conditions.

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The results of all tests shall be certified by the manufacturer, Contractor or independent agency as appropriate.

Document files containing material certificates, welding procedures, test report etc. shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

B0.7.2 Testing during manufacturing

B0.7.2.1 Material tests

Major steel forgings
Purchase specifications shall clearly state the quality and inspection requirements and should include:

a. Chemical composition range
b. Heat treatment
c. Mechanical test specimen locations
d. Mechanical properties
e. Magnetic properties (when applicable)
f. Non-destructive testing
   - methods and procedures
   - stage and extent of application
   - recordable indication size
   - allowable indication size
g. Thermal stability test (HP and reheat turbine shafts only).

Each forging shall be suitably marked with an identification number which shall transfer throughout all machining stages. The identification number shall be indicated on all documents relating to the forging.

Repair welding will not be permitted on rotating parts and on other components the proposal will be subject to approval by the Employer's Representative.

Rotor forgings
The profile of forgings at the stage of final ultrasonic inspection should be such as to minimize the regions where complete coverage is not possible. Ultrasonic indications should be measured by the equivalent flat bottomed hole or AVG (DGS) method.

The toughness of rim and core (where applicable) material shall be evaluated by testing Charpy V impact specimens over a range of temperatures and thus determining the 50% fibrosity fracture appearance temperature (FATT).

Allowable indication size and material toughness are interdependent design related criteria and the Contractor must be prepared, if requested by the Employer's Representative, to justify his proposals by reference to fracture mechanics calculations.

Bores, when provided, shall be magnetic particle inspected and a suitable intrascope used for examination.

Residual stress measurement shall be provided for rotor forgings.

Major steel castings
Purchase specifications shall clearly state the quality and inspection requirements and should include:

a. Chemical composition range
b. Heat treatment
c. Mechanical test specimen locations
d. Mechanical properties
e. Non-destructive testing
   - methods and procedures
   - stage and extent of application
   - recordable indication size
   - allowable indication size
f. Other tests
g. Standard weld repair-procedure

Each casting shall be identified by hand stamped or cast-on reference numbers which shall be indicated on all documents relating to the casti

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Non-destructive testing
Minimum requirements are as follows:

a. Crack detection of critical areas of castings which in the case of castings to operate at high temperature or high pressure shall consist of 100% of all accessible areas. Magnetic particle inspection shall be used for ferritic steel castings.
b. Ultrasonic inspection of all surfaces of castings to operate at high temperature or high pressure.
c. Ultrasonic thickness check of critical areas.
d. Radiographic examination adjacent to future butt weld regions (Acceptance Standard Level 1 of ASTM E446 or E186 as appropriate).
e. Radiographic examination shall also be used to assist in defining defects indicated by ultrasonic inspection.
f. Blue matching on the parting plane between upper half and lower of the turbine casing
g. Creep test shall apply for high chrome casting and forging, in particular when used for more than 540°C.

000215

In addition to being applied as necessary quality control on as cast items, inspections outlined in a) and b) above shall be applied to the finally heat treated casting.

Prior to non-destructive testing all surfaces shall be satisfactorily prepared and visually examined.

Either colour matching of casting by putting two halves together or feeler gauge thickness check from outside to ensure required contact area and joint tightness are acceptable

Repair Welding

Unacceptable defects observed by visual examination or indicated by non-destructive testing shall be excavated by chipping or thermal gauging and grinding and their complete removal proved by crack detection.

In the case of excavations which penetrate more than 25 mm or 50% of the wall thickness or cover more than 10,000 mm^2 area the Employer's Representative written approval of the proposed repair must be obtained.

Only welders qualified by performance tests on similar cast materials shall be used.

On completion of repair welded areas shall be ground smooth and carefully blended into the surrounding material. The repaired areas shall be surface crack detected; magnetic particle inspection being used for ferritic steel castings and in addition ultrasonic inspection shall be used on castings to operate at high temperature or high pressure.

After repair weldings hardness shall be checked.

Steel Plates and Sections

The following requirements, which may be supplementary to the applicable material standards, shall be considered when selecting material grades:

- impact testing of plate or Sections over 50 mm thick (impact requirements to be dependent on application).
- ultrasonic testing of plate where the presence of non-metallics may interfere with the interpretation of ultrasonic testing of future welds;
- ultrasonic testing and through thickness ductility measurement, where the application involves the risk of lamellar tearing in the material at regions of high restraint (e. g. at set-on nozzle locations or cruciform joints);
- ultrasonic testing clad materials to detect lack of bonding. (Proposed rectification procedures shall be submitted for the approval of the Employer's Representative).

Reinforced Thermosetting Resin Pipes

Checks shall be made on all raw materials to ensure that they comply with the relevant ASTM Standard.

000216

All deliveries of resin shall be checked for consistency by viscosity and reactivity. Any resins deviating from the manufacturer's published figures shall not be used.

Testing of reinforced thermosetting resin pipes:

- Long term hoop strength (type test for pressure pipes only)
- In accordance with ASTM D2992 Procedure B with the exception that the test results shall be extrapolated to determine the stress which the pipe can withstand for a period of 60 years without failure. The lower 95 % confidence limit at 60 years shall also be calculated.
- Hydraulic test
- 100 % of the pipes shall be subjected to an internal hydraulic pressure test at the manufacturer's works prior to delivery. The test shall be applied to a pressure equal to 1.5 times the maximum working pressure stated for each classification of pipe. The test pressure shall be applied for a minimum period of 5 minutes without signs of leakage.
  In addition to the above the first pipe and every thirtieth thereafter of each class and diameter shall be maintained at test pressure for a minimum of 4 hours without signs of leakage.
- Each pipe and fitting shall be subjected to an internal low pressure air test at the manufacturer's works prior to delivery. The test pressure shall be an overpressure of 0.1 bar and this shall be applied for a minimum period of 5 minutes without signs of leakage or distress. Fittings which are of mitred construction shall be manufactured from pipes which have successfully passed the tests defined above.
- Dimensions
  The dimensions and tolerances of all pipes shall be determined in accordance with the relevant standards (e.g. DIN 16965, DIN 16964, DIN16867, DIN 16868, DIN EN 14364)
- Stiffness
  A minimum of one pipe for every 30 pipes manufactured shall be tested for stiffness in accordance with AD 2000 HP110R and N1. A minimum of one pipe of each class and diameter of pipe shall be tested.
- Longitudinal and hoop tensile strength
- The tensile strength properties of a minimum of one pipe for every 100 pipes manufactured shall be measured in accordance with AD 2000 HP110R and N1. A minimum of one pipe of each class and diameter of pipe shall be tested.
- Cure
  Curing, to be tested by the Barcol Hardness test determined in accordance with DIN EN 59: 100% of the produced pieces. Minimum acceptable hardness is 90% of the value recommended by the resin manufacturer of the particular resin used, when non-reinforced.
  The sample pipe shall also withstand a commercial acetone test on the internal portion of the laminate.

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- Loss on ignition
  A minimum of one pipe for every 30 pipes manufactured shall be tested in accordance with ASTM-D 2584 "Standard Method of Test for Ignition Loss of Cured Reinforced Resins".
- Joint tests
- A minimum of two pipes in every 100 pipes manufactured shall be jointed and tested in accordance with the requirements of **Section 7.2 of ASTM-D 3262**.
- Visual inspection
- Each pipe and fitting shall be subjected to a complete visual inspection before shipment in accordance with ASTM-D 2563.
- Vacuum test
- Vacuum test for those piping Sections being operated under vacuum shall be carried out for each diameter once at beginning of production. The vacuum to be applied shall be equivalent to the condition which occurs during full vacuum. The corresponding derated vacuum for this test shall be proved by the pipe manufacturer.
- Failure of tests on completed pipes
- In the event of a specimen not fulfilling the minimum requirements for strain corrosion resistance, all pipes of that class and diameter which have been manufactured shall be rejected and shall be replaced entirely.

Any pipe or fitting which fails any of the quality control tests which are to be carried out on each and every pipe or fitting shall be rejected. In the event of any pipe failing any of the remaining tests outlined above that pipe shall be rejected and the relevant test shall be carried out on a further ten pipes of that class and diameter. If any one of these ten pipes fails than the manufacture of pipes of that class and diameter shall cease and the Employer reserves the right to reject all the pipes of that class and diameter.

Thermal insulating materials
Materials shall be tested for bulk density, specific heat, compressive strength, fire resistance under pressure, service temperature limit in accordance with VDI 2055 or equivalent standards.

HP Piping
Ultrasonic inspection of all HP piping shall be performed at manufacturers place and proven by certificates.

B0.7.2.2 Manufacturing tests

RT is not carried out for pulverizer component.

B0.7.2.2.1 Welding tests

Non destructive examination of pressure and vacuum containment welds
Welds shall be non-destructively tested in accordance with the construction

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standard applicable to the item of plant. In addition the requirements of the following Table 1 shall be observed. Table 1 shall also apply in cases where the standards used for design and construction of an item of plant does not specify the quality requirements for welds. Fault limitations to be subject of agreement with the Employer's Representative prior to fabrication. Hardness testing shall determine the hardness for welds and heat affected zone according to all scale i.e Vickers (HV10) , HRC and HB.

Non destructive examinations of steam turbine internal piping will be performed by Radiographic examinations.

The Bidder/Contractor has to fulfil the requirements specified in ASME B31.1 and the stricter requirements of the VGB Guideline R 503.
For turbine internal piping 15% of welds will be checked by radiographic testing. If failures are detected the intensity of testing will be increased which means even more than 15% of the welds will be tested.

Hydraulic tests for steam turbine internal prefabricated pipe systems must not be executed, in case equivalent non destructive examinations of steam turbine internal piping are performed by radiographic examinations. The requirements specified in ASME B31.1 and the stricter requirements of the VGB Guideline R 503 shall be fulfilled.

The test procedure ISO 6507-1 or equivalent shall be used. Minimum 3 hardness locations shall be tested for the weld. On circumferential welds the test locations shall be located at 120° distance. Hardness tests shall be conducted after PWHT.

Following percentages of welds shall be hardness tested.

Carbon steels or low allow steels (<2%Cr)	10%
2.5% Cr steels	50%
9 - 12% Cr steels	100%
Austenitic steels	

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TENDER NO PSER:SCT:KLN-C1984:19 (TCN-05) (TECH SPEC FOR SWM- REV-01)

THIS IS THE PART OF TECHNICAL SPECIFICATION NO. PE-TS-421-177-A001

TABLE 1

Type of Steel	Design factor (shell)	Wall thickness (mm)	Inside diam (mm)	Type and Extent of non destructive testing			Remarks
				Butt	Nozzle	Fillet	
C and C-Mn steels with C content not exceeding 0.25%	≤ 0.85	≤ 10	all	-	-	-	Only applicable to: Atmospheric systems (excluded systems, which handle chemicals, toxics or inflammable media).
		40≤	all	20% R	-	-	
		> 40	all	100% R	10% M	10% M	
	> 0.85	≤ 40	≤ 100	20% R	-	-	
			> 100	100% R	10% M	10% M	
		> 40	all	100% R	100% M	100% M	Test after stress relief
C-Mn steels with C content 0.25 to 0.35%, CrMoVsteels, C 1/2 Mo steels, low alloy steels, and CrMo steels except 12% Cr steels		≤ 30	all	20% R	10% M	10% M	
	all	> 30	all	100% R	100% M	100% M	Test after stress relief
Low alloy steels except CrMoV and 2 CrMo	all	all	all	100% R	100% U**	100% M	Test after stress relief
12% Cr ferritic/martensitic steels	all	all	≤ 100 > 100	100% R 100% R* 100% U	100% M 100% M 100% U	100% M 100% M	Test after stress relief Test after stress relief

* Radiographic examination may be omitted if done on as-welded joint

** If feasible, otherwise 100% M

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TENDER NO PSER:SCT:KLN-C1984:19 (TCN-05) (TECH SPEC FOR SWM- REV-01)

THIS IS THE PART OF TECHNICAL SPECIFICATION NO. PE-TS-421-177-A001

Type of Steel	Design factor	Wall thickness	Inside diam	Type and Extent of non destructive testing			Remarks
	(shell)	(mm)	(mm)	Butt	Nozzle	Fillet	
Austenitic Stainless Steels	≤ 0.85	≤ 15	all	-	-	-	Not applicable to Butt welds made from one side only Operating temperatures exceeding 200 °C
		≤ 30	all	20% R	-	-	
		> 30	all	20% R	10% D	10% D	
	> 0.85	≤ 30	≤ 100	20% R	-	-	
			> 100	100% R	10% D	10% D	
		> 30	all	100% R	100% D	100% D	

Legend: R = Radiographic examination
U = Ultrasonic examination
M = Magnetic particle examination
D = Dye penetrant examination

Note:

1. Where 10% examinations are shown for pipework under 100 mm diam bore this shall be the circumference of 10% of the welds by each welder selected at random with a minimum of one per welder.
2. Where 10% examinations are shown for vessels or large diameter pipework this shall be 10% of each weld length and must include all intersections of longitudinal and circumferential welds.
3. Where partial examinations reveal rejectable defects, adjacent welds or areas of weld shall be examined. In the event of rejectable defects being found welds shall be subject to 100% examination.
4. Welds in clad materials shall be tested in accordance with the requirements of the base material and the surface of the overlaid welds shall be dye penetrant tested throughout their length.

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Non-destructive examination of structural welds
Welds shall be non-destructively tested in accordance with the construction standard applicable to the item of plant. Where appropriate, the following requirements shall also be observed:

- magnetic particle testing of the tension side welds in major fabricated girders and Sections,
- ultrasonic examination of heavily restrained welds (e. g. cruciform joints) where there is a risk of lamellar tearing in the parent material.

Weld Repairs
Unacceptable defects observed by visual examination or indicated by non-destructive testing shall be completely removed by chipping or thermal gouging and grinding. The resulting excavation shall be crack detected prior to rewelding.

Details of the original defects and repair shall be recorded.
Repaired welds shall be subjected as a minimum requirement to the same inspection requirements as the original welds and test records should indicate that a repaired weld is referred to.

B0.7.2.2.2 Pressure testing

All items subjected in service to internal pressure or vacuum shall, unless otherwise agreed, be pressure tested in the manufacturer's works and at site and prior to any internal or external coating.
In case pressure test can't be executed at site NDT checking of welding shall be 100%.

Pulverizer assembly shall be excluded from Pressure testing, Required NDT will be carried out during manufacturing stage to ensure quality. (RT will not be carried out for Pulveriser Component)

Hydrostatic testing
Suitable water shall be used as the test media unless otherwise agreed. The test pressures shall be in accordance with ASME.

The test pressure shall be no less than the greater of

- the pressure corresponding to the maximum loading to which the pressure equipment may be subject in service, taking into account its maximum allowable pressure and its maximum allowable temperature multiplied by the coefficient 1.25

$$p_{test} = 1.25 * PS * f_{test}/f$$

- maximum allowable pressure, multiplied by the coefficient 1.43,

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$$p_{test} = 1.43 * PS * f_{test}/f$$

Where:

- p_{test} test pressure (hydrostatic)
- PS design pressure
- f_{test} nominal design stress for design conditions at test temperature
- f nominal design stress for design condition at design temperature

The design pressure shall be in any case not less than 3.5 bar overpressure.

Test pressure of vacuum containment items shall be agreed with the Employer's Representative. Any local legal requirement prevails.

The test pressure shall be maintained for sufficient time to permit complete visual examination of all surfaces and joints and in no cases less than specified in the applicable construction standard.

The chloride content of water used for testing austenitic stainless steel items shall not exceed 30 ppm unless immediate flushing with water of this quality is done after the test.

Pneumatic testing
The Contractor shall apply pneumatic testing in cases where hydrostatic testing is impractical or undesirable (e.g. oil pipes). Safety precautions, test pressures/duration and degree of prior non-destructive examination of the subject items shall be agreed with the Employer's Representative.

Pneumatic or gas leak testing supplementary to hydraulic testing shall be applied in appropriate cases where specified by the applicable construction standard.

B0.7.2.2.3 Testing of corrosion protection

Surface coatings
Following tests have to be performed before, during and after coating:

- visual inspection of blasted surfaces according to ISO 12944
- test the blast profile with a profile gauge
- checking of coating material
- measurement of air humidity, air temperature and coating substrate temperature and determination of dew point
- visual inspection of coating
- checking of dry film thickness (DFT); All zinc rich paint used for such repairs must contain a minimum of 81% by mass of zinc in the dry film.

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- checking of adhesion with a dolly pull adhesion tester in accordance with ASTM D4541-09 type A1

Galvanized zinc coatings
Surfaces shall be visually inspected. Bare patches, lumps blisters or inclusions of foreign matter shall be cause for rejection.

Zinc coating thickness shall be determined non-destructively in accordance with ISO 2178 or coulometrically in accordance with ISO 2177 (or ASTM equivalent). For coatings with a weight exceeding 900 g/m^2 the coulometric test method specified in ISO 2177 shall be used.

Hard rubber linings
Surfaces shall be visually inspected. Uneven surfaces, splits, blisters or inclusion of foreign matter shall be cause for rejection.

The thickness of linings shall be measured in accordance with EN 14879 or equivalent. A tolerance of + 10 % is permitted for rubber coatings of 3 mm nominal thickness.

Hardness tests shall prove compliance with the rubber manufacturer's standards.

The absence of pores shall be proved by the induction sparking test method. The potential used shall be 5000 Volts for each mm of thickness plus an additional 5000 Volts (i. e. potential of 20,000 Volts for 3 mm thick lining).

B0.7.2.2.4 Testing of pressure part assembly

Trial assembly shall be checked at the manufacturing place before shipment.

B0.7.2.2.5 Testing of auxiliary and ancillary systems

The Contractor shall provide in his ITPs the specialised checks for various equipments like idlers, pulleys, conveyor belts, coal crusher, stacker reclaimer, coal unloaders, vacuum pumps, air compressors, bottom ash handling equipments, pumps, valves, pipes, EOT & hoists, inert gas system, deluge valves, foam system

The Contractor shall also follow the requirements for testing in the **Sections B1 to B12.**

B0.7.2.2.6 Hangers

Load Test for hangers (in particular spring type) and supports in particular for HP piping shall be executed. All hangers shall be pre-loaded at the manufacturing place.

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B0.7.2.3 Mechanical equipment

Rotating units

Balance testing of rotating units
Each rotating unit shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft). However, Generator rotor will be dynamically balaned according to ISO 11342. A check balance of items that have undergone overspeed test shall also be made.

Vibration testing of rotating units
The vibration characteristics of rotating units shall be measured during performance tests. Locations of measurement and standards to be achieved shall, on request, be subject to agreement by the Employer's Representative.

Pumps
Running tests and performance tests shall be conducted on all pumps: Performance tests shall be conducted through the full operation range of the pump to closed valve conditions. Graphs indicating flow/head, flow/ power absorbed, flow/ efficiency, flow/NPSH and speed shall be produced. Results for feedpumps shall be assessed with reference to ISO 9906 class 1 (without construction tolerances), and results for other pumps to class II or III as agreed. No negative tolerance on head, capacity and efficiency and no positive tolerance on power are accepted.

The lubricating oil used in the test shall be of the same brand and grade as that recommended by the manufacturer for service use.

Dismantling of the pump for visual examination of parts for damage following test shall be done when required by the inspection standard, when considered necessary by the manufacturer, or when requested by the Employer's representative witnessing the running or performance tests. Replacement of parts following test shall necessitate repeat testing.

Clearance check of the pumps and balancing test of the impeller (acc. to VDI 20160 or eq.) shall be conducted before pump commissioning.

Pump tests shall be carried out with the motor, as supplied with the pump. In case several pumps of same size and typ are supplied, test can be carried out with the same motor.

Pumps under the scope of auxiliary package/systems shall be tested with calibrated shop motor. The high energy pumps including turbine lube oil and control oil pumps shall be tested with job motor (with the motor, as supplied with the pump).

Full load full speed/back to back locked rotor torque test for one gearbox shall be ensured.

No-load mechanical run test for boiler feed pump drive turbine as per API 612 / ISO 10437 to be ensured.

Steam turbines

The turbines shall be completely assembled with their control; on a suitable erection rig at the manufacturer's works and shall be carefully inspected and measured for manufacture and assembly tolerances.

Stop and governing valves shall be delivered and installed separately.Therefore stop and governing valves will be inspected and measured for manufacture and assembly tolerance seperately.

Functional tests shall be performed on the safety equipment (running with steam is not requested).

Important items of turbine control equipment which cannot be adequately tested during the main tests shall be separately bench tested.
Furthermore, testing shall be in accordance with IEC 60953-1 and comprise:

- balancing and overspeed test of the assembled rotor,
- measurement of radial and axial clearances,
- assembling inspection.

Minimum clearances between shaft seal casing and shaft seal ring, radial and axial blade clearances in blading section. axial and radial alignment of rotor in respect of shaft seals, alignment of overspeed governor etc. shall be ensured and verified by Bidder/Contractor.

Testing of free standing blades natural frequency and moment weight shall be performed for IP & LP blades.

All moving blades over 225 mm of active length shall be moment weighed and assembled on shaft in a prescribed sequence to ensure optimum balancing of rotor. Natural frequency of LP turbine blades shall be determined before mounting on rotors to ensure that the same are outside operating frequency range.

No load run test or a rig test at the workshop as per Bidder's/Contractor's/OEM's practice for the two main turbines is acceptable.

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Air compressors

Air compressors shall be tested in accordance with the requirements of ISO 1217 or equivalent standards. Any request for deviation from the test conditions shall be accompanied by the manufacturers' proposals for the adjustment of the correction factors contained in the standard.
Tolerances will be allowed according to ISO 5167-1.

Cooling towers
One Cooling Tower per unit shall be tested on site to an appropriate CTI standard. Any request for deviation from the test conditions shall be accompanied by the manufacturers' proposals for the adjustment of the correction factors contained in the standard.

In addition performance testing to be carried out for the whole system (all cells).

Cranes and hoists
Where size permits cranes and hoists shall be completely assembled at the manufacturers works and functional tests without load conducted.

Flue gas (IDF) and air fans (FDF, PAF, SAF)
Axial and radial fans shall be tested in accordance with the requirements of ISO 14694 or equivalent standards for vibration. ISO 12499 shall also apply. Any request for deviation from the test conditions shall be accompanied by the manufacturers' proposals for the adjustment of the correction factors contained in the standard.

Performance tests shall follow VDI 2044, ISO 5801 or equivalent standard.

Before commissioning, the following tests shall be conducted: NDT, trial assembly of casing, blue matching, and clearances.

Dampers and Gates
Large dampers and valves shall be leakage / tightness tested (type test) in the workshop and at site the whole system shall be tested.

Rotary air preheater (RAPH)
Before commissioning, the following tests shall be conducted: NDT, trial assembly of casing, blue matching, and clearances.

Coal Pulverizer
Before commissioning, the following tests shall be conducted: NDT, trial assembly, blue matching, and clearances. The tests will be carried out during manufacturing stage wherever possible.

B0.7.2.4 Electrical equipment

Electrical equipment and material which is not covered by the tests specified elsewhere in this document shall be inspected and tested in accordance with the latest edition of standards listed hereafter. Alternatively, equivalent standards approved by the Employer's Representative may be used. Type tests shall be carried out if type test certificates certified by an independent test authority are not available.

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Installation Material
IEC 60130 Connectors for frequencies below 3 MHz

IEC 60364	Low voltage electrical installations/ Electrical installations of buildings
IEC 60423	Conduits for electrical purposes

Materials for earthing and lightning protection

IEEE 80	Guide for safety in AC Substation Grounding
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface potentials for Ground system
NFPA 780	Installation of lightning protection systems

Insulators and Bushings

IEC 60383	Insulators for overhead lines with a nominal voltage above 1000 V
IEC 60507	Artificial pollution tests on high voltage insulators to be used on AC systems
IEC 60137	Insulating bushings for AC voltages above 1000 V

Surge Protection Equipment

The surge protection equipment shall be tested in accordance with IEC 60099.

AC Switchgear for voltages above 1 kV

IEC 62271	High-voltage switchgear and control gear
IEEEC37.013	IEEE standard for AC-High-Voltage generator circuit breakers on a symmetrical current.

At least the following tests shall be performed in the manufacturer's workshop on the individual apparatus and on the complete installation, respectively, all in accordance with IEC Standards:

- Visual inspection
- Power frequency HV tests
- Dielectric tests of the auxiliary circuits
- Measurement of the main contacts resistance with dc
- Temperature rise test on circuit breakers (type test certificate)
- Test of mechanical endurance (type test certificate)
- Measurement of the contact opening period (type test certificate)
- Functional tests of the control circuits
- Check of the operational sequence
- Measurement of the instrument transformer's angle and ratio errors (according to IEC-standards 60044)
- Check of the denominations.

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Note 1: All MV switchgear shall be type tested according IEC 62271-1, IEC62271-100 and IEC 62271-200 including internal arc classification IAC

= AFLR. Related type test certificates shall be provided with the Tender. If the test has already been carried out on similar type switchgear, type test certificates may also be accepted.

Note 2: All GIS above 52 kV shall be tested according IEC 62271-1, IEC 62271-203.

Type tests shall be carried out, at the expense of the Contractor and without any impact on the projects overall time schedule, if type test certificates certified by an independent test authority are not available.

Note 3: Generator circuit breakers shall be tested according IEEE Std C37.013.

High voltage fuses
IEC 60282 High voltage fuses
IEC 60644 Specification for high voltage fuse links for motor circuit applications

Oil-immersed power transformers
IEC 60076 Power transformers
IEC 60214 On-load tap-changers
IEC 60404-2 Magnetic materials

a) Tanks

- Inspection of weld preparations, approved crack detection of major strength welds.
- Hydraulic test and vacuum test
- Visual and dimensional checks
- Certification of test results.

b) Cores

- Material
  - Checks on flatness
  - Checks for absence of burrs such as may be caused by slitting, cropping and punching
  - Electrical insulated tests
  - Visual and dimensional checks.
- Assembly
  - Inspection during assembly stage, whilst core is still horizontal
  - Visual and dimensional checks on complete core
  - Checks on straightness of clamps
  - Checks on clamp welding
  - High voltage tests between core packets, clamps and belts in all relevant combinations
  - Check actual weight of core steel in magnetic circuit against design weight
  - Check that all block and sheet insulation and all spacers are in position
  - Check earthing of core packets to clamps.

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c) Windings

- Windings
  - Copper checks
  - Fewest possible number of welds
  - Quality of weld and finishing
  - Insulation on copper
  - Check for correct material
  - Check correct application to conductor
  - Visual and dimensional checks
- Winding of turns
  - Checks during winding of different Sections of winding
  - Checks on positions of starts and finishes of Sections
  - Checks on correct directions of windings of turns (Polarity)
  - Visual checks
- Assembly of windings together
  - Check on relative positions and numbers of leads
  - Check that vertical and horizontal coolant ducts are clear and to full design dimensions
  - Visual checks
- Assembly of windings on core
  - Visual and dimensional checks.

d) Leads

- Checks on disposition, insulation and support of tapping leads
- Checks on insulation support and positioning of bushing leads and provision for connection to bushings
- Checks on lead connections (crimping, brazing etc.)
- Checks on interphase connections
- General visual checks.

e) Insulation

- Checks on arrangement of petalling
- Checks on inter-phase and earth barriers
- Checks on shields
- Checks on clearance and creepage distances
- General visual checks.

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f) Coolant flow ducts

- Check that vertical and horizontal passages are clear and to full design dimensions
- General visual checks.

g) Current transformers, links and connections

- Check that built-in current transformers are in the correct leads
- Check that the connections and alternative connections are clearly marked and that the marked ratios are correct.

h) Assembly of transformer in Tank

- Check insulation between transformer and tank
- Check security of fixing of transformer in tank and of any packing used
- Check electrical clearances between tank and leads and windings
- Checks for cleanliness and freedom from debris of inside of tank
- General visual check.

i) Valves

- Check action of valves after welding into position (especially butterfly valves)
- Checks for leaks under pressure.

j) Paint work

- Checks for preparation of surfaces
- Checks for use of correct paint system
- Visual checks on general finish.

k) Conservator

- Check for leakage
- Check capacity
- Visual checks.

l) Bushings

- Check against standards
- Check that routine tests have been done
- Checks for leakage when mounted on transformer
- Checks for distortion, flaws and chips.

m) Tap-changers (on-load and off-circuit as appropriate)

- Inspection on completion of manufacture, including a review of manufacturer's stage test records and procedures
- Mechanical and electrical checks in the manufacturer's works
- Tests in accordance with the appropriate IEC or other standard as applicable
- Check ten complete cycles from end to end of the range
- Check five cycles on full current
- Check five cycles at full voltage
- Check transmitters for correct number of steps and impedance values
- Check interlocks
- Check warning, alarm and trip contacts
- Visual and dimensional checks.

n) Pumps and fans

- Checks for direction of rotation against motor terminal markings

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- Visual and dimensional checks.

o) Heat exchangers

- Checks on radiators for leaks
- Checks on radiators for paint finish and inner cleanliness
- Checks on oil-to-water heat exchangers for leaks at manufacturer's works
- Checks on oil-to-water heat exchangers for cleanliness of oil chambers and passages
- General visual and dimensional checks.

p) Processing

- Checks on pressures and temperatures with manufacturer's process charts available.

q) Control cubicles, kiosks and terminal boxes

- Checks on functioning of contactors, overloads isolators and general operation of control circuits for cooling gear
- Checks on operation of circuits for thermometers, thermal images, pressure relief valves, oil and gas operated relays, flow detectors, heaters, lights and power output sockets
- Checks on wiring arrangements and terminal boards
- Checks on weather sealing of doors, cable glands and other external features
- Visual and dimensional checks.

r) Workshop tests on complete transformer

The following routine test in accordance with IEC 60076:

- Measurement of winding resistance
- Measurement of voltage ratio and check of voltage vector
- Measurement of impedance voltage, short circuit impedance and
- load loss
- Measurement of no-load loss and current at Ur, 1.05 x Ur and 1.1 x Ur
- Dielectric routine tests in accordance with IEC 60076-3
- Test on on-load tap changers
- Insulation resistance
- Separate source voltage withstand test
- Induced overvoltage test to be carried out on all main transformers (see item 3) acc. to IEC 60076-3, table 1 (ACLD/ACSD).
- PD test to be carried out for all generator transformers, interconnecting transformers and start-up/standby transformer together with ACLD.
- Frequency response analysis.
- FRA test to be carried out on all main transformers (see item 3).

The above tests shall be carried out on all transformers.

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The following tests in accordance with IEC to be carried out as type tests (type tests shall not be repeated if type test certificates of an identical/ similar rated transformer issued by a recognized test laboratory are available):

- Temperature rise test including direct measurement of hot-spot temperature
- Measurement of the harmonics of the no-load current
- Dielectric type tests in accordance with IEC 60076-3
- Measurement of zero sequence impedance
- For the above type tests, test certificates may be accepted at the discretion of the Employer/Engineer, in place of tests on the first transformer of each basic type excepting the generator transformer. In the case of generator transformers the type tests must be carried out
- Noise measurements.
- The generator step-up transformer, the 400/230 kV interconnection transformer, the unit auxiliary and the auxiliary transformers shall be dynamic short circuit withstand tested according IEC 60076-1 & -5 either in the manufacturers workshop or in a recognized 3rd party test lab (as special test).

In addition to the above tests, the following tests shall be made as routine tests:

- Tangent delta measurements on the insulation, the method to be agreed with the Employer/Engineer
- Core insulation test on magnetic circuit
- On windings of 30 kV rating or above either:
  - ration influence voltage tests, the method to be agreed with the Employer/Engineer or
  - partial discharge measurements in accordance with IEC
- Transformer oil analysis according to IEC 60296, IEC 60567 and according IEC 62535 for detection of potential corrosive sulphur in mineral oils
- Transformer tanks, conservators, oil pipework and air cooled cooling plant shall withstand without leaking or permanent distortion, the application for 24 hours of a pressure which is such that the test pressure at any point in the equipment is twice theworking pressure at that point or 0.7 kg/cm2 plus the working pressure at the point or 0.3 kg/cm2 plus the pressure exerted at that point when the pressure relief is opened slowly by oil pressure whichever is the greatest.
- Tank vacuum & pressure test
- Pressure test of radiators
- Oil leakage test
- Pressure relief device, Buchholz relay, oil, winding meters, oil level indicator, dry cool breather, dissolved gas analyzer test / check.

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Fault withstand (fault versus time) curve for all transformers shall be submitted by the Contractor.

Over-excitation curves shall be provided by the manufacturers for the station transformers.

Separate type and routine tests shall be carried out for all accessories like bushings, bushings CTs, tap changers, cooling fans, control panels, etc.

Dry type transformers
The following routine tests in accordance with IEC 60076 shall be carried out on all transformers:

- Measurement of winding resistance
- Measurement of voltage ratio and phase displacement
- Measurement of short circuit impedance and load loss
- Measurement of no-load loss and current
- Separate source AC withstand test
- Induced AC voltage test
- Lightning Impulse test
- Partial discharge measurement.

The following tests in accordance with IEC 60076 to be carried out as type tests (type tests shall not be repeated if type tests certificates of an identical transformer issued by a recognized test laboratory are available):

- Temperature rise test
- Measurement of sound level
- Short circuit test
- Environmental Test according Class E2
- Climatic test according Class C1
- Fire behaviour test according to Class F1.

Also, Lightning impulse test shall be a type test.

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Fault withstand (fault versus time) curve for all transformers shall be submitted by the Contractor.

Separate type and routine tests shall be carried out for all accessories like bushings, bushings CTs, tap changers, etc.

Current and voltage transformers
The current and voltage transformer shall be tested in accordance with IEC 61869

Generators
IEC 60034, IEEE 115, ISO 1680 and ISO 10816.

a) Generator test report

Comprehensive test reports for the generators are to be compiled and submitted by the Contractor, which shall include:

- Description of the test method, equipment used and any limitations of the test plant.
- Copies of the oscillographs recorded with appropriate calibration data
- Open circuit saturation, short circuit and loss curves for the generator
- A performance chart of the generator (being a diagram of constant stator and rotor current curves plotted on rectangular axis of MVAr and MW load) The recommended loading, stator core end heating and stability limits shall be shown on the chart.
- Calculations of full load temperature rise for the stator, rotor and exciter. Any correction factors used to allow for different voltage current and cooling conditions shall be justified by reference to published literature or to previous type tests.
- Calculations of the efficiency of the complete generator at 100%, 75% and 50% load. Any correction factors for losses that could not be measured at routine tests shall be justified by reference to published literature or to previous type tests.
- Calculations of machine parameters (according to IEC 60034-4) such as transient reactance and time constant, sub-transient reactance and time constant, short circuit ratio, synchronous reactance, negative phase sequence reactance, zero sequence reactance, capacitance and also the harmonic analysis of the neutral current.
- Calculation of full load excitation of the machine at rated power factor lagging and at unity power factor, excitation V curves.

b) Routine tests on generator

- Generator stator frame
  - hydrostatic test (if H2 cooling)
  - resistance check of temperature detectors
  - Generator rotor
  - ultrasonic examination
  - mechanical balance
  - over-speed test
  - measurement of 50 Hz rotor impedance (at 3000 RPM).
- Stator core laminations
  - Magnetization of stator core laminationlayer resistance between the layers of the core
- Generator H2 cooler (if H2 cooling)
  - hydrostatic test
- Generator assembled:
  - three phase short circuit characteristic test and current balance check
  - dielectric test

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- measurement of insulation resistance
- measurement of winding resistance
- open circuit characteristic test and voltage balance, phase sequence check
- segregation of mechanical loss and core loss
- segregation of stray load loss
- efficiency calculation
- unbalanced load test for negative-phase sequence and zero sequence reactance
- shaft voltage measurement
- oscillographing of verified voltage wave form and harmonic analysis
- measurement of vibration
- polarization index
- tan delta measurement of complete winding
- bearing insulation resistance.

c) Type tests on generator (as far as type test certificates are not available)

- Sudden short circuit test at reduced voltage (30%, 50% and 70% of rated voltage), extrapolated to 100% voltage
- Equivalent heat run test consisting of:
  - windage and friction heat run, open circuit heat run at 105% rated voltage, short-circuit heat run at rated line current, open-circuit heat run at rated line voltage
  - measurement of open-circuit direct-axis transient time constant
  - noise measurement
  - moment of inertia
- Measurement of excitation response time*)
  - overall characteristic coupled with generator and AVQC cubicle at no load*)

*) applicable to assembled unit consisting of generator, exciter and voltage regulator, may be carried out on site

Type tests shall be carried out if type test certificates (Not older than 5 years as on date of bid opening) certified by an independent test authority are not available.

Sudden short circuit test shall be carried out in line with IEC at voltage level to be finalized during detailed engineering.

d) Routine tests on generator exciter

- Resistance of windings
- Insulation resistance
- High voltage tests
- Short-circuit characteristic
- No-load characteristic.

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Motors
IEC 60034, ISO 1680, ISO 10816

- Type tests (each motor type) as far as type test certificates are not available
  - measurement of starting (locked rotor) current and torque
  - power factor and efficiency measurement
  - heat run test
  - noise measurement
  - temperature rise measurement
- Routine tests (each motor)
  - measurement of winding resistances
  - measurement of shaft current
  - no-load and current measurement
  - no-load short circuit measurement
  - open circuit secondary induced voltage test at stand still (wound rotor)
  - dielectric test (high voltage test)
  - measurement of insulation resistance
  - overspeed tests (120% for 2 minutes)
  - check of motor vibrations
  - oscillographic measurement of starting current.

Emergency diesel sets
All relevant routine and type tests according to:

ISO	3046	Reciprocating internal combustion engines - Performance
ISO	8528	Generating sets with reciprocrating internal combustion engines

a) Type tests
The diesel generator unit (DGU) and all auxiliary equipment shall be fully type tested. These tests shall include all type tests as defined in the relevant latest IEC and ISO recommendation (as a minimum requirement).

Evidence shall be given that the DGU together with the auxiliary equipment to be provided, under these specifications, have successfully passed all type tests of design, service frequency, impulse, insulation level, dynamic operating range, and electrical and mechanical endurance performance, as appropriate and as specified.

However, if deemed necessary, the Employer shall decide if additional tests are required to be performed by the Tenderer/Contractor.

The Tenderer/Contractor shall supply certified copies of type test certificates covering the proposed DGU of similar capacity or higher, operating range, data features, design and construction.

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b) Sample tests

Sample Tests shall be performed, comprising as a minimum the following tests:

- Visual checks and measurements of dimensions
- Functional tests.

c) Routine tests

The Tenderer/ Contractor is required to carry out routine tests on each assembled and finished diesel generator unit and its relevant auxiliary equipment to demonstrate the integrity of the system.

Routine test certificates shall be submitted for the Employer's review and approval before shipment of the DGU.

The DGU shall pass all the routine tests as laid down in the relevant latest revisions of IEC & ISO Standards. In addition, the visual Inspection, which shall determine conformity of the DGU & the relevant equipment with the requirement, shall be part of the routine tests.

The acceptance test for the diesel engine at the Manufacturer's workshop test bed shall include the measurements, calculations and functional checks stated in ISO 3046-1 (E).
A test report in English shall be issued according to ISO 3046-1 (E) giving evidence of the following data:

- Engine model, order No., rated output, operating speed, number of cylinders, bore, stroke, compression ratio, cylinder displacement, no. of strokes, date of test, the Employer's name, inspector's name, ambient air temperature, relative humidity, barometric pressure, fuel specific gravity, fuel net calorific value, setting data of injection pump, firing sequence, valve timings, type of fuel oil filter, type of lube oil filter, type of turbocharger and inter-cooler, type of governor, type of injectors.

The Tenderer/Contractor shall submit together with the test report a certificate showing the emission levels of the exhaust gases: NOx, CO and PM (particulate matter).

The diesel engine shall be proven to be capable of operating in steady state condition on all above mentioned loads. If the diesel engine fails to operate in steady state condition on one or more loads, this engine type shall be not accepted for the scope of the diesel generator units.

d) Special tests

The diesel engine shall be at least tested in total for one hour at the following loads:

• Warm-up of the diesel engine	as required
• 25 % load operation	10 minutes
• 50 % load operation	10 minutes

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- 75 % load operation 10 minutes
- Full load operation 20 minutes
- 110 % load operation 20 minutes
- Cool down of the diesel engine.

During the test run, temperatures, pressures and fuel consumption shall be measured and recorded.

The diesel engine shall be proven to be capable for operation in steady state condition on all above mentioned loads. If the diesel engine fails to operate in steady state condition on one or more loads, this engine type shall not be accepted.

Low voltage switchgear
The following standards and regulations or equivalent shall be used:

IEC	60947	Low-voltage switchgear and control gear
IEC	61439	Low-voltage switchgear and control gear assemblies
IEC	60529	Degrees of protection provided by enclosures (IP Code)
IEC	60898	Specifications for circuit-breakers
IEC	60079	Electrical apparatus for potentially explosive atmospheres
IEC	60947	Regulations for low-voltage switchgear

The "Design Verification" of all low voltage switchgears/ motor control centers shall be carried out by following methods:

- "Testing" for the Pos. No. 1., 2., 3., 4., 5., 9., 10., 11., 12. and 13 of IEC 61439-1/Annex D, Table D.1
- "Assessment" for the Pos. No. 6., 7. and 8 of IEC 61439-1/Annex D, Table D.1

In addition to the above tests for which certificates shall be submitted, at least the following tests shall be performed in the manufacturer's workshop on the individual apparatus and on the complete installation, respectively, all in accordance with IEC Standards:

- Visual inspection
- Power frequency HV tests at main circuit
- Dielectric tests of the auxiliary and control circuits
- Functional test of the control circuits
- Check of the operational sequence.

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Capacitors

IEC	60831	Shunt power capacitors
IEC	60871	Shunt capacitors for A.C. power systems
IEC	60931	Shunt power capacitors
IEC	60143	Series capacitors for power systems
IEC	60358	Coupling capacitors and capacitor dividers
IEC	60384	Fixed capacitors for use in electronic equipment

Batteries, charging equipment inverters and DC/DC converters

IEC	60086	Primary batteries
IEC	60119	Recommendations for polycrystalline semiconductor rectifier stacks and equipment
IEC	60146	Semiconductor converters
IEC	60896	Stationary lead-acid batteries
IEC	61204	Low voltage power supply devices DC output

Chargers and batteries shall be tested together in the factory. Testing of chargers and batteries together at site will also be accepted. All factory tests shall be repeated at site.

Chargers

- Visual inspection (to be repeated on site)
- Functional tests (to be repeated on site)
- Heat run (type test)
- Output voltage stability measured for 25% load steps
- Ripple voltage measurement without connected battery
- Ripple measurement (voltage and current) with connected battery (at site will also be accepted.
- Insulation test (to be repeated on site).

Batteries

- Visual inspection (to be repeated on site)
- Insulation test (to be repeated on site)
- Charge test and discharge tests

Fuse Box

- Visual inspection (to be repeated on site)
- Functional tests (on site)
- Insulation test (on site)

Inverters and DC/DC converters

- Visual inspection (to be repeated on site)
- Functional tests (to be repeated on site)
- Heat run (type test)
- Insulation test (to be repeated on site).

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Lamps and accessories

IEC	60081	Double-capped fluorescent lamps
IEC	61347	Lamp control gear
IEC	60921	Ballasts for tubular fluorescent lamps
IEC	60155	Glow starters for fluorescent lamps
IEC	60598	Luminaries
IEC	60188	High-pressure mercury vapor lamps
IEC	60400	Lampholders and starter holders for tubular fluorescent lamps
IEC	60901	Single-capped fluorescent lamps
IEC	60662	High pressure sodium vapor lamps
IEC	60192	Low pressure sodium vapor lamps
IEC	60923	Auxiliaries for lamps
IEC	61347	Part 2-13: lamp control gear for LED Modules
IEC	62031	LED modules for general lighting - Safety specifications
IEC	62560	Self-ballasted LED-lamps for general lighting services by voltage > 50 V - Safety specifications
IEC	62612	Self-ballasted LED-lamps for general lighting services by voltage > 50 V - Perforce requirements
IEC	62471	Photobiological safety
IEC	62384	DC or AC supplied electronic control gear for LED modules - Perforce requirements
IEC	60838	Part 2-2: miscellaneous lampholders - Connectors for LED-modules
IEC/PAS	62717	LED Modules for general lighting - Performance requirements
IEC/PAS	62722	Luminares Performance

HV-, MV- and LV-cables

All relevant routine and type tests according to:

IEC	60060	High voltage test techniques
IEC	60071	Insulation co-ordination
IEC	60230	Impulse tests on cables and their accessories
IEC	60811	Common test methods for insulating and sheathing materials of electric cables
IEC	60840	Power cables with extruded insulation and their accessories for rated voltages above 30 kV up 150 kV
IEC	62067	Power cables with extruded insulation and their accessories for rated voltages above 150 kV up 500 kV
IEC	60502	Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV

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a) LV-cables

LV cables shall be workshop tested as per IEC 60502-1 with the following tests as a minimum:

Type tests:

- electrical type tests acc. to: IEC 60502 - 1 Clause 17
- non electrical type tests acc. to: IEC 60502 - 2 Clause 18.

Also following additional type tests shall be carried by the Contractor at their own cost prior to the first shipment of all offered cable if no type test certificates of identical cables are available:

- Fire Resistant according to IEC 60331, BS 6387
- Flame Retardant according to IEC 60332
- Low Smoke Test according to IEC 61034
- Halogen Content Test according IEC 60754
- Water Tree Test of XLPE Insulation (accelerated)
- Test voltage = 3 x Uo
- Test frequency = 500 Hz
- Core environment = 400C water
- Duration of test = 4 month
- Test after 4 months: Dielectric stress withstand >14kV/mm.

Moreover, test certificates shall be provided, proving that each cable type to be used has successfully passed type tests as required by the applicable standards during the last 12 months before award of contract. Otherwise, these tests have to be repeated or sample Sections.

Routine tests: according IEC 60502 – 1, Clause 15

- measurements of electrical resistance of conductors according to Clause 15.2
- voltage tests according to clause 15.3.

Sample tests: according IEC 60502 – 1, Clause 16

- conductor examination according Clause 16.4
- check of dimensions according Clause 16.5 to 16.8
- hot set test for EPR, HEPR and XLPE insulations and elastomeric sheath according Clause 16.9.

b) MV-cables

MV cables shall be workshop tested as per IEC 60502-2 with the following tests as a minimum:

Type tests:

- electrical type tests acc. to: IEC 60502 - 2 Clause 18
- non electrical type tests acc. to: IEC 60502 - 2 Clause 19.

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Also following additional type tests shall be carried by the Contractor at their own cost prior to the first shipment of all offered cable if no type test certificates of identical cables are available:

- Fire Resistant according to IEC 60331, BS 6387
- Flame Retardant according to IEC 60332
- Low Smoke Test according to IEC 61034
- Halogen Content Test according IEC 60754
- Water Tree Test of XLPE Insulation (accelerated)
- Test voltage = 3 x Uo
- Test frequency = 500 Hz
- Core environment = 400C water
- Duration of test = 4 month
- Test after 4 months: Dielectric stress withstand >14kV/mm.

Moreover, test certificates shall be provided, proving that each cable type to be used has successfully passed type tests as required by the applicable Standards during the last 12 months before award of contract. Otherwise, these tests have to be repeated on sample Sections.

Routine tests: according IEC 60502 – 2, Clause 16

- measurements of electrical resistance of conductors according to Clause 16.2
- partial discharge test according to Clause 16.3 on cables having cores with conductor screens and insulation screens in accordance with Clause 7.1 and 7.2
- voltage tests according to clause 16.4.

Sample tests: according IEC 60502-2 Clause 17

- conductor examination according Clause 17.4
- check of dimensions according Clause 17.5 to 17.8
- voltage test for cables of rated voltages above 3.6/6 (7.2) kV according to Clause 17.9
- hot set test for EPR, HEPR and XLPE insulations and elatomeric sheath according Clause 17.10.

c) HV-cables

The 230 kV XLPE-Insulated Single-Core Underground Cables and Accessories shall be tested as per latest IEC 62067 including all subsequent amendments and relative standard. The Employer/Engineer shall witness the required Type and Sample tests.

The approval of the Employer/ Engineer or the passing of any such inspection or test will not however, prejudice the right of the Employer/ Engineer to reject the 230 kV XLPE-Insulated Single-Core Cables and accessories if it does not comply with the Specification.

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Defects discovered during the type/routine/sample tests shall entitle the Employer/Engineer to reject the cables/accessories fabricated for this Project.

The Tenderer/ Contractor shall fabricate without additional cost the cable lengths and accessories necessary for the tests, over and above those required to complete the Works at Site.

For the definitions of the Type Tests, Sample Tests, Routine Tests and Tests after installation, reference shall generally be made to the relevant IEC Standards.

HV cables and accessories shall be workshop tested as per IEC 62067 with the following tests as a minimum:

Type tests on cable systems: according clause 12:

- Electrical type test according Clause 12.4
  - Check of insulation thickness acc. to Clause 12.4.1
  - Bending test on the cables acc. to Clause 12.4.4 followed by installation of accessories and a partial discharge test acc. to Clause 12.4.5
  - Tan δ measurement acc. to Clause 12.4.6
  - Heating cycle voltage test acc. Clause 12.4.7
  - Partial discharge test acc. to Clause 12.4.5 (at ambient and at high temperature)
  - Switching impulse voltage test acc. to Clause 12.4.8
  - Lightning impulse voltage test followed by a power frequency voltage test acc. to Clause 12.4.9
  - Test of outer protection for joints
  - Examination of cable system with cable and accessories after completion of tests acc. to Clause 12.4.10.
  - Tesitivity of semi-conducting screen acc. to Clause 12.4.11.

- Non electrical type tests according to Clause 12.5
  - Check of dimensions acc. to Clause 12.5.1
  - Tests for determination the mechanical properties of insulation acc. to Clause 12.5.2
  - Tests for determination the mechanical properties of oversheats acc. to Clause 12.5.3
  - Aging tests acc. to Clause 12.5.4
  - Pressure test at high temperature on oversheets acc. to Clause 12.5.6
  - Other test on oversheets according to the type used.
  - Hot set test for XLPE insulation acc. to Clause 12.5.10
  - Measurement of carbon black of black PE oversheats acc. to Clause 12.5.12
  - Water penetration test acc. to Clause 12.5.14.

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Also following additional type tests shall be carried by the Contractor at their own cost prior to the first shipment of all offered cable if no type test certificates of identical cables are available:

- Fire Resistant according to IEC 60331, BS 6387
- Flame Retardant according to IEC 60332
- Low Smoke Test according to IEC 61034
- Halogen Content Test according IEC 60754
- Water Tree Test of XLPE Insulation (accelerated)
  - Test voltage = 3 x Uo
  - Test frequency = 500 Hz
  - Core environment = 400C water
  - Duration of test = 4 month
  - Test after 4 months: Dielectric stress withstand >14kV/mm.

Cables and accessories shall have passed type approval tests in accordance with IEC Specifications and details of the cable designs offered shall be given in the appropriate place in the Technical Schedules. Type test reports shall include cable design details and design drawings of each jointing accessory included in the type test.

The Tenderer/Contractor shall submit certified copies of type test certificates covering the proposed Cables.

Routine tests: according Clause 9

- partial discharge test according to Clause 9.2
- voltage tests according to according to Clause 9.3
- electrical test on oversheath according to Clause 9.4

Sample tests: according to Clause 10

- conductor examination according Clause 10.4
- measurement of electrical resistance of conductor according to Clause 10.5
- measurement of thickness of insulation and oversheath according to Clause 10.6
- measurement of thickness of metallic sheath according to Clause 10.7
- measurement of diameters according to Clause 10.8
- hot set test XLPE insulations and elatomeric sheath according Clause 10.9
- measurement of capacitance according to Clause 10.10
- lightning impulse voltage test follows by a power frequency voltage test according to Clause 10.12
- water penetration test according Clause 12.5.14
- Lead alloy composition and behavior (BS 3908, BS EN 12548).

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Type tests of accessories
All accessories shall be tested as per IEC 62067 and all subsequent amendments and relative standards considering Test of Outer protection for buried joints (if applicable).

Routine Tests, Insulation Joints
The insulation flange shall be designed to withstand tests voltages as specified in the Technical Data Sheets and shall be tested accordingly.

Routine Tests, Bonding/Earthing Leads
The Bonding/Earthing Leads shall be designed to withstand tests voltages and currents as specified in the Technical Data Sheets and shall be tested accordingly.

Telecommunication installations
IEC 60215 Safety requirements for radio transmitting equipment

Aerials
IEC 60169 Radio-frequency connectors

Power installations up to 1000 V
IEC 60364 Electrical installations of buildings
IEC 61439-4 Particular requirements for assemblies for construction sites (ACS)

Power installation above 1000 V
IEC 60060 High-voltage test techniques
IEC 62271 HV switchgear and control gear
(incl. Appendix AA "Internal Arc Test")

Protection equipment
Equipment for modular static protection systems (e.g. generator, distance, busbar, protection, etc.) pre-assembled in the relevant standardized boards/ cubicles etc. shall be tested in the manufacturers' workshops according to IEC 60255 as far as wiring and proper function is concerned. Simulated inputs (binary signals, current and voltage inputs from test power supplies) shall be used.

Fire alarm system
All relevant routine and type tests according to:
NFPA National Fire Protection Association
DIN VDE 0800 Telecommunications
DIN VDE 0833 Alarm systems for fire, intrusion and hold-up

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B0.7.2.5 Control and monitoring equipment

All control and monitoring equipment shall be tested at the manufacturers' works before dispatch to site. Certificates shall be issued for

- synchronizing units
- flow evaluators

On request the correct operation of equipment with specified temperature and humidity limits shall be demonstrated by tests conducted within the limits.

Electrical measuring instruments
All electrical measuring instruments shall be tested in accordance with the following rules and regulations. Alternatively, equivalent standards approved by the Employer's Representative may be used.

IEC 60051	Recommendations for direct-acting indicating electrical measuring instruments and their accessories
IEC 60258	Direct acting recording electrical measuring instruments and their accessories
IEC 61036	Alternating current static watt-hour meters for active energy
IEC 61010	Safety requirements for electrical equipment for measurement, control and laboratory use

Electrical remote indication
Meters for active power, reactive power and similar remote indication equipment:

VDE 0418	Regulations for electric integrating meters
IEC 60338	Telemetering for consumption and demand

Calibration Tests
The Contractor shall conduct calibration tests of the following instruments and equipment:

- all local indicators over the full range of the indicator
- all transmitters over the full range of the transmiter
- all binary transmitters over the full range including initial setting
- all remote indicators over the full range of the indicator
- all recorders over the full range of the recorder
- one of each type of indication loop with circuit resistance of the loop increased to a value which is equal to the highest value expected, and under worst case operating conditions
- all superheated steam thermocouples
- one of each type of thermocouple or resistance element
- all kinds of analogue transmitters over the full measuring range

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- all modules and subassemblies for measuring and control e.g. analogue limit monitors, flow evaluators, function generators
- all quantity meters
- all synchronizing units according to IEC standards
- the actual dimensions of all orifices, nozzles, Venturi nozzles have to be checked as per ISO5167.

Closed-loop control systems
All main closed-loop control systems shall be tested for polarity and function in accordance with the applicable standards. Control valves shall be tested in accordance with mechanical functional tests on control valves and shall be performed with the actuator mounted (open to closed position and vice-versa). Actuators shall be subject to mechanical and electrical function tests.

Sequence logic equipment
All sequence logic equipment shall be tested using simulated inputs.

Alarm annunciator and fault printing system
The alarm annunciator and fault printing system shall be tested using simulated inputs.

DCS system
The system shall be thoroughly tested at the manufacturers' workshops before dispatch to site. Test programs shall be devised and these shall subsequently be made available to the Employer's Representative. Tests shall be made to ensure that the system operates correctly within the ambient conditions as specified by the manufacturer and that if these conditions are exceeded, i.e. in the case of failure of the air-conditioning system, that the system will automatically fail safe and that neither hardware nor software will be damaged.

Further I&C equipment
Type test reports shall be provided for the following:
- UPS
- 24 V DC battery chargers
- Batteries
- Control valves
- Instrumentation cables
- Flow nozzle orifice plates
- Measuring instruments
- Local instrument enclosures
- Local instrument racks
- PLCs
- Etc.

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Type test reports

The minimum type test reports for each of the major I&C systems shall be as follows:

1. Surge Withstand Capability (SWC) for solid state equipment/ systems
   All solid state systems/ equipment shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a Power Plant. All the solid state systems/ equipment shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence all front end cards which receive external signals like analogue input & output modules, binary input & output modules, etc. including power supplies, data highway, data links shall be provided with protections that meet the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronic systems to meet this requirement, the relevant tests carried out, the certificates etc. shall be submitted with the proposal. As an alternative to above, suitable class of EN61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test.
2. Dry heat test as per IEC 60068-2-2 or equivalent
3. Damp heat test as per IEC 60068-2-3 or equivalent
4. Vibration test as per IEC 60068-2-6 or equivalent
5. Electrostatic discharge tests as per EN 61000-4-2 or equivalent
6. Radio frequency immunity test as per EN 61000-4-6 or equivalent
7. Electromagnetic field immunity as per EN 61000-4-3 or equivalent

Tests as listed under items number 5 to 7 as applicable for electronic cards only as defined under item 1 above.

B0.7.3 Testing at site

B0.7.3.1 Civil works testing

The Contractor shall carry out all required civil construction tests. Thereby part of the test like concrete and earthwork tests have to be carried out at site, other tests have to be performed in the manufacturer workshops.

The Contractor shall submit all test certificates of materials subject to approval and shall arrange for tests of all materials to be carried out in laboratories on site or elsewhere. The cost of all test equipment, samples, tests and transport to the laboratory shall be borne by the Contractor.

The testing operations shall be performed in accordance with the relevant codes and standards and under the supervision of the Employer.

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Where in the specifications materials are specified to be approved samples shall be submitted for approval at the earliest possible date and strictly before any purchasing or delivery to the site is made. The individual tests and inspection for the materials, supply and execution shall be carried out in compliance with the requirements of the individual technical specifications. In the case of rejection, further samples of the rejected materials shall be submitted to SC until they are approved or the material is replaced. The Employer may reject any material which in his opinion is not in accordance with the approved standard. All samples shall be submitted free of charge to the Employer.

The characteristics as determined in the samples which are approved shall indicate the standard to be maintained in the materials used in the execution of the works.

The test samples of materials subject to approval by the Employer shall be kept in a safe place and protected against damage or deterioration until completion of the works.

For materials (e.g. steelwork, pipes, ducts, etc.) to be manufactured in workshops respective manufacturer test certificates including test results shall be submitted to the Employer subject to approval.

After final completion of certain civil structures/ parts to be ready for erection of further equipment individual "Civil Completion Certificates" shall be issued by the Contractor under the following conditions:

- Except for minor items of work that would not affect the safety, all civil works for applicable parts, structures or buildings have been carried out and tested
- All such civil works are in a manner that does not void any subcontractor or vendor warranties or violate any applicable law or applicable permit
- Punch List has been agreed upon by the Employer and the Contractor
- Contractor warrants that all necessary works have been undertaken and all applicable parts, structures or buildings are ready for erection.

If the Employer is satisfied that the pre-conditions for the issuance of the Civil Completion Certificate for the respective civil structures/ parts have been met the Civil Construction Completion Certificate shall be signed off by the Employer.

Further testing requirements for civil works are specified in **Section B9**.

An indicative field quality plan for civil works to be followed by the Contractor at site is required to be submitted with the Tender.

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B0.7.3.2 Erection tests

General

During erection all required erection tests as well as final erection checks of the mechanical completion of the systems and part thereof have to be performed.

The Employer shall have the right to witness on request all tests on site and shall be informed of site test 24 hours in advance.

After successful mechanical completion of each system, Individual Erection Completion Certificates will be issued.

The activities necessary for mechanical completion shall include but not be limited to following testing:

- visual inspection after unloading at site
- checking of completion of relevant systems
- completion of buildings and civil works
- test of ventilating and air-conditioning units
- alignment of rotating equipment coupled on site
- safety audit
- testing of site welds (non-destructive examinations)
- pressure testing, leak tests, tightness tests
- checking of pipe hangers, supports, guides, etc.
- pipe line and equipment flushing and cleaning
- chemical protection of piping systems
- checking of coating
- testing of cranes and hoists.

Electrical equipment tests

The following tests or measurements must be made during and after erection but before any item of equipment is put on trial operation:

- design and visual checks
- screwed connections for correct assembly
- terminals and terminal connections for correct assembly
- checking of earthing connections and testing of earthing resistances
- measurement of insulation values (didactic tests)
- verification of earthing conditions
- fire-proof partitioning
- marking, inscription, provision of designation plates
- rotating-field measurement
- phase coincidence with 2 half-busbars
- voltage checks
- polarity checks in the case of DC voltages
- fuses, overcurrent trips, short circuit trips, time settings, relay settings
- oil levels

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- status indication, alarm and trip signals
- checks on wiring and cabling for conformity with the constructional circuit drawings and plans
- high voltage tests
- current and voltage transformer circuits
- functional test of all protection relays including winding and oil temperature monitoring as well as Buchholz protection etc.
- interface with the DCS and SCADA.

The tests shall be carried out according to relevant standards.

The Contractor shall submit for each test of all equipment a method statement, with relevant diagrams explaining the procedure of the tests and test criteria supported by relevant standards and test methods.

All major equipment shall have a separate test package.

All high voltage tests shall be carried out at 50 Hz. Equipment for which DC tests is proposed shall be justified and approved by Employer/Engineer. HV tests of switchgears shall be carried out with the relevant circuit breakers in open and closed positions.

Unless otherwise agreed, all erection and civil works related to the equipment shall be completed before starting any site tests.
All switchgears shall be verified by primary injection in addition to secondary injection.

Generators

This Section covers the specific requirements for the site tests and performance tests requirements in the turbine plant.

These tests shall include:

- Routine tests as per IEC 60034 - as far as practicable under site condition comprising of:
  - testing of running behaviour (overspeed)
  - determination of temp. rises of coolants and lubricants for bearing and shaft seals
  - determination of friction losses
  - recording of no-load saturation characteristics and determination of core losses
  - measurement of shaft voltage
  - verification of phase sequence and appropriate terminal marking
  - measurement of excitation current and determination of losses at rated current on short circuit
  - calculation of efficiency from sum of individual losses
  - winding insulation measurement
  - HV test on windings
  - functional test of accessories and attachments

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- measurement of excitation response time – GTG: measuring will be carried out at site during commissioning
- overall characteristics coupled with generator and AVR cubicle at no load (applicable for the assembled unit consisting of generator, exciter and voltage regulator) – GTG: measuring will be carried out at site during commissioning.

The Contractor has to provide a detailed test procedure subject to approval by the Employer/Engineer.

Motors
Tests at Site (with motor coupled):

- measurement of insulation resistance
- measurement of shaft current
- measurement of motor vibrations
- at motors rated 47 kW or higher, in addition:
  - oscillographic measurement of starting current (if not performed during workshop testing)
  - measurement of starting period.

Switchgear for Voltages above 1 kV
The complete installation shall be tested at site as follows:

- dielectric test
- visual inspection
- contact resistance/torque test of bus bar joints
- CT's, VT's ratio, magnetisation characteristic and burden measurement
- HV test
- mechanical functioning test
- test of the functional sequence
- testing of all interlocks
- testing of all protection relays and circuits by primary/secondary injection and functional tests of the arc protection
- testing of high speed transfer systems
- testing of all alarms (local and remote).

LV switchgear (AC and DC)
The complete switchgear and the individual apparatus shall be tested on site as follows:

- visual inspection
- dielectric test
- contact resistance/torque test of bus bar joints
- CT's, VT's ratio, magnetisation characteristic and burden measurement
- testing of all interlocks
- setting and testing of all protection relays and circuits by primary/ secondary injection. Test kit of adequate rating to be provided

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- testing of automatic change over devices
- testing of all alarms (local and remote)
- functional test
- test of the functional sequence.

Setting and functional test of protection devices (primary injection method). However, test plugs and socket facilities for secondary injection tests shall also be made available. Tests kits of adequate ratings shall be made available for the tests.

Batteries and chargers
Chargers and batteries shall be tested together in the factory. All factory tests are to be repeated at site.

Chargers
- visual inspection (to be repeated on site)
- functional tests (to be repeated on site)
- heat run (type test)
- output voltage stability measured for 25% load steps
- ripple voltage measurement without connected battery
- ripple measurement (voltage and current) with connected battery
- insulation test (to be repeated on site).

Batteries
- visual inspection (to be repeated on site)
- insulation test (to be repeated on site)
- charge test and discharge tests (100%).

Fuse Box
- Visual inspection (to be repeated on site)
- Functional tests (on site)
- Insulation test (on site).

Inverters & DC/DC Converters
Following test shall be carried out:

- visual inspection (to be repeated on site)
- functional tests (to be repeated on site)
- insulation test (to be repeated on site).

Earthing and lightning protection

The complete earthing and lightning protection systems shall be tested as follows:

- The earthing system as a whole shall be tested and verified before putting any major equipment into operation.
- visual inspection of exposed elements
- Measurement of the earth electrode potential UE by the voltmeter/ ammeter method, test current 100 300 A or an equivalent, approved method if above will be proved to be not feasible,
- measurement of the touch potential UB,
- measurement of step potential.

Diesel generator units

The diesel generator units (DGU) shall be thoroughly tested at site. The acceptance tests shall be performed according to the Technical Specifications and acc. to ISO 8528 6:1993 (E) and ISO 3046-1:1995 (E) and -3:1989 (E) for the diesel engine. At site the diesel engine shall be measured and documented according to the stipulations made in Clause 7.6.20. The exhaust gas shall be invisible when the Unit is operating at loads between 50 and 110%. The diesel engine's filter smoke number shall be measured according to BOSCH Index No. 3 or better within a load range from 60 to 100%. A test report in English language shall be issued according to ISO 8528:1993 (E). Upon full satisfaction of the Employer/Engineer after the successful operation tests, in every respect, and that all components are working properly, the DGU with all ancillaries shall be operated at 100% output for 48 hrs without failure or interruption whatsoever. The performance test measurements of the DGU shall be performed according to ISO 8528 6:1993 (E) for the diesel generator unit, ISO 3046-1:1995 (E) and -3:1989 (E) for the diesel engine and latest issue of IEC 60034-2 for the Generator. All guaranteed values shall be assumed to include all necessary tolerances for accuracy of testing, sampling, instrumentation, notwithstanding the performance test code standard. No further tolerances of any kind shall be permitted.

230 kV XLPE Cables

Test after laying is to be recommended by the manufacturer considering the following minimum requirements and recommendations from CIGRE WG.21.9 (Electra No.173 August '97), IEC 62067 and other applicable standards to Employer/ Engineers approval.

- visual and function test of bonding/earthing system
- phase Identification Test
- conductor and screen/sheath Continuity Test
- primary connection check
- cable connection bolt tightness check
- cable supporting check
- cable fixing check
- insulation resistance test before and after installation
- DC conductor resistance test (IEC 60228)
- contact resistance test of connecting bars in link boxes
- capacitance test
- earthing measurements
- positive/negative and zero sequence impedance measurements
- testing of SVL
- cross bonding check, primary injection Subsequent repeat tests (after guarantee period)
- DC sheath test according Clause 5 of IEC 60229 between metallic sheath/screen/armouring including cross bonding system, etc. and ground.
- AC voltage test according IEC 62067 Section 14.2.
- measurements of induced voltages on pilot/telephone cables installed in parallel with the power cables.

Tests accord the Electricity Transmission Code of Bangladesh and Great Britain

Any other tests required to demonstrate compliance with the above indicated Grid Codes.

B0.7.3.3 Pre-commissioning tests

Preconditions for the pre-commissioning are:

- the issue of the individual Erection Completion Certificates;
- the rectification of all relevant erection punch points; and
- the availability of the accepted commissioning test program and commissioning procedures.

The pre-commissioning tests shall cover mainly the functional tests of the individual items of all mechanical, electrical and I&C systems including their alarm and tripping systems. Following tests shall be included, but not limited to:

Mechanical equipment

- Individual pre-commissioning runs of all rotating equipment such as pumps, compressors, dosing equipment etc.
- Functional tests of the mechanical equipment
- Testing and adjustment of safety devices

Electrical equipment

As far as not already covered by the erection tests the pre-commissioning tests shall cover:

- Voltage tests
- Generator and transformer protection system checks
- Automatic voltage and reactive power control (AVQC), governor setting and adjustment and response to grid system signals
- Trip tests
- Functional tests of the equipment e.g.:
  - Motor checks
  - Circuit breakers, LV, MV, HV cabling and switchgears checks for operability
  - Batteries, chargers and UPS checks for operability
- Remaining tests on turbine generator: In addition, a repetition of winding resistance and insulation resistance measurement, as well as dielectric tests shall be carried out in any case on each turbine generator.

Control equipment

- Comprehensive loop tests shall be performed for all measuring loops at least for 0, 50% and 100% value.
- Closed loop control checks up to DCS (for all functions like indication, control, alarms, etc.):
  - Polarity and function test in accordance with the applicable standards.
  - Control valves shall be tested in accordance with mechanical functional tests on control valves and shall be performed with the actuator mounted (open to closed position and vice-versa)
  - Actuators shall be subject to mechanical and electrical function tests.
- All sequence logic equipment shall be tested using simulated inputs.
- The alarm annunciation and sequence of event recording system shall be tested using simulated inputs.
- Binary field contact circuit fault detection.
- Functional tests of control equipment, interlocks, inter-tripping, protection inputs, etc.
- Test of signal exchange with other systems (also with third parties – like LDC, etc.)
- Archiving system (capacity, consistency, redundancy, access times).

- Reports generation
- Emission analyser calibration and emission evaluation tests
- Calibration of metering system (accuracy shall be proven by certificates)

B0.7.3.4 Tests on Completion (Commissioning tests)

Preconditions of the Tests on Completion are:

- the successful completion of the individual erection checks of all items of the whole system;
- the issuing of the Final Erection Completion Certificate; and
- the successful completion of all pre-commissioning test.

Should the Employer decide that the preconditions for the Tests on Completion have not been adequately met, the Employer will advise the Contractor accordingly and withhold the commencement of the the Tests on Completion until the outstanding work is completed.

The Tests on Completion shall prove that the Plant is prepared and adjusted to ensure the correct functioning of the individual components and of the complete Plant.

The Tests on Completion shall cover at least following tests:

- Protection tests
  - Operation of selected turbine train protection devices including the following as a minimum:
    - fire protection
    - boiler protection
    - steam turbine protection
    - generator protection
    - transformer protection.

Method of alarm/ trip condition reset for subsequent starting.

- Operation of auxiliary systems:

Method of changeover of main equipment to stand-by equipment prior to Plant starting (see start-up tests) and during normal operation for fuel oil, coal handling, ash handling, oil lube and cooling systems

- Operation of fire protection systems.

- Isolation procedures
  - Method of isolation of plant equipment for safe shut-down and maintenance procedures including as a minimum:
    - HV station and unit supplies
    - LV supplies
    - fuel oil systems
    - coal handling systems
    - ash handling systems

- fire protection systems.
- Protection systems/ settings, in accordance with agreed design and the requirements of the transmission system.
- Start-up tests
  - normal semi-automatic start to preset load
  - staged semi-automatic including start to synchronous speed, manual synchronizing (including synchro-check), automatic synchronizing, manual and automatic loading
  - starting with stand-by auxiliaries
  - operation of all auxiliaries.
- Verification of start-up times and loading rates of power unit and steam generator at various downtime conditions.
- Power unit(s)/Plant, to test partial and full load rejection to demonstrate
  - full load rejection tests to measure transient maximum speed and steady state speed at normal governor droop setting
  - method of resynchronism to be demonstrated steam turbine bypass operation capability.
- Power unit(s)/Plant, to verify and check
  - operating stability when operated between 30% and 100% nominal load conditions with load variations by increasing or decreasing the electric load
  - start-up/main fuel change-over:
    - semi-automatic change-over from fuel oil operation to coal operation
    - semi-automatic change-over from coal operation to fuel oil operation.
- Demonstration of the capabilities of the power unit to operate at rated voltage and frequency, at power factors and reactive conditions between 0.85 (lag) and 0.95 (lead).
- Start-up tests of the Plant equipment, facilities and systems including checking of automatic change-over of standby facilities as well as fuel.
- Verification of vibration guarantees.
- Environmental monitoring equipment, water quality monitoring equipment, functioning tests and verification of guarantees.
- Demonstration of the teledispatching and telemetering systems.
- Verification of Active Power Response and Voltage Control Response according to the requirements specified in the Network Connection Conditions.
- Demonstration of proper controlling, monitoring and recording according to the requirements of the Grid Code, including but not limited to the following tests:
  - Reactive Power
  - Fault Detection and Clearing Limits
  - Load Following Capability
  - Black Start (if applicable)
  - Voltage Following Capability (AVQC)
  - Excitation System and Power System Stabiliser
  - Primary, Secondary and High Frequency MW Response

- Unit Start
- Despatch Ramp Rate
- Protection System
- House Load Operation
- Underfrequency Relay
- Loss of AC Power Supply
- Minimum Load
- Site Test for Validation
- Verification of completeness of scope of supply.

B0.7.3.4.1 Additional test in accordance with the PPA

Tests prior to synchronisation of each generating unit of the Plant
According to the requirements of the BPDB which are part of the PPA, the Contractor shall carry out the following additional tests prior to synchronisation of each generating unit of the Plant:

- automatic voltage regulator setting and adjusting in stand-still condition and with the generator running at no load
- turbine governor control checks, including (but not limited to) a steam governor overspeed test (This test may be performed after a specified period of running of the Unit on load as per the manufacturer's recommendation)
- open circuit and short circuit tests on the generator
- functional testing and timing of high voltage switchgear in the substation of the Facility
- The Company and BPDB shall verify that the protection level settings for switchyard protection equipment are as agreed by the Joint Coordinating Committee
- Voltage phasing checks will be carried out between the Grid System and the Facility; and

All inter-tripping circuits between the Plant and BPDB equipment shall be proved.

Tests for commissioning of each generating unit of the Plant
In addition to the above specified tests and according to the requirements of the BPDB which are part of the PPA, the following tests shall be carried out by the Contractor for commissioning of each generating unit of the Plant after completing the tests set out before:

a. **Dependable Capacity Test**
Refer to Section **0.7.4.**

b. **Reliability Run**
Refer to Section **B.0.7.5**

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c. **Automatic Voltage Regulator ("AVR") Droop Test**
The AVR will be demonstrated to control the steam turbine generator voltage over its entire set range.

d. **Steam Turbine Governor Operation Test**
The operation of the steam turbine speed governor will be demonstrated.

e. **Reactive Capacity Test**
This test will demonstrate the capability of the Plant to operate at rated voltage and frequency at power factors and under reactive conditions in accordance with the manufacturer's generator rating curves to be provided by the Contractor, insofar as these tests can be accommodated within the grid system.

f. **Minimum Load Capability Test**
This test will demonstrate the capability of each Unit to be operated at minimum stable load while the steam turbines, and auxiliaries remain in a stable and controlled condition, see also

B0.7.3.4.2 72h Full Load Continuous Test Run

After successful completion of the Tests on Completion and availability of the Commissioning Completion Certificate (CCC), signed by the Employer and the Contractor, the "Authorization to Start the 72 h Full Load Continuous Test" shall be signed.

No trip is admitted during these 72 h. Should the Plant or a Unit, as the case may be, not follow the requested load during the 72 h test, the test shall be restarted.

B0.7.4 Performance Tests

Performance Tests of the Unit(s)
After successful completion of the 72h Full Load Continuous Test Run and after relevant test protocols have been accepted by the Employer for the Unit(s) and Common Facilities, the Contractor shall be allowed to prepare the Unit(s) for the Performance Tests.

For the Unit(s) following guarantees given in the **Technical Schedule B0** shall be tested during the related Performance Test; this includes:

- Performance guarantees of the Unit(s)
- Operating guarantees
- Emission guarantees
- Guarantees of steam generator(s), steam turbine generator(s), flue gas treatment systems etc.

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Performance Test of the Plant

After completion of the Performance Tests of the Unit(s), the guarantees of the Plant and the common facilities shall be tested in a separate Performance Test; this includes:

- Performance guarantees of the Plant
- Emission guarantees of the Plant
- Emission guarantees of the auxiliary boiler
- Noise guarantees
- Guarantees of the water and waste water treatment systems
- Effluent and water outfall guarantees.

Dependable Capacity Test according to the PPA

Dependable Capacity means- means at any given time the net amount of capacity at the tariff metering; either for the first generating unit or for the Plant, as the case may be, as determined by the most recent dependable capacity test which shall be comply with ASME standards and shall be carried out as part of the Reliability Run. The Dependable Capacity of the Plant is measured at the Delivery Point. It equals the average Export Power Output, corrected to Reference Site Conditions using correction factors, delivered during twelve continuous thirty (30) minute periods divided by six (6) hours.

Dependable Capacity is the power output/capacity of a unit or the plant which can be reliable evacuated to the grid and which shall be verified by the "Dependable Capacity Test according to PPA". In additon refer to the defnition under B0.2.9.2

The Dependable Capacity Test and the Performance Testing in general will carried out under the the actual prevail conditions. The measued power output and other guaranteed performance data shall be corrected to the reference conditions using the correction curves to be provided by the Bidder/Contractor.

Performance Tests shall be conducted in accordance with following standards:

- the Plant ASME PTC 46
- steam generator ASME PTC 4
- steam turbine ASME PTC 6
- cooling tower ASME PTC 23
- FGD plant ASME PTC 40.

As for supercritical steam power plants operation without make-up must be possible for a defined time period, the guarantee figures shall not include make-up.

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The curves required for the correction of the power output and specific heat rate to the site specified ambient conditions shall be listed in the technical schedules of the Plant performance and steam generator and steam turbine performance, and shall be submitted with the Tender. These curves shall be conclusive and no extra correction shall be given.

The margins required for instrument inaccuracies and for all other reasons shall be deemed to be included in the guarantee figures. The actual figures determined during performance tests shall hence be not corrected with any margins due to instrument inaccuracies prior to comparison with the guarantee figures.

Degradation and fouling during commissioning and other operation prior to Provisional Acceptance shall be deemed to be included in the guarantee figures. The actual figures determined during performance tests shall hence be not corrected for any degradation or fouling effect prior to comparison with the guarantee figures.

Degradation curves for the Plant and Unit(s) performance shall be submitted by the Contractor with bid. The curves shall show the equipment's degradation in power output and heat rate versus equivalent operating hours. The curves shall be applicable up to and including final major overhaul.

Test program

In due time prior to the tests a detailed procedure covering the testing to be undertaken and the methods to be employed shall be provided by the Contactor. The test procedure shall also detail areas of responsibility and the items that specifically require preparation and agreement before the tests can be carried out.

The test program shall cover the following documents but not be limited to:

- test procedure and standards (including proposed formulae / curves and standards)
- test schedule
- type of test
- manpower and deployment schedule of the Contractor for performing the tests forms of test records and report
- description of instrumentation to be used, including accuracy, and calibration test results
- method of data recording
- list of all auxiliary loads that will be operating during the tests. The list of auxiliary loads shall be provided with the test program and agreed in the Test Procedure.
- method and equations/correction curves used for adjustment of recorded data to the design conditions.

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Test responsibility
All tests shall be prepared and conducted by the Contractor. The Plant shall be operated by Contractor's operation personnel.

The Employer and/or an independent third party, awarded by the Employer.shall have the right to witness the tests.

Contractor's personnel appointed to carry out the tests shall be adequately skilled and experienced. Information on these personnel shall be provided to the Employer as part of the test program for review.

Test instrumentation
The Contractor shall supply and install all test instrumentation needed to conduct the tests. Temporary instrumentation installed for test purposes only and shall be retained at Site upon the satisfactory conclusion of all tests and shall be then removed.

All instruments to be used for the test shall be strictly dedicated calibrated measurement equipment. Each measuring instrument used shall be according to controlled and provided with a valid calibration certificate.

The calibration of PG Test instrument shall be carried out as per PTC-6 by an independent authorised company, which shall have appropriated quality standards and which shall be to be approved by the Employer, except for instruments which are calibrated and certified at a certified laboratory and holding the authorized traceability certificate. The certificate shall not be older than six (6) months.

Test Duration
The test shall begin after the Plant or a Unit including common facilities, as the case may be, has established stable operation, as judged by the Employer and/or an independent third party, awarded by the Employer.

The test duration shall be in accordance with the standards and codes.

One 60-minute test run shall be conducted for each guaranteed load point, during which the operating conditions shall remain within the defined plant stability criteria.

Test conditions
Performance tests shall be conducted at conditions close to the conditions of the Guarantees. Thereby the boiler and steam turbine cycle shall be adjusted to the conditions of the corresponding heat balance diagram.

Since the accuracy of the test results highly depend on the exact water-steam cycle arrangement respective cycle isolation is required to avoid any unknown cycle leakages. The valve position list has to be provided by the Contractor prior to the performance test. This cycle arrangement shall fully remain during the whole testing period. Any changes of the performance

conditions during the tests are not allowed.

Test evaluation
The Contractor shall submit for the acceptance of the Performance Test all detailed measurements, calculations and individual test results (such as, but not limited to turbine efficiency calculations, generator and transformer details, condenser performance, feedwater heaters and deaerator details, boiler efficiency calculations, pulverizing fineness and other results, air heater temperature traverses and leakage results, coal handling system performance, ash characteristics and ash handling systems performance, ESP and FGD performance and emissions, individual auxiliary power consumption figures, major consumers performance, noise and effluents etc.) and the corrections made based on the correction curves.°

The Performance Test report shall be submitted by the Contractor. This report shall include, as a minimum, the following:

- description of the test procedures
- instrumentation details and calibrations (not older than six months)
- full process flow diagrams for fuel, air and flue gas and water and steam with indication of instrument position
- standards that were used
- test logs and summary (arithmetic average) of test readings used for performance calculations
- full set of correction curves
- calculations
- instrument calibration certificates
- list of all auxiliary loads that were operated during the tests
- performance tests results for the "As-run" condition and for the "Corrected as-run conditions"
- conclusions of performance tests: test passed or not.

B0.7.5 Reliability test run

After successful completion of all Performance Tests the Plant or a Unit including common facilities, as the case may be, shall start the 30 (thirty) days Reliability Test Run.

During the Reliability Test Run the Contractor shall demonstrate that the Plant or a Unit including common facilities, as the case may be, is fit for commercial operation.

During the specified periods, the Plant shall be operated continuously and in accordance with the prevailing power requirements of the Transmission System/BPDB or as required by the Employer.

During the Reliability Test Run the Employer's operation personnel shall operate the Plant under the full supervision and the responsibility of the

Contractor's Personnel and according to the O&M manual as supplied by the Contractor.

For the successful completion of the Reliability Test Run, a maximum of 4 trippings of not more than combined outage of 24 hours are allowed, otherwise the Reliability Test Run will be considered as failed and a new Reliability Test Run will have to be executed until the test has been completed.

At the conclusion of the Reliability Test Run the Contractor shall request from the Employer the issuing of the Provisional Acceptance Certificate (PAC).

A list of minor pending items, which are at the judgment of the Employer do not jeopardize the trouble-free operation of the Plant or a Unit including common facilities, as the case may be, could be attached to that certificate. The envisaged completion date for each item shall be stated in it.

With the issuing of the PAC the Employer takes legal possession of the Plant or a Unit including common facilities, as the case may be, and the Warranty Period will begin.

During the Warranty Period the Contractor has to keep at site at least three Warranty Engineers at Site. Part of their duty shall be inter alia to complete in time the works for the minor punch items mentioned in the PAC. They shall issue, together with the Employer, special reports, should any damages occur to any equipment. Moreover they shall assist the Employer during the daily plant operation and issue additional operational instructions, if requested. They shall assist the Maintenance Superintendent in his work organization and spare part handling procedure.

At the successful conclusion of the Warranty Period, the Contractor shall request the Employer to issue the Final Acceptance Certificate (FAC).

Additional requirements as per the PPA The Facility shall operate continuously (without interruption) for
Seventy two (72) continuous hours at then demonstrated Dependable Capacity. For ninety six (96) hours the output shall be as requested by BPDB in accordance with the Dispatch provisions as outlined in the PPA.

Abbreviations

(Please refer also to relevant Sections "**Standards and Codes**" and "**Units of measurement**")

AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
AGC	Automatic Grid Control

ASC	Average Site Conditions
ATRS	Automatic Turbine Run-up System
ATT	Automatic Turbine Testing System
AVQR	Automatic Voltage and Reactive Power Control
AVT	All Volatile Treatment
BFP	Boiler Feedwater Pump
BIMS	Building Information Management System
BMCR	Boiler Maximum Continuous Rating
BMS	Burner Management System
BOD	Biological Oxygen Demand
BOP	Balance of Plant
BOQ	Balance of Quantities
BPDB	Bangladesh Power Development Board
BPS	Boiler Protection System
CCR	Central Control Room
CCTV	Closed Circuit Television
CD	Chart Datum
CEMS	Continuous Emission Monitoring System
CHP	Coal Handling Plant
CO	Carbon Monoxide
COD	Commercial Operation Date
COD	Chemical Oxygen Demand
CT	Current Transformer
CW	Cooling Water
DAF	Dry Ash Free
DC	Direct Current
DCDB	DC Distribution Board
DCS	Distributed Control System
DDCMIS	Distributed Digital Control Monitoring & Information System
DCS	Distributed Control System
DOE	Department of the Environment, Bangladesh
DOSH	Department of Safety and Health, Bangladesh
DPC	Damp Proof Course
DWT	Dead Weight Tons
ECP	Electrochlorination Plant
EHG	Turbine Electro Hydraulic Governor Control System
EHSG - TTP	IFC Environmental Health and Safety Guidelines Thermal Power Plants
EHV	Extra High Voltage (500 kV)
EIA	Environmental Impact Assessment
EMC	Electro-Magnetic Compatibility
EPC	Engineering, Procurement, Construction
ESP	Electrostatic Precipitator
ETP	Effluent Treatment Plant
FDF	Forced Draught Fan
FEGT	Furnace Exit Gas Temperature
FGD	Flue Gas Desulphurization Plant
FTU	Field Mounted Termination Unit

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GCV	Gross Calorific Value
G-EHSG	IFC General Environmental Health and Safety Guideline
GJ	Gigajoule
GPS	Global Positioning System
GRP	Glass Fiber Reinforced Piping
GWh	Gigawatt hour
GSO	Grid System Operator
HART	Highway Addressable Remote Transducer
HAZOP	Hazard and Operability Study
HCSD	High Concentration Slurry / Solids Disposal
HDPE	High Density Polyurethane
HHV	Higher Heating Value
HMI	Human Machine Interface
HRC	High Ruption Capacity Fuse
HV	High Voltage
HVAC	Heating, Ventilation, Air Conditioning
Hz	Hertz
I&C	Instrumentation and Control
IDF	Induced Draught Fan
IOD	Initial Operation Date
IP	Intermediate Pressure
IPL	Independent Protection Layer
IPP	Independent Power Producer
IR	Infrared
kV	Kilovolt
kW	Kilowatt
LAN	Local Area Network
LCC	Local Control Center
LCV	Lower Calorific Value
HSD	High Speed Diesel
LHV	Lower Heating Value
LIE	Local Instrument Enclosure
LIR	Local Instrument Rack
LP	Low Pressure
LV	Low Voltage
LVS	Large Video Screen
MCC	Motor Control Center
MCL	Maximum Continuous Load
MCR	Maximum Continuous Rating
MCWP	Main Cooling Water Pump
MDBFP	Motor Driven Boiler Feed Pump
MLSD	Land Survey Datum
MNCL	Minimum Continuous Load
MNCR	Minimum Continuous Rating
MOV	Motor Operated Valve
MV	Medium Voltage
MVA	Megavolt Ampere
MVAR	Megavolt Ampere Reactive
MWh	Megawatt hour

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INTERNATIONAL OPERATIONS DIVISION
नई दिल्ली / New Delhi-3 (India)

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MWQCS	Marine Water Quality Criteria and Standards
NCC	Network Control Center
NDE	Non Destructive Examination
NFPA	National Fire Protection Association
NLDC	National Load Dispatch Centre
NO_x	Nitrogen Oxides
NOR	Notice of Readiness
NPSH	Net Positive Suction Head
NRV	Non Return Valve
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
OHL	Over head line
P&I	Piping and Instrumentation
P&ID	Piping and Instrumentation Diagram
PA	Public Address
PABX	Private Automatic Branch Telephone Exchange
PA	Primary Air
PADO	Plant Performance Analysis, Diagnosis and Optimization System
PAF	Primary Air Fan
PC	Pulverized Coal
PCDD	Polychlorinated Dibenzodioxins
PCDF	Polychlorinated Dibenzofurans
PF	Performance Fuel
PLC	Programmable Logic Controller
PPA	Power Purchase Agreement
PQR	Procedure Qualification Record
PSS	Power System Stabiliser
PVC	Polyvinyl Chloride
PWD	Public Works Department
PWHT	Post welding heat treatment
QA	Quality Assurance
RAPH	Regenerative Air Preheater
RC	Reinforced Concrete
RSC	Reference Site Conditions
SA	Secondary Air
SAH	Steam Air Heater
SCADA	Supervisory Control and Data Acquisition
SCAPH	Steam Coil Air Heater
SCS	Substation Control System
SER	Sequence of Events Recording
SG	Steam Generator
SI	Soil Investigation
SIL	Safety Integrity Level
SO_2	Sulphur Dioxide
SOE	Sequence of Events
SSC	Summer Site Conditions
ST	Steam Turbine
STG	Steam Turbine Generator

SWAS	Steam and water analyses system
TCS	Technical Comment Sheet
TDS	Total dissolved solids
TEFC	Totally enclosed Fan cooled
TG	Turbine Generator
TIG	Tungsten Inert Gas
TLA	Three-Letter Abbreviation
TMC	Turbine Maximum Capacity
TMCR	Turbine Maximum Continuous Rating
TSCS	Turbine Stress Control System
TSI	Turbine Supervisory Instruments
UHF	Ultra High Frequency
UV	Ultraviolet
VDU	Video Display Unit
VT	Voltage Transformer
VMS	Vibration monitoring system
VWO	Valves Wide Open
WSC	Winter Site Conditions
WPS	Welding procedure specification
WTP	Water Treatment Plant
WWD	Weather Working Days
WWTP	Waste Water Treatment Plant

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B0.9 Technical Schedules

The following technical schedules comprise part of this specification. The data and requirements specified in the respective forms are to be adhered to and the missing data of forms are to be completely filled in. The completed technical schedules are to be submitted with the Bid.

B0 Technical Schedule General
B0 Sub-supplier List

B6

Water Treatment Systems

B6.3.4 Tanks

Tanks shall be designed in accordance with the requirements of API Standard 650 or an approved equivalent standard. If the specification contains requirement beyond the requirements of API standard 650, the requirements of the specification shall have priority.

The tank roofs shall have exterior structures and shall be supported by pipe columns.

Inside the tank all surfaces must be completely smooth so that after erection the specified paint system can be applied without any difficulty.

All column supports and/or connections have to be sealed by welds. In cases where seal welds are not possible and/or proper painting after erection cannot be applied, transition pieces made of stainless steel type AISI 340 or an approved equivalent material shall be provided.

To prevent any damage to the water storage tanks by storms, they shall be adequately stiffened.

The maximum storage temperature for the tanks shall be the highest one-day mean ambient temperature plus 20 K. The tank shell temperatures reached due to solar irradiation must also be considered.

Corrosion allowances shall not be applied in the design of the tanks.

The tank bottom shall be pitched downward conically to the outside with a slope of at least 1%.

Around the inside of the tank perimeter, six drainage sumps shall be provided. Each sump shall be equipped with a 50 mm diameter drain pipe connected to the shell double flange nozzle. A shut-off valve with a blind flange shall be provided.

Welded joints are to be produced as follows:

- Bottom joints — one-sided lap weld
- Shell to bottom joint — two-sided fillet weld
- Shell joints — two-sided butt weld
- Roof to shell joint — one-sided fillet weld
- Roof joint — two-sided butt weld

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All tank internals (pipes, etc.) shall be made of stainless steel type AISI 304 or approved equivalent materials. Bolts, nuts, etc. located within the tank shall also be made of stainless steel.
The tanks shall be designed, constructed and painted in such a manner that internal and external corrosion and especially contamination of the stored water by rust and/or by other material is entirely prevented.

All nozzles at the tank with the exception of inlet nozzles, ventilation, sounding hatch and overflow nozzles are to be arranged in the lower shell course. All connection nozzles shall be provided with flanges inside and outside of the tank.

The overflow pipes shall be located opposite each other in the upper course of the tanks and routed down outside the ground. At its end the pipes shall be equipped with a 45° bend and hinged cover plate. The diameter of each overflow pipe shall be at least one pipe size larger than that of the inlet nozzle.

Vents shall be designed for 100% capacity to pass air so that at the maximum possible flow rate of the water, either entering or leaving the tank, excessive positive or negative pressure will not be developed. To prevent any ingress of sand, dust, insects, etc. the vents shall be equipped with filters containing exchangeable filter elements with a mesh width of not more than 0.5 mm. Each clear filter area shall be at least 200% of each filter and shall be equipped with sensors to trigger an alarm when the filter is blocked by 30% of its clear area.

The shell manholes and the clean out fitting are to be equipped with hinges (davits) and safety devices which prevent unintentional closure of the covers.

The clear diameter of all manholes (shell and roof) and the clean out fittings shall be 600 mm minimum.

The tank shall have a spiral staircase, which shall start at the level of the tank bottom. Two intermediate platforms shall be arranged at an appropriate height.

A 10 cm high kick plate, tightly welded around the entire tank perimeter and acting as a gutter is to be arranged on the tank top edge. For each tank four rain down pipes, connected to the kick plate and provided at their bottom ends with a 45° bend, are to be provided.

The surface preparation, interior and exterior coating application, including appurtenances, shall be applied according to the standard specification for painting and corrosion protection as specified in **Section B0**.

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B6.3.5 Piping and accessories

For the desalination and the waste water system GRP is preferred, Bona-Pipe and coated carbon steel is acceptable. For saline water and the water and waste water treatment systems LPP piping will be accepted also. PVC will not be accepted. SS316 seems not to be resistant to chloride concentrations up to 10,000 ppm.

MOC shall be finalized during basis/detail engineering and shall be subject to BIFPCL approval.

If a carbon steel system is offered, a cathodic protection system shall be employed for inside and outside. For steel underground piping where cathodic protection is not feasible coal tar epoxy coating shall be applied.

Further details see **Section B0**.

B6.4 Technical Schedules

The following technical schedules comprise part of this specification. The data and requirements specified in the respective forms are too adhered to and the missing data of forms are to be completely filled in. The completed technical schedules of all equipment shall be provided by the Contractor and are to be submitted with the Bid.

B6 TS Technical Schedules

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B12

Part 9: Waste Management

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B12. Waste Management

This section specifies the municipal solid waste management (waste collection, recycling, treatment and disposal) service required to be provided by the Contractor for the waste collected from the Maitree-STPP, the Jetty and the adjacent Township.

In a first step the Owner's Engineer (OE) has determined the waste streams and estimated the waste quantities expected to be generated from the facilities mentioned above. The collected waste streams shall be transferred to the Waste Management Centre (WMC) which shall be designed, procured, constructed and operated by the Contractor until the Hand Over of the Maitre-STPP to the Owner, Bangladesh-Indian Friendship Power Corporation Pvt. Ltd. (BIFPCL)

Within this WMC a waste composting facility, a sorting and recycling facility and a landfill for the disposal of all waste streams which cannot be recycled or composted shall be considered.

The composting facility shall in a first step receive only green waste (grass, leaves, branches, etc.), park waste, etc.) and at a later stage expanded to treat organic and kitchen wastes from households, canteens, etc.

The sorting facility shall be designed to sort the mixed fraction (paper, cardboard, plastic, glass and metal) collected from the township and power plant site. It must be considered that this facility can be extended to sort other recycling fractions, in case there are other fractions that can be sold on the market.

The residual waste shall be collected and transportation to the landfill in the WMC. The landfill shall be designed for a running or operational lifetime of 25 - 30 years.

Due to the very small quantities of organic waste generated from the Township, green areas and parks, the OE did not propose expensive biological treatment technologies like anaerobic digestion etc.

B12.1 Waste Quantities

It is assumed that following waste streams will be generated by:

1. Township (from residents and commercial enterprises);
2. Power Plant;
3. Jetty (waste from the transfer barges);
4. Green areas (grass, leaves, branches, etc.).

For the design of the facilities, an amount of 0,8 kg waste / capita/day is to be assumed to be generated.

Waste producers	Township population 3,000 Plant personnel 160			
Household Waste from Township and Plant	t/day t/year	2.4 876	m³/day m³/year	12 4,380
Bulky Waste	t/day t/year	0.25 91	m³/day m³/year	1.6 584
Commercial Waste	t/day t/year	0.72 263	m³/day m³/year	4.8 1,752
Waste from Power plant	t/day t/year	0.13 47	m³/day m³/year	0.64 234
Waste from barges	t/day t/year	0,02 7.3	m³/day m³/year	0,08 29
Green/Park Waste	t/day t/year	0,17 62	m³/day m³/year	0,34 124
Total waste generation	t/day t/year	3.69 1.346	m³/day m³/year	19.46 7.103

Table 1: Waste generation at Maitree-STPP and Township

The waste streams generated shall be recycled, treated and disposed off as defined below and visualized in Table 2.

1. About 0.15 t/day of green/park waste (grass, leaves, and branches) shall be the potential for composting on the WMC.

2. About 0.7 t/day of recycling materials (papers, cardboard, metals and plastics) are to be transported to the waste recycling centre located in the WMC.

3. About 3.45 t/day of residues shall be transported and disposed off at the landfill located in the WMC.

Waste for Composting	t/day	m³/day	t/year	m³/year
Green/Park Waste (collection ratio 90% of 0.17 t/day)	0.15	0.30	54.8	110
Total waste for composting	0.15	0.3	54.8	110
Waste for Recycling	t/day	m³/day	t/year	m³year
Paper/Cardboards (Share 9.7% of 4.8 t/day; collection ratio 60%)	0.3	0.6	109.5	219.0
Metals (Share 8.8% of 4.8 t/day; collection ratio 60%)	0.25	0.50	91.3	182.5
Plastics, Glass (Share 5.1% of 4.8 t/day; collection ratio 60%)	0.15	1.5	54.8	547.5
Total waste for recycling	0.70	2.60	255.6	949.0
Waste for Disposal	t/day	m³/day	t/year	m³/year
Household waste from Township	2.4	12	876	4,380
Bulky Waste	0.2	1.2	90	450
Commercial Waste	0.7	4.6	250	1,667
Waste from Power plant	0.13	0.6	47	234
Waste from barges	0.02	0.1	5	27
Total waste for disposal	3.45	18.5	1,268	6,753

Table 2: Treatment and disposal of generated waste

The waste composition used in the calculation above has been taken from the Sources "Waste Concern Technical Document; Urban Solid Waste Management, Scenario of Bangladesh, Problems and Aspects/June 2005".

B12.2 Scope of Work

The Scope of Supply and Services for the Municipal Solid Waste Management System comprises the waste segregation at the source, waste collection, recycling, treatment and disposal of the municipal solid waste collected from the Maitree STPP Project and the Township.
This specification covers:

1. The supply of:
   - waste collection and transportation equipment and services for the township with an estimated population of 3,000 inhabitants;
   - waste collection and transportation equipment and services for the power plant with an estimated number of employees of 160;
   - waste collection and transportation equipment and services for the Jetty.
2. Provision of site and infrastructure (internal and external) for the WMC.
3. Engineering, procurement and construction of the WMC.
4. Collection of Residual Waste from Township, Power plant, Jetty and transportation to the landfill in the WMC.
5. Collection of recycling materials from Township, Power plant, Jetty and transportation to the Sorting Plant in the WMC.
6. Collection of Green Waste from parks, public green, etc. and transportation to the composting plant in the WMC.
7. Mechanical and were necessary manual sweeping, cleaning/washing and litter picking from Township, Power plant, Jetty, as well as all operated primary and secondary streets and roads, pedestrian, bus and taxi stops, etc. and transportation of the sweeping waste to the landfill in the WMC.
8. Placement of public litter bins, their maintenance and frequent collection of them.
9. Operation of the entire waste management system as described in Clause B12.2.4 below.
10. Operation and maintenance of the WMC until the Hand-Over of the Maitree-STPP to the Owner.

B12.2.1 Waste collection and transportation within for the Township

As mentioned above, next to the Power Plant a Township with an estimated population of about 3,000 will be constructed.

The Contractor shall provide for each building in the township:

- At least one (1) container to collect recycling materials from each building within the township. The size or volume of the containers to be provided by the Contractor for the residential accommodation shall be calculated based on 1.2 litres per resident and day.
- At least one (1) container to collect residual waste from each building. The size or volume of the containers to be provided by the Contractor for the residential accommodation shall be calculated based on 6 litres per resident and day.
- Sufficient number of waste baskets to be distributed on the streets, at least one waste basket each 50 meters distance.
- At least two (2) waste collection vehicles to collect the containers from each building. The size of each waste collection vehicle should be a minimum of 8 m^3 and can be optimized based on waste quantities as presented above the waste collection intervals as well as distance to the WMC. The waste collection vehicles should be able to collect all types of containers distributed in the area.
- At least one (1) open truck to collect bulky waste and green/park waste from the township and to transport the waste to the WMC. The size of the open truck shall be calculated based on the bulky waste quantities as presented above, waste collection period as well as the distance to the WMC.
- The collection frequency for the residual waste collection bins/containers shall be daily.
- The collection frequency for the recycling collection bins/containers shall be according to the requirement, but not less than once per week.
- Collection of bulky waste and green waste shall be upon request of the waste generator. The Contractor is required to implement a suitable system for announcement and collection.
- All waste collected will be transferred to the WMC.

In order to calculate the required volume for waste storage for different types of buildings, following data shall be used.

Building use	Waste storage requirements
Residential Building	6 litres per person and day
School	2 litres per pupil and day
Restaurants	2 litres per dining space and day
Commercial Enterprise	15 litres per 10 m^2 of floor space and day
Offices	3 litres per 10 m^2 of floor space and day
Mosque	120 litre bin per mosque for residues 120 litre bin per mosque for paper
Hotel	11 litres per room and day

Table 3: Waste Storage requirements for buildings

In order to design the waste storage area required in each waste collection point, following data shall be considered.

Bin / Container size	Waste storage area requirements
120 litres	0.5 x 0.6 m per bin
240 litres	0.6 x 0.8 m per bin
660 litres	1.6 x 1.2 m per bin
1,100 litres	1.6 x 1.6 m per container

Table 4: Container Storage requirements

B12.2.2 Waste collection from Maitree-STPP

The Contractor shall provide a sufficient number of containers to collect and store the waste generated in the power plant as well as the Jetty. Each building in the Power Plant and the Jetty shall be provided with a minimum of the following:

- At least one (1) container to collect the residual waste. The size or volume of the containers shall be calculated based on the table below.
- At least one (1) container to collect papers. The size or volume of the containers shall be calculated based on the table below.
- The collection frequency for the residual waste collection bins/containers shall be daily.
- The collection frequency for the paper collection bins/containers shall be according to the requirement, but not less than once per week.

Building	Waste storage requirements
Canteen	1.500 litres per 20 dining spaces
Offices Residual Waste Papers/cardboard	 3 litres per 10 m² of floor space and day 240 litres per 100 m² of floor space 750 litres per 250 m² of floor space 1,100 litres per 500 m² of floor space
Mosque	120 litres bin per mosque for residues 120 litres bin per mosque for paper

Table 5: Waste storage requirements for different use

B12.2.3 Waste recycling/composting and disposal centre

The Contractor shall design, procure and construct a WMC comprising the following:

1. One recycling plant to separate the content of the recycling bins in the different fractions papers, cardboard, plastics, glass and metals. The capacity of the plant shall be about 700 kg/day (256 t/year) and shall be designed to allow future extension as needed. The generated recyclables shall be marketed by the Contractor.

2. One windrow composting facility for green and park wastes. The capacity of the plant shall be in the beginning about 150 kg per day. The generated compost shall be used as fertilizer for the green areas and parks in the township and power plant.

3. One landfill for the disposal of the waste which cannot be recycled or composted. The capacity of the landfill shall be designed for 4.0 t/day or 1,460 t/year.

4. A depot for all mobile equipment used for operation of the waste management system.

5. All environmental control and monitoring equipment and systems including laboratory.

6. All infrastructures required for access and operation of the WMC.

B12.2.3.1 Site selection

The Contractor shall identify the site for the WMC in cooperation with the Owner. The following main activities must be considered:

1. Preparation of site selection study and identification of the best suitable site for this centre. The site selection study shall consider the existing local and national environmental legislations as well as Worldbank standards. The selected site shall be suitable and available for 25 - 30 years. The area required for the WMC is estimated to be 15 ACRE.

2. The Contractor shall undertake for the selected site all required environmental studies, site investigation, and geological and hydrogeological as well as topographical survey as requested by the responsible environmental authorities.

3. The Contractor is responsible to get approval for the selected site from all responsible authorities.

B12.2.3.2 Landfill

1. As soon as the site for the WMC has been selected and approved by all responsible authorities, the Contractor shall prepare a preliminary overall design for the possible complete lifetime of this Centre comprising the landfill site, composting plant and sorting plant. The Landfill shall be designed to receive 4 t/day or 1,460 t/year and shall be divided into cells. Each cell shall be designed for a lifetime of approx. 5 years. The preliminary design shall demonstrate the final shape of the complete Landfill as it might be after the possible complete lifetime. The Contractor shall develop only those cells, which are needed for the term of this Agreement.

2. The Contractor shall be responsible for the construction of an access road to connect the Township and the Power Plant to the WMC.

3. The Contractor shall prepare the detailed design only for the 1st cell required for the first landfill operation period of 5 years. This design must be approved by the Owner.

4. The landfill body shall be developed during the operation in such geometry to ensure long-term stability. The height of the landfill body will rise in accordance with the emplaced waste. Thus, the maximum slope of the waste body must be 1:3 to allow long-term stability. The waste body must be designed accordingly.

5. The landfill shall be equipped with a basal liner in accordance with Annex 1 of the European Union COUNCIL DIRECTIVE 1999/31/EC on the landfill of waste. It shall be assumed, that no geological barrier does exist. The complete barrier shall be designed artificially with the basal liner system. No slope of the basal liner shall be steeper than 1:2.

6. A leachate drainage system shall be installed above the basal liner. The leachate shall be collected to a leachate pond sealed with an impermeable liner. The leachate pond shall have a capacity to receive the average leachate quantity of 20 consecutive days or the quantity after 3 days continuous heavy rainfall, whatever is larger. The leachate shall be treated prior to discharge to a quality permitted by local regulations to be discharged to surface water.

7. After being filled each cell shall be covered provisionally, until a final capping will be installed. Each completed cell shall have a sloped surface not exceeding a slope of 1:3. Until construction of the final capping a provisional capping need to be added to all closed areas.

8. The final capping with a sealing impermeable to water to prevent infiltration of rain shall be installed.

9. All temporary landfill roads shall be constructed to allow use by the vehicles delivering waste or any other material to be landfilled at any season and weather conditions. Building rubble or gravel might be used for construction. Separate roads shall be constructed for landfill compactors and bulldozers.

10. An appropriate drainage system shall be implemented for rain water coming from those parts of the site where no waste is handled. The rain water retention basin shall be designed to ensure storage of all rainfall from the site at a defined discharge of no more than 10 l/s.

11. The site shall be separately surrounded by a fence of 2 m height and 3 rows of protecting wire and a gate, which can be locked during hours of no operation.

12. The Contractor shall ensure at all times a sufficient number of equipment and vehicles required for the operation of the WMC will be available.

13. The Centre shall be equipped with a wheel washing facility so that dirt and litter originating from the site is not dispersed onto public roads and the surrounding land.

14. The Contractor shall establish a control and monitoring system as requested by the local authorities. Minimum requirements are a monitoring system for all incoming waste, indicating at least source of waste, quantity (weight) and date.

15. Waste shall be deposited in layers not exceeding a thickness of 0.5 m. Each layer has to be compacted thoroughly prior to deposition of the next layer. In total the emplaced waste shall have an average density of more than 800 kg/m³.

16. The Contractor shall take appropriate measures to prevent water from precipitation entering into the landfill body.

17. Delivered waste has to be covered with soil or other suitable material and sloped at the end of each working day.

18. It is prohibited under any circumstances to burn waste at the site or at any waste collection point outside the Centre.

19. Around the landfill the Contractor shall install, operate and maintain groundwater monitoring wells. One (1) of the wells shall be located upstream of the groundwater flow in order to receive quality data of clean groundwater and two (2) wells shall be located downstream. Groundwater samples shall be taken at least once a month and analyzed. In case of indication of pollution of the groundwater, the Contractor shall immediately inform the responsible authorities.

20. After final filling, a covering system on the final waste surface shall be constructed. This system consists of a drainage gravel layer overlaid by a top soil layer. For both components, the applied slopes of 1:3 will be stable.

B12.2.3.3 Composting plant

1. The Contractor is responsible to construct a community composting plant with a design capacity of 150 kg/day in order to treat green and park waste (grass, leaves, branches, etc.) generated on the township and power plant site.

2. The Contractor is requested to submit a general layout and arrangement drawings (plan views of all operating levels, sections, etc.) of the Plant offered. The local site conditions are to be shown in a General Layout Drawing.

3. The input material shall be converted into a high quality compost using the Windrow Technique (a non-mechanised aerobic and thermophile composting procedure). During the thermophilic phase, which commences very rapidly, the compost piles are turned frequently to regulate their temperature and ensure an equal decomposition level throughout the pile. The mature compost shall then be screened (4 and 2mm mesh sizes) and prepared for further use and marketing. The intense composting time shall be at least one month and the post composting time 6 months.

4. The composting plant shall consist of 3 main components: the mechanical treatment (shredding), the intense composting section and the post composting section with refinement of the compost product.

5. The scope of supply shall cover all parts which are necessary for the safe operation of the composting facilities to avoid noise and dust emissions and give protection against bad weather. This includes also all mobile equipment for operation of the facility.

6. The composting area shall be covered by lightweight construction. The floor shall be constructed of concrete with a surface fall towards the collection pits. In the discharging areas, where the trucks are unloaded, there shall be sufficient collection pits for drainage purposes.

7. The fine compost fraction shall have a grain size of up to 10-15 mm to establish a high quality product.

8. The plant and its process shall be designed to generate a minimum of environmental pollution and under all operating conditions to comply with all local and national acts and regulations.

B12.2.3.4 Recycling plant

1. The Contractor shall conduct a marketing study for waste recycling. In this study the possibility of selling the waste fractions (paper, cardboard, plastic, glass and metals) shall be investigated as well as the revenues generated from selling those fractions to recycling companies.

2. The Contractor will be responsible to construct a community sorting plant with a design capacity of 700 kg/day in order to sort the mixed fraction collected from the Township and Power Plant site.

3. The Contractor is requested to submit a general layout and arrangement drawings (plan views of all operating levels, sections, etc.) of the sorting plant offered. The local site conditions are to be shown in a General Layout Drawing.

4. The sorting plant shall consist of 3 main components: the receiving area, the sorting area and the balling area.

5. The scope of supply shall cover all parts which are necessary for the safe operation of the sorting facility to avoid noise and dust emissions and give protection against bad weather.

6. The sorting facility shall be covered by lightweight construction. The floor shall be constructed of concrete with a surface fall towards the collection pits. In the discharging areas, where the trucks are unloaded, there shall be sufficient collection pits for drainage purposes.

7. Minimum requirements: The sorting area will have a long sorting table of approx. 5 x 1.5 m and 20 of 240 litres storage bins for the sorted fractions. The Contractor may propose an alternative system for optimized operation.

8. The Contractor shall provide a bale press to compact the sorted plastic materials, paper and cardboard. The minimum throughput capacity of this press shall be 1 t/d.

9. The plant and its process shall be designed to generate a minimum of environmental pollution and under all operating conditions to comply with all local and national acts and regulations.

B12.2.4 Operation of the waste management system including the WMC

1. The Contractor is responsible to operate the entire waste management system comprising also the waste collection and transportation system, the WMC as specified above until the Hand-Over of the Maitree-STPP to the Owner.

2. The Contractor shall keep all facilities used for performing the services in good repair, appearance and sanitary condition and ensure a sufficient supply of spare parts on hand to ensure the timely and continuous performance of the services.

3. The Contractor shall renew any equipment or component of equipment at its own expenses whenever needed for proper performance of the Services.

4. All Facilities shall be operated by qualified and skilled operators. The Contractor shall ensure, that sufficient operating staff is available at the site at any operating time required.

5. In case of any long term unscheduled outages of the disposal facility the Contractor shall ensure alternative disposal of waste in accordance with the applicable regulations at its own expenses until operation of WMC can continue.

6. The Contractor shall immediately purchase, rent, or lease vehicles and equipment to satisfy additional demand in transportation capacity or replace retired vehicles and equipment.

7. Treatment of delivered waste shall be carried out in less than 12 hours upon delivery in order to prevent degradation, odor, formation of leachate, wastewater and attraction of vermin and insects.

8. The Contractor shall take adequate measures to prevent the attraction of vermin and rodents.

During the operation phase Quarterly and Annual Reports shall be submitted on the technical performance of the Services one month after the end of the respective quarter or year. These reports shall include any information in relation to the Services and issued to the Owner.'

The report shall include the following Table of Contents:

1. Landfill operation:
   - Emplaced waste types and quantities;
   - Quantities of leachate collected and treated;
   - Results of analysis of discharged leachate;
   - Results of surface water and ground water monitoring data;
   - Results of annual survey (only in annual report);
   - Remaining volume and lifetime of landfill;
   - Replacements of vehicles or staff;
   - Log of problems, outages, breakdowns etc.

2. Composting Facility:
   - Received waste types and quantities;
   - Compost quantities produced;
   - Compost quantities on store;
   - Compost quantities sold/taken off (broken down per use and off taker);
   - Results of compost analysis;
   - Quantities of waste water collected and treated;
   - Analysis of discharged waste water;
   - Replacements of vehicles, machinery or staff;
   - Report on marketing activities;
   - Log of problems, outages, breakdowns etc.

3. Recycling Facility:
   - Received waste types and quantities;
   - Material types separated, products produced and their quantities, (broken down per use and off taker);
   - Replacements of vehicles, machinery or staff;
   - Report on marketing activities;
   - Quantities of waste water collected and treated and results of analysis;
   - Log of problems, outages, breakdowns etc.

The indicative Lay-Out of the Maitree-STPP and the Township and other surveys are attached in Part "C" of the Functional Technical Specification.

ANNEXURE XII

INPUT DRAWINGS

S. NO.	DRAWING TITLE
1.	PLOT PLAN INDICATING LOCATION OF BINS FOR ROADS OF POWER PLANT (EXCLUDING TOWNSHIP) FOR SOLID WASTE MANAGEMENT SYSTEM
2.	LAYOUT OF TOWNSHIP
3.	PLOT PLAN

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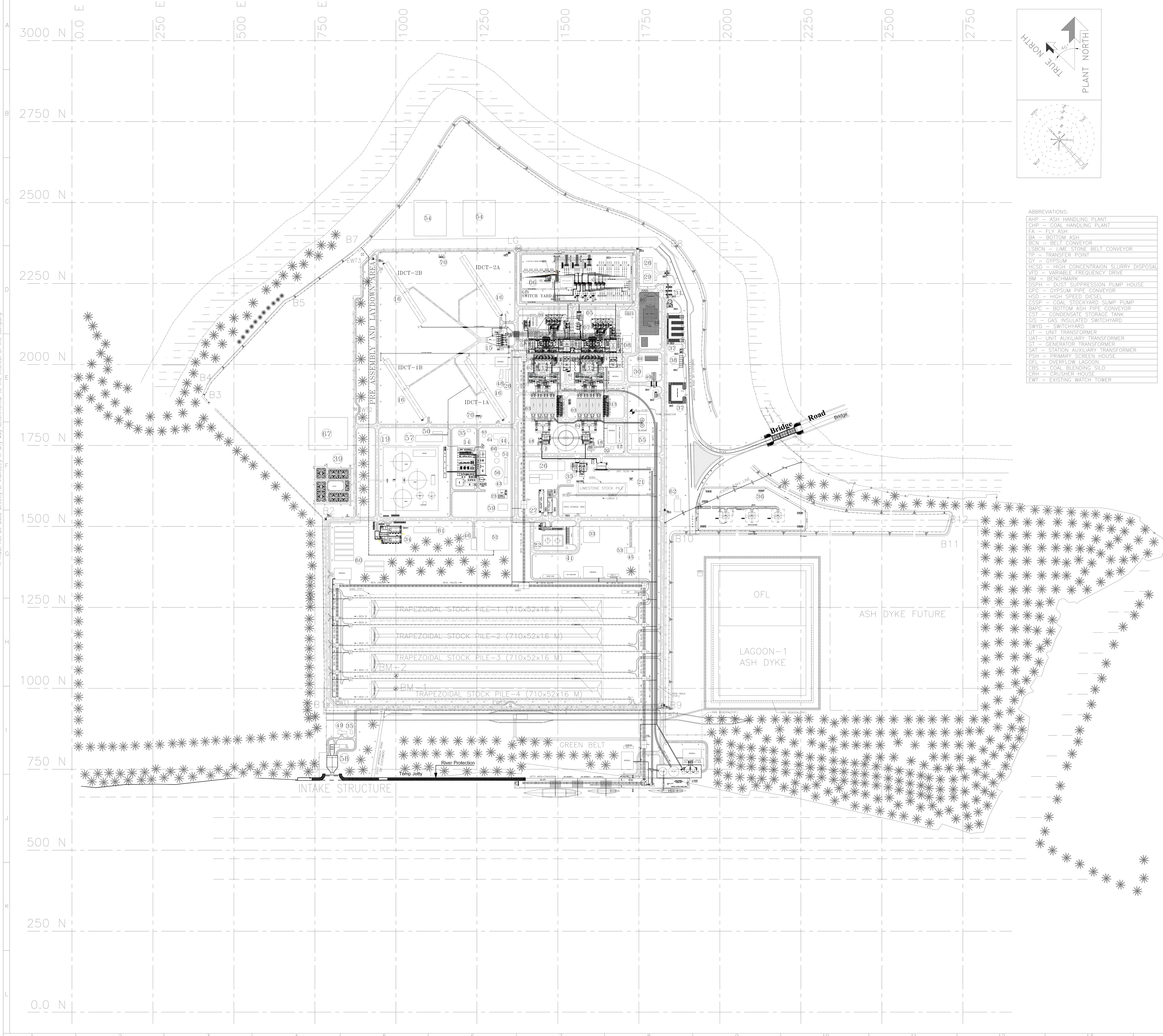
it must not be used directly or indirectly in any way deterimental to the interest of the company.

COMPUTER FILE NAME: Maitree-0-MA-LD-421100M001PEM-C

DRAWING NO. MAITREE-0-MA-LD-421100M001PEM-C

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



ITEM NO.	DESCRIPTION
1.	TG BUILDING
2.	BOILER AREA
3.	ELECTROSTATIC PRECIPITATOR
4.	CHIMNEY
5.	TRANSFORMER YARD
6.	SWITCH YARD
7.	DIESEL GENERATOR HOUSE
8.	SERVICE BUILDING
9.	COMPRESSOR HOUSE
10	CONDENSATE STORAGE TANK, TRANSFER PUMP HOUSE & BOILER FILL PH
11	CENTRAL CONTROL BUILDING
12	AHP COMPRESSOR HOUSE
13	ESP/VFD CONTROL ROOM
14	RO DM PLANT
15	COOLING WATER PUMP HOUSE
16	COOLING TOWER
17	ASH HANDLING UNIT
18	FGD
19	PT PLANT WITH CHEMICAL HOUSE
20	CW TREATMENT PLANT
21	LIMESTONE STOCK PILE
22	FUEL OIL AREA
23	AUX BOILER
24	MILL BAY
25	POTENTIAL RAIN WATER RETENTION POND (NOT SHOWN)
26	WORK SHOP
27	O & M STORE/PERMANENT STORE
28	AUDITORIUM
29	ADMIN BUILDING
30	CANTEEN
31	MAIN GATE HOUSE
32	DELETED
33	SPACE FOR STEEL STORAGE YARD
34	CUSTOMER OFFICE
35	LOCAL SERVICE BUILDING
36	HELIPAD
37	PARKING (CAR, TRUCK TRAILER)
38	SHOPS, WAITING COMPLEX, REST ROOM & PRAYER HALL.
39	LIVING ACCOMMODATION
40	FIRE STATION AND DRILL TOWER
41	FOAM PUMP HOUSE
42	BOOSTER PUMP
43	FIRE WATER PUMP HOUSE
43a	DELETED
44	CPU REGENRATION
45	HYDROGEN PLANT
46	SEWAGE TREATMENT PLANT
47	CPU VESSEL AUXILLARIES
48	GAS CHLORINATION FOR CWPH
49	GAS CHLORINATION FOR RIVER INTAKE
50	CW MAKE UP & DESALINATION FEED WATER P/H.
51	CLARIFIED P/H
52	ETP
53	GAS CYLINDER ROOM
54	SOLID WASTE TREATMENT PLANT
55	FGD WASTE WATER TREATMENT PLANT
56	DESALINATED WATER STORAGE TANK
57	PRE TREATED WATER STORAGE TANK
58	INTAKE PUMP HOUSE & DESILTING CHAMBER
59	CHEMICAL LAB
60	SITE STORE(TEMPORARY)
61	BHEL SITE OFFICE (TEMPORARY)
62	SUB STATION(TEMPORARY)
63	SERVICE WATER STORAGE TANK
64	POTABLE WATER TANK FOR PLANT
65	WEIGH BRIDGE
66	DM STORAGE TANK
67	BHEL FIELD HOSTEL (TEMPORARY)
68	CUSTOMER AREA
69	EXISTING STORE BY CUSTOMER
70	SWITCHGEAR FOR COOLING TOWER

ABBREVIATIONS:

AHP – ASH HANDLING PLANT
CHP – COAL HANDLING PLANT
FA – FLY ASH
BA – BOTTOM ASH
BCN – BELT CONVEYOR
LSBCN – LIME STONE BELT CONVEYOR
TP – TRANSFER POINT
GY – GYPSUM
HCSD – HIGH CONCENTRAION SLURRY DISPOSAL
VFD – VARIABLE FREQUENCY DRIVE
BM – BENCHMARK
DSPH – DUST SUPPRESSION PUMP HOUSE
GPC – GYPSUM PIPE CONVEYOR
HSD – HIGH SPEED DIESEL
CSSP – COAL STOCKYARD SUMP PUMP
BAPC – BOTTOM ASH PIPE CONVEYOR
CST – CONDENSATE STORAGE TANK
GIS – GAS INSULATED SWITCHYARD
SWYD – SWITCHYARD
UT – UNIT TRANSFORMER
UAT – UNIT AUXILIARY TRANSFORMER
GT – GENERATOR TRANSFORMER
SAT – STATION AUXILIARY TRANSFORMER
PSH – PRIMARY SCREEN HOUSE
OFL – OVERFLOW LAGOON
CBS – COAL BLENDING SILO
CRH – CRUSHER HOUSE
EWT – EXISTING WATCH TOWER

LEGEND:

1. ROADS (DOUBLE LANE) . . . . (SHOULDER LINE, PAVEMENT LINE)
   ROADS (SINGLE LANE) . . . .
2. BOUNDARY WALL . . . . (IN CUSTOMER'S SCOPE)
3. LIMITS OF EARTH FILLING . . . .
4. GREEN BELT . . . .
5. EXIST. 33KV LINE . . . .
6. FENCING . . . .
7. COMPACTOR ENABLED BINS OF PVC . . ☐

NOTES

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. FINISH FLOOR LEVEL = RL (+)5.60 M, CORRESPONDS TO PLANT EL 0.0M WHICH IS GROUND FLOOR OF STG BUILDING. FINISHED GROUND LEVEL SHALL BE RL.(+)5.0M
3. LOCATION/SIZES OF VARIOUS FACILITIES/BUILDINGS ARE TENTATIVE ONLY, SHALL BE FINALISED DURING DETAIL ENGINEERING.
4. CO-ORDINATE SYSTEM:-

BENCH MARK	EARLIER CO-ORDINATES AS PER		REVISED CO-ORDINATES	
	NORTH COORD.	EAST COORD.	NORTH COORD.	EAST COORD.
BM-1	497991.883	454127.265	1000	1000
BM-2	-	-	1040.405	1000.750

GRID HAS BEEN ROTATED W.R.T. BM-1.
COORDINATE OF BM-2 IS DERIVED AFTER ROTATION W.R.T. BM-1.

DATE	ALTERED	CHECKED	APPROVED	NOTE

PROJECT: 2x660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH (EPC MAIN PLANT PACKAGE)

OWNER CONSULTANT: FICHTNER M/s FICHTNER GmbH & Co KG, Stuttgart,GERMANY

OWNER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NOIDA

SCALE: 1:4000 | SHEET 1 OF 1

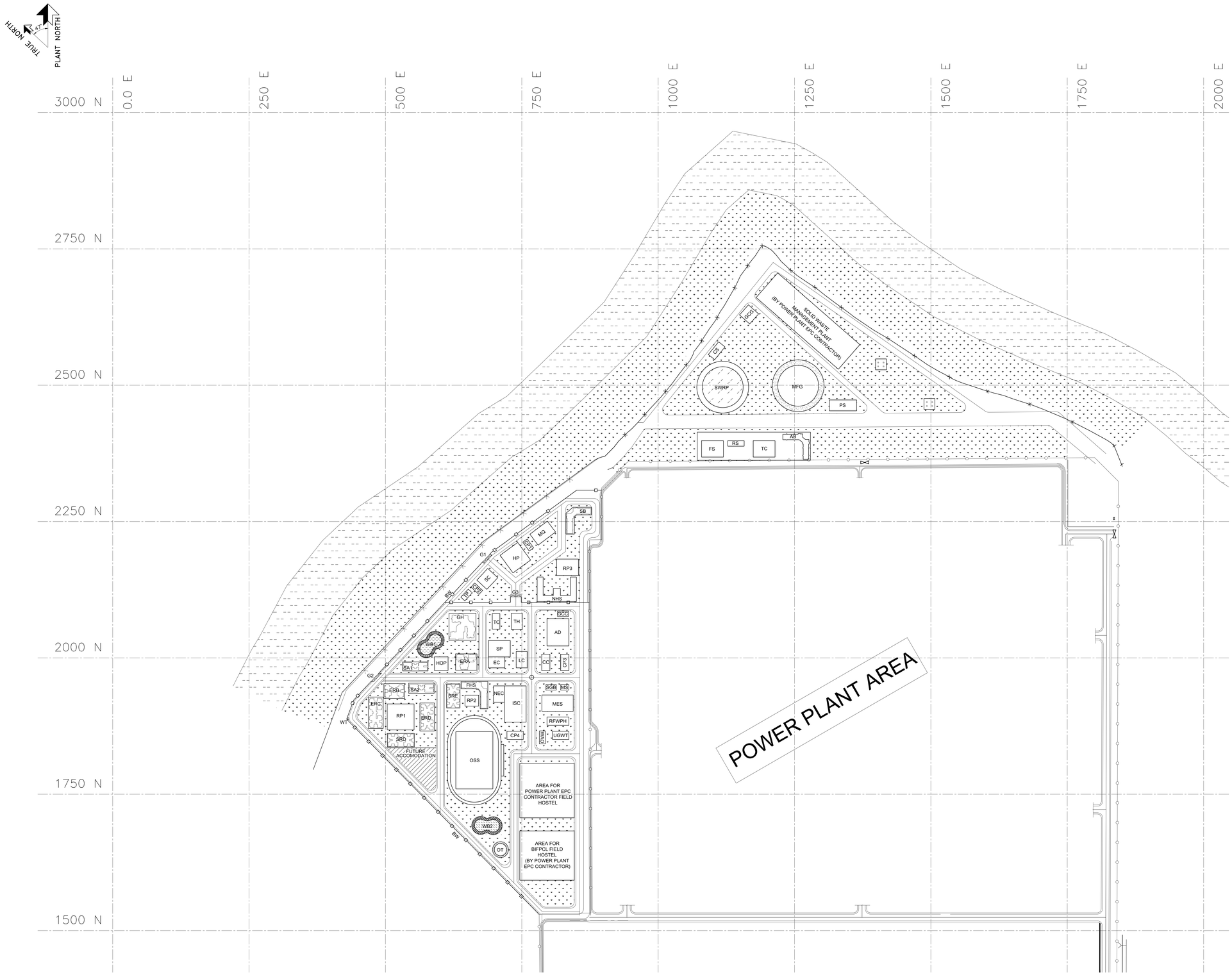
DRAWN BY | DESIGN BY | CHECKED BY | APPROVED BY | SUPERSEDES: | SUPERSEDED BY: | SYSTEM: | DATE | NAME

TITLE: PLOT PLAN INDICATING LOCATION OF BINS FOR ROADS OF POWER PLANT (EXCLUDING TOWNSHIP) FOR SOLID WASTE MANAGEMENT PLANT

SIZE: A0 | PROJECT NO.: 421 | FILE: | ANNEX: - | DRAWING NO.:MAITREE-0-MA-LD-421100M001PEM-C | REV C

SIZE-A0

CUSTOMER'S DRAWING NO.



SI NO	AREAS IN TOWNSHIP	LEGEND
	A - OUTSIDE TOWNSHIP AREA	
1	POLICE STATION	PS
2	MONUMENT AND FLOWER GARDEN	MFG
3	CYCLONE SHELTER	CS
4	STORM WATER RETENTION POND	SWRP
5	GAS CYLINDER GODOWN	GCG
6	ARMY BARRACKS	AB
7	TRANSPORT CENTER	TC
8	ROW OF SHOPS	RS
9	FUEL STATION	FS
	B - OPEN AREAS	
1	BOUNDARY WALL	BW
2	GATE AND SECURITY	G1, G2 & G3
3	CAR PARKS	CP1,CP2,CP3 & CP4
4	RECREATIONAL PARK	RP1, RP2 & RP3
5	WATER BODY	WB1 & WB2
	C - PUBLIC ACCESS ZONE	
1	SECURITY BARRACKS	SB
2	NURSERY AND HIGH SCHOOL	NHS
3	MOSQUE	MQ
4	HOSPITAL	HP
5	SHOPPING CENTER	SC
6	TEMPLE	TP
	D - RESIDENTIAL BUILDINGS	
1	HOP BUNGALOW	HOP
2	GUEST HOUSE	GH
3	STUDIO APARTMENTS	SA1 & SA2
4	EXECUTIVE RESIDENCE – A	ERA
5	EXECUTIVE RESIDENCE – B	ERB
6	EXECUTIVE RESIDENCE – C	ERC
7	EXECUTIVE RESIDENCE – D	ERD
8	STAFF RESIDENCE – D	SRD
9	STAFF RESIDENCE – E	SRE
10	FIELD HOSTEL – STAFF	FHS
11	TRAINEES HOSTEL	TH
	E - NON-RESIDENTIAL BUILDINGS	
1	AUDITORIUM	AD
2	COMMUNITY CENTER	CC
3	LADIES CLUB & BAL BHAVAN	LC
4	EXECUTIVE CLUB	EC
5	NON–EXECUTIVE CLUB	NEC
6	TRAINING CENTER	TC
7	WELFARE ASSOCIATION OFFICE	WAO
8	SWIMMING POOL	SP
9	INDOOR SPORTS COMPLEX	ISC
10	OUTDOOR SPORTS STADIUM	OSS
11	RAW WATER AND FIRE WATER PUMP HOUSE	RFWPH
12	MAIN ELECTRIC SUBSTATION	MES
13	MAINTENANCE STORE	MS
14	UG WATER TANK	UGWT
15	OBSERVATION TOWER	OT
16	SWITCHGEAR BUILDING	SGB
17	WATCH TOWER	WT
18	GARBAGE COLLECTION CENTER	GCC

REVIEW PRINT
01.06.2017

NOTES

1. GRID LINES ARE DRAWN IN 250M INTERVALS.
2. ALL DIMENSIONS ARE IN METERS AND LEVELS ARE IN METERS, UNO.
3. DO NOT SCALE THE DRAWING FOLLOW WRITTEN DIMENSIONS ONLY.
4. ARRANGEMENT OF THE BUILDINGS AND FACILITIES SHOWN IN THE DRAWING IS PRELIMINARY.

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	PROC.	ELEC.	INST.
				APPROVED BY				
A	01.06.17	FOR TENDER PURPOSE	CS	MAP				

FICHTNER

TOWNSHIP
2x660 MW MAITREE STPP

LAYOUT OF TOWNSHIP

	SIGNATURE	DATE
DRAWN	CS	01.06.17
DESIGNED	LK	01.06.17
CHECKED	MAP	01.06.17
DEPT.HEAD	ST	01.06.17
PROJ.MGR.	MAP	01.06.17

RELEASED FOR

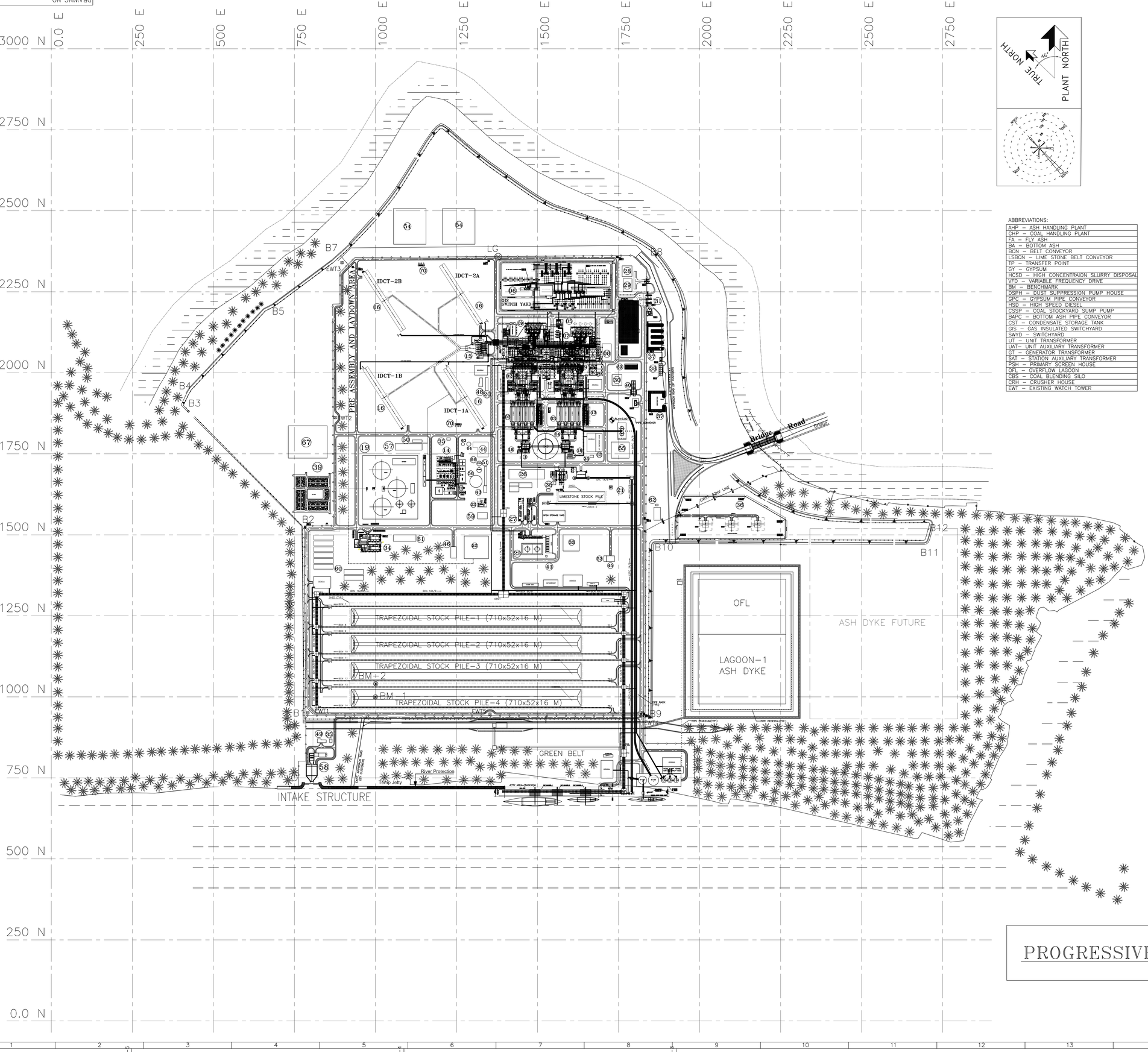
PRELIMINARY	
TENDER	✓
ENGINEERING	
CONSTRUCTION	

DEPT. CIVIL | JOB NO. 1114129 | SCALE: 1:1000 | REV.

DWG.NO. 00–1114129–C–001 | A

RA–a SIZE–A0

THIS IS THE PART OF TECHNICAL SPECIFICATION NO: PE-TS-421-177-A001
FIRST ANGLE PROJECTION
ALL DIMENSIONS ARE IN MM
DRAWING NO. MAITREE-O-MA-LD-421100M001PEM-C
CUSTOMER'S DRAWING NO.



ITEM NO.	DESCRIPTION
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2.	BOILER AREA
3.	ELECTROSTATIC PRECIPITATOR
4.	CHIMNEY
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30	CANTEEN
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32	DELETED
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35	LOCAL SERVICE BUILDING
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43a	DELETED
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48	GAS CHLORINATION FOR CWPH
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50	CW MAKE UP & DESALINATION FEED WATER P/H.
51	CLARIFIED P/H
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64	POTABLE WATER TANK FOR PLANT
65	WEIGH BRIDGE
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67	BHEL FIELD HOSTEL (TEMPORARY)
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69	EXISTING STORE BY CUSTOMER
70	SWITCHGEAR FOR COOLING TOWER

ABBREVIATIONS:

AHP	ASH HANDLING PLANT
CHP	COAL HANDLING PLANT
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BA	BOTTOM ASH
BCN	BELT CONVEYOR
LSBCN	LIME STONE BELT CONVEYOR
TP	TRANSFER POINT
GY	GYPSUM
HCSD	HIGH CONCENTRAION SLURRY DISPOSAL
VFD	VARIABLE FREQUENCY DRIVE
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GPC	GYPSUM PIPE CONVEYOR
HSD	HIGH SPEED DIESEL
CSSP	COAL STOCKYARD SUMP PUMP
BAPC	BOTTOM ASH PIPE CONVEYOR
CST	CONDENSATE STORAGE TANK
GIS	GAS INSULATED SWITCHYARD
SWYD	SWITCHYARD
UT	UNIT TRANSFORMER
UAT	UNIT AUXILIARY TRANSFORMER
GT	GENERATOR TRANSFORMER
SAT	STATION AUXILIARY TRANSFORMER
PSH	PRIMARY SCREEN HOUSE
OFL	OVERFLOW LAGOON
CBS	COAL BLENDING SILO
CRH	CRUSHER HOUSE
EWT	EXISTING WATCH TOWER

LEGEND:

1. ROADS (DOUBLE LANE) . . . . . SHOULDER LINE / PAVEMENT LINE
   ROADS (SINGLE LANE) . . . . .
2. BOUNDARY WALL . . . . . (IN CUSTOMER'S SCOPE)
3. LIMITS OF EARTH FILLING . . . . .
4. GREEN BELT . . . . .
5. EXIST. 33KV LINE . . . . .
6. FENCING . . . . .

NOTES

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. FINISH FLOOR LEVEL = RL (+)5.60 M, CORRESPONDS TO PLANT EL 0.0M WHICH IS GROUND FLOOR OF STG BUILDING. FINISHED GROUND LEVEL SHALL BE RL.(+)5.0M
3. LOCATION/SIZES OF VARIOUS FACILITIES/BUILDINGS ARE TENTATIVE ONLY, SHALL BE FINALISED DURING DETAIL ENGINEERING.
4. CO-ORDINATE SYSTEM:-

BENCH MARK	EARLIER CO-ORDINATES AS PER		REVISED CO-ORDINATES	
	NORTH COORD.	EAST COORD.	NORTH COORD.	EAST COORD.
BM-1	497991.883	454127.265	1000	1000
BM-2	-	-	1040.405	1000.750

GRID HAS BEEN ROTATED W.R.T. BM-1.
COORDINATE OF BM-2 IS DERIVED AFTER ROTATION W.R.T. BM-1.

PROGRESSIVE COPY

	DATE	ALTERED	CHECKED	APPROVED	NOTE
C	21.02.17	KK	SK	JJ	1. DRAWING REVISED AS PER FICHTNER COMMENTS DATED 08.06.16 2. CHP/AHP LAYOUT, WATCH TOWERS, INTAKE AREA ROAD LAYOUT, FIRE STATION, DRILL TOWER, CUSTOMER OFFICE, STORES, MAIN GATE, ADMIN BLDG, PARKING, SHOPPING COMPLEX, RO-DM PLANT, PRE-ASSEMBLY AREA UPDATED. 3. SWITCHYARD SHIFTED TO MATCH WITH ROAD AND REVISED CO-ORDINATES OF TAKE-OFF SANTRES MARKED IN NEW & OLD CO-ORDINATE SYSTEM.
B	27.05.16	KK	SK	JJ	DRAWING REVISED AS PER FICHTNER COMMENTS DATED 04.05.16
A	02.04.16	KK	SK	JJ	DRAWING REVISED AS PER FICHTNER COMMENTS DATED 18.03.16

PROJECT
2x660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH (EPC MAIN PLANT PACKAGE)

OWNER CONSULTANT:
FICHTNER
M/s FICHTNER GmbH & Co KG, Stuttgart,GERMANY

OWNER:
BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NOIDA

	DATE	NAME
DRAWN BY	29/02/16	SD
DESIGN BY	29/02/16	SD/KK
CHECKED BY	29/02/16	SK
APPROVED BY	29/02/16	JJ
SUPERSEDED		
SUPERSEDED BY:		
SYSTEM		

SCALE: 1:4000
SHEET 1 OF 1

TITLE
PLOT PLAN

SIZE: A0 | PROJECT NO: 421 | FILE:Maitree-O-MA-LD-421100M001PEM-C
ANNEX: - | DRAWING NO:MAITREE-O-MA-LD-421100M001PEM-C | REV C
SIZE-A0

COMPUTER FILE NAME: Maitree-O-MA-LD-421100M001PEM-C

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ANNEXURE- XIII

SEA WORTHY PACKING

PACKING AND MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. Packing shall be done to ensure protection against the coastal environment prevailing at site.

All equipment's shall be delivered in containers suitable for the transit as well as for storage at site. In case any item is not possible to be containerized due to dimensional limitations, then the storage of the same shall be as per the guidelines given under Sub section IIA of this specification.

The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing. Packing and shipping instructions shall be as detailed below.

	TITLE	SPECIFICATION NO. **PE-TS-888-100-A001**
	TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	VOLUME II B
		SECTION D
		REV. NO. 0 DATE 10/08/2010
		SHEET 1 OF 52

1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

2.0 **SCOPE**

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.

3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

4.0 Definitions

"BHEL" : Main EPC vendor

"OWNER" : Customer for a particular export project.

"VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.

"GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.

"PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .

"FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

5. General Information

The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves VENDOR of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support GOODS during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the GOODS to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the GOODS during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When VENDOR do not have packing capabilities/facilities of their own and therefore intends to sub-contract, VENDOR have to inform BHEL/Purchaser of the name and address of proposed PACKER(s) for approval.

6.0 Criteria for Selection of Packaging

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the GOODS have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If VENDOR has any doubt about the correct method of protection or packing, he should contact BHEL/Purchaser in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
-

Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

6.1 Hazardous Materials

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

6.2 Non-Hazardous GOODS

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

	TITLE	SPECIFICATION NO. **PE-TS-888-100-A001**
	TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	VOLUME II B
		SECTION D
		REV. NO. 0 DATE 10/08/2010
		SHEET 3 OF 52

7. 0 Marking Instructions & Despatch details, Storage Code

7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- **"KEEP DRY"**

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.

The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.

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7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour.**

X Crates or packages to be stored outdoor without covers
XX Crates or packages to be stored under tarpaulin
XXX Crates or packages to be stored in covered or enclosed premises
XXXX Crates or packages which must be stored in air-conditioned premises

8.0 GUIDELINES FOR PACKING GOODS

8.1 In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

IMPORTANT NOTE:
Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.

8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.
All pipes **2"** included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.
All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

8.1.4 Structural Steel

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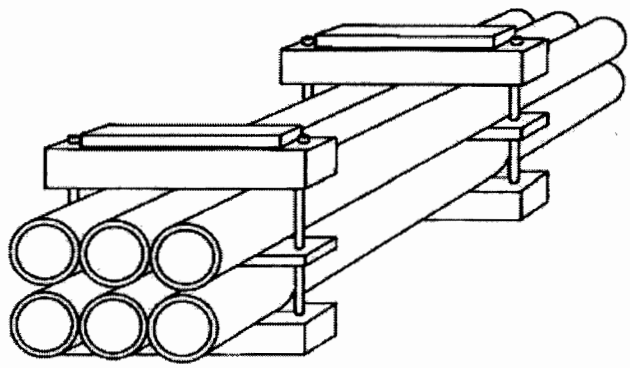
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

8.2 Bundling – Packing Category I

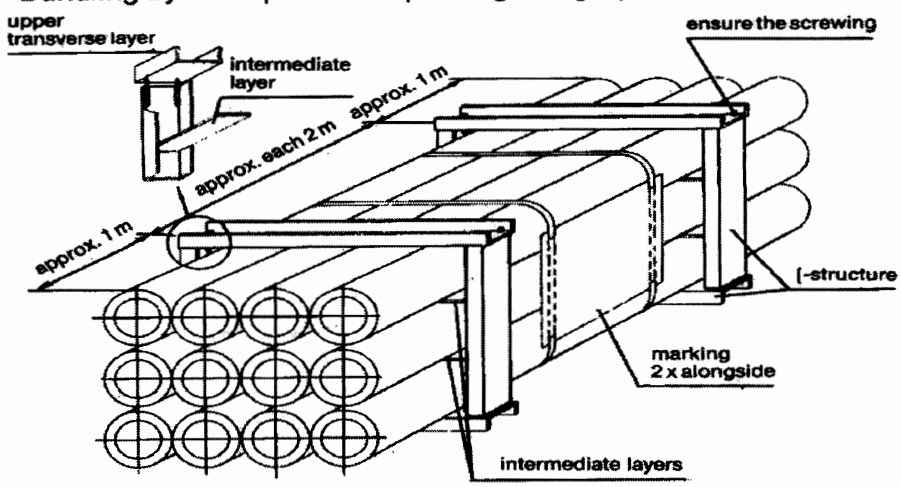
8.2.1 Type of Equipment

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.

Packing category I



Bundling by U-shaped iron – packing category I A



8.2.2 Type of Construction

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Bundling has to be effected

- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

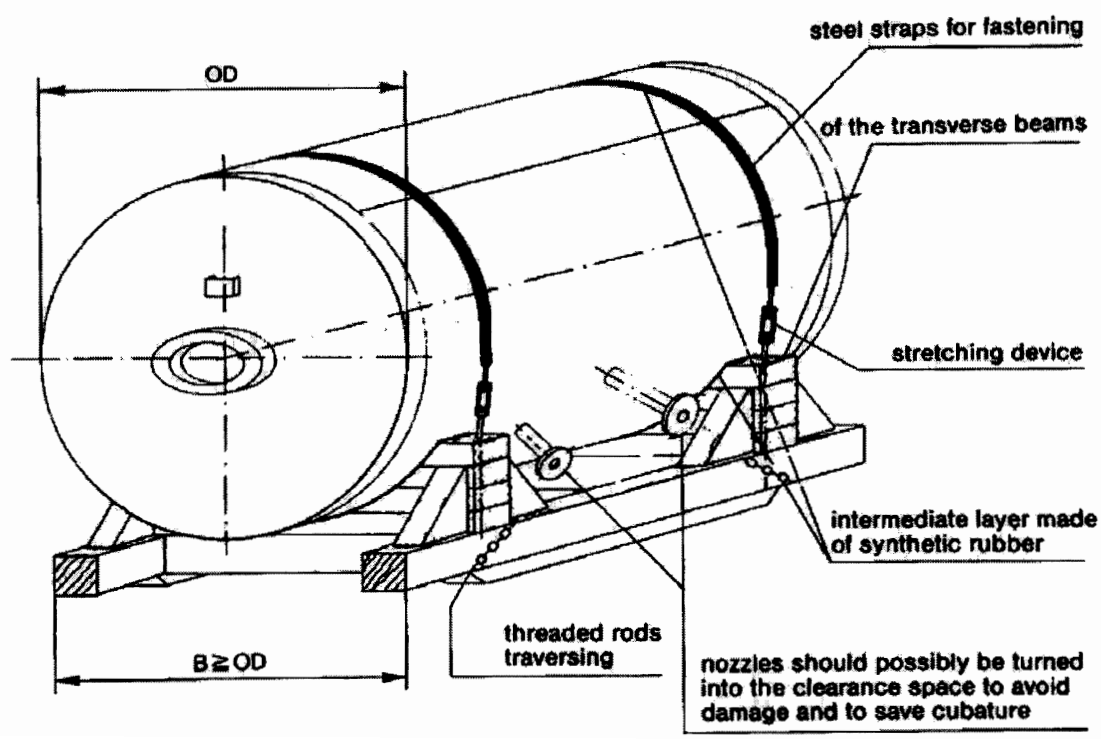
8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



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8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.

8.4.1 Packing Category III

8.4.1.1 Type of Equipment

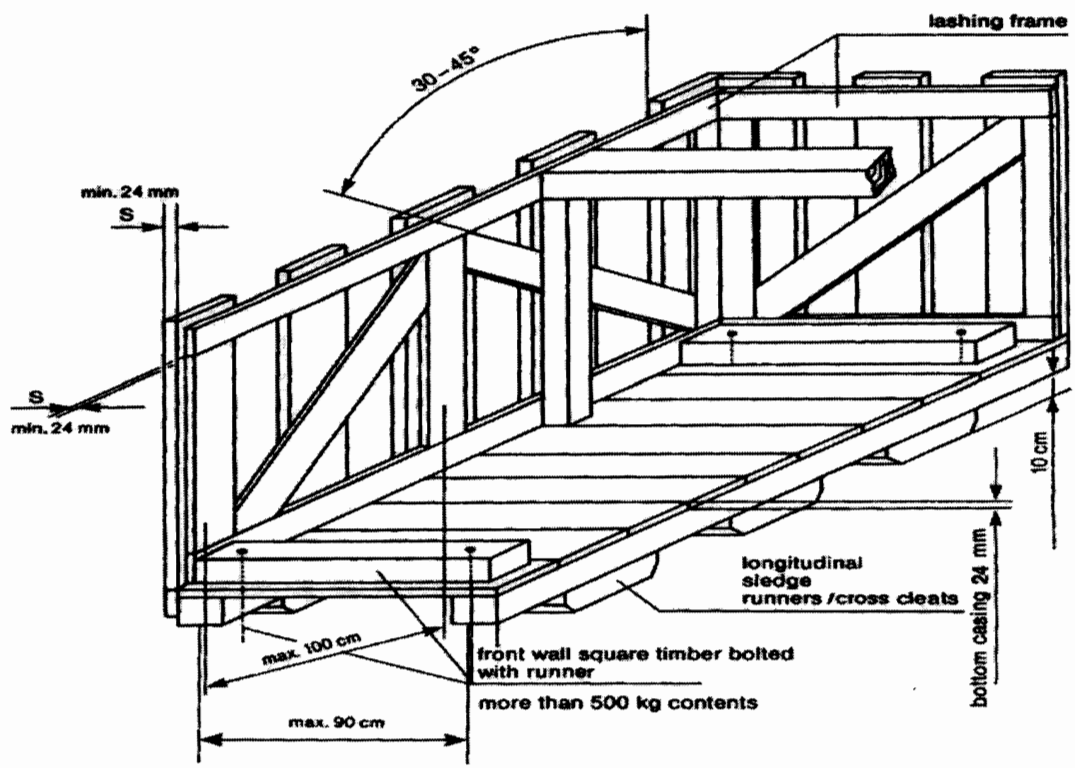
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

Packing Category III



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8.4.2 Cases with Lining – Packing Category IV

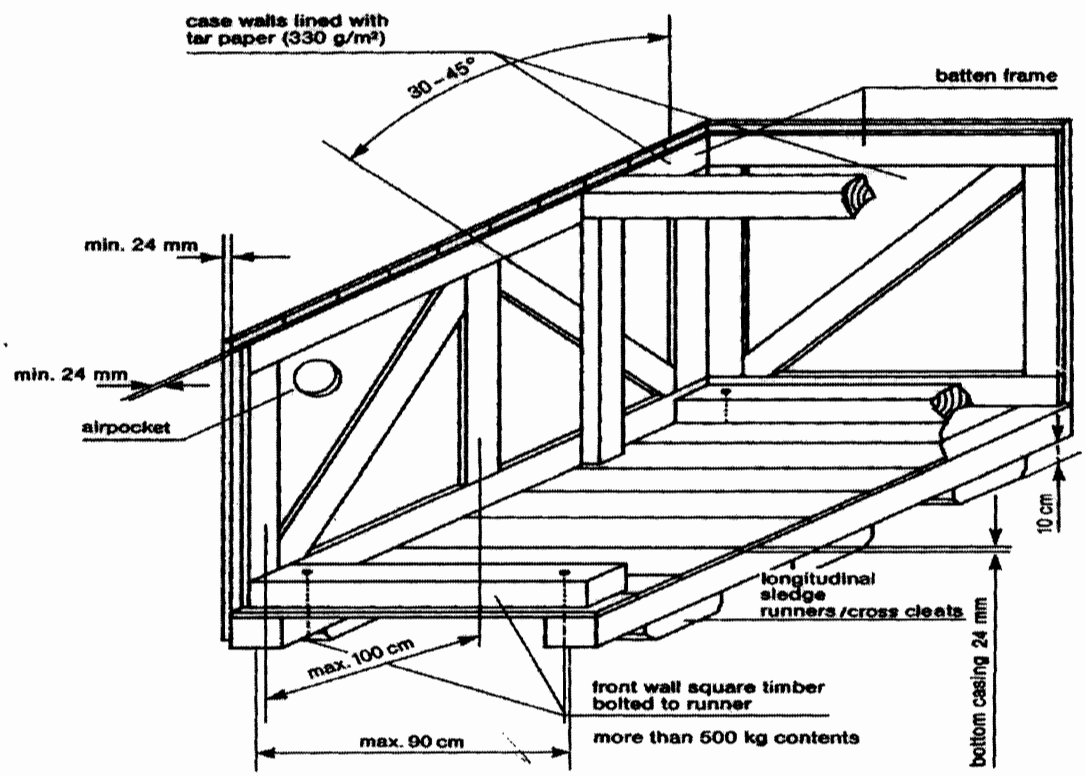
8.4.2.1 Type of Equipment

Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.

8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

Packing Category IV



8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A

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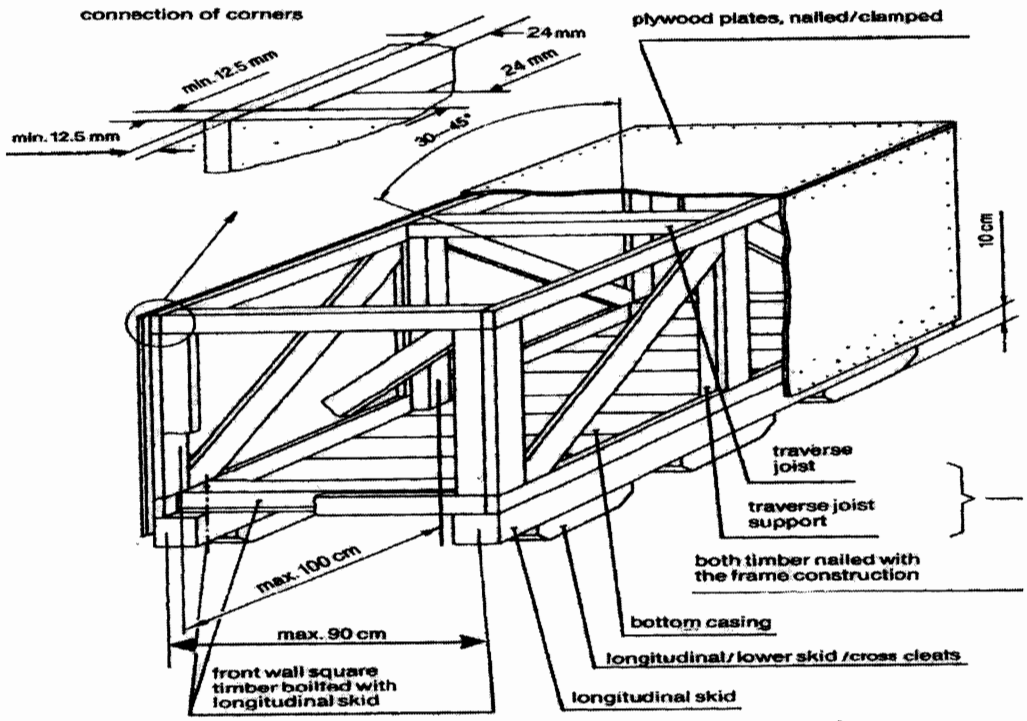

Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

8.4.4.2 Type of Construction

Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.
Additional marking:

- Case with desiccants.

8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

8.4.5.1 Type of Equipment

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Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

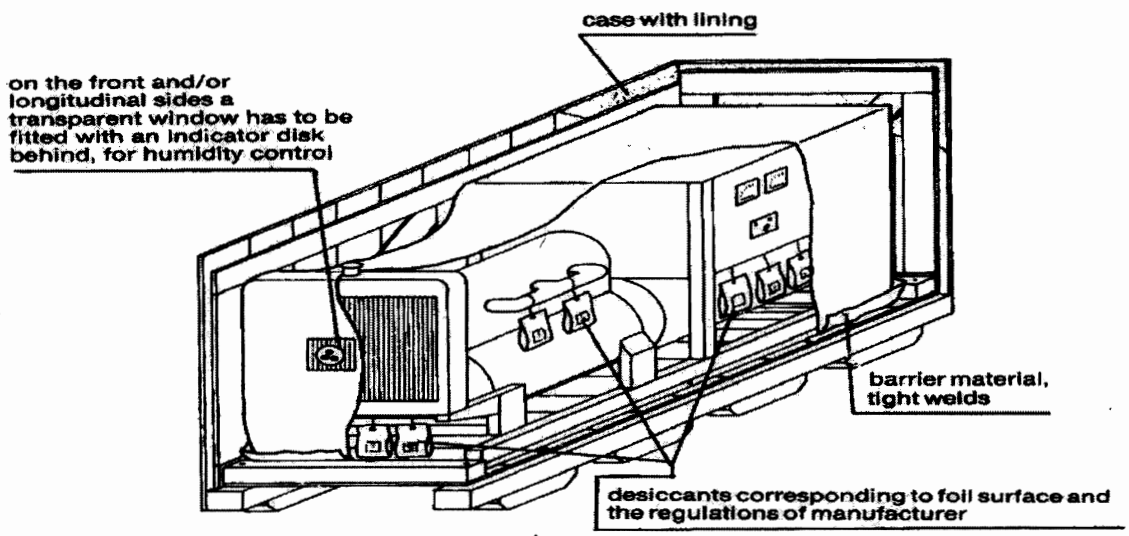
8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:

- Case with desiccants.

Packing Category V/VI



8.4.6 Double Case – Packing Category VII

8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

8.4.7 Cable Drum – Packing Category VIII

8.4.7.1 Type of Equipment

All type of cables, wires, ropes, hoses.

8.4.7.2 Type of Construction

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/ protected cable ends prior to packing.

8.4.8 Hazardous Materials – Packing Category IX

8.4.8.1 Type of Equipment

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

8.4.8.2 Type of Construction

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

8.4.9 Wooden Floor as a Transport Support – Packing Category X

8.4.9.1 Type of Equipment

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

8.4.9.2 Type of Construction

- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

8.5 Air Transport Packing

8.5.1 General

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.

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8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
- Wooden/cardboard packing cases.
- Plywood cases.

Are to be adapted to pallets used for air transportation.

9.0 <u>Detailed specification for Wooden Crates/Boxes/Cases and other packing materials</u>

9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, crakes, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

9.2 Chemical Treatment of Wood:

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

9.3.1.1 Bottom Frame

The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

9.3.1.2 **TOP FRAME**

The construction of top frame shall be as per fig-3.

9.3.1.3 **END PANELS**

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

9.3.1.4 **Sling Plate**

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

9.3.1.5 **Angle Iron Cleats**

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

9.3.1.6 **Other Requirements**

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length I.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

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shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.

- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.

- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.

- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.

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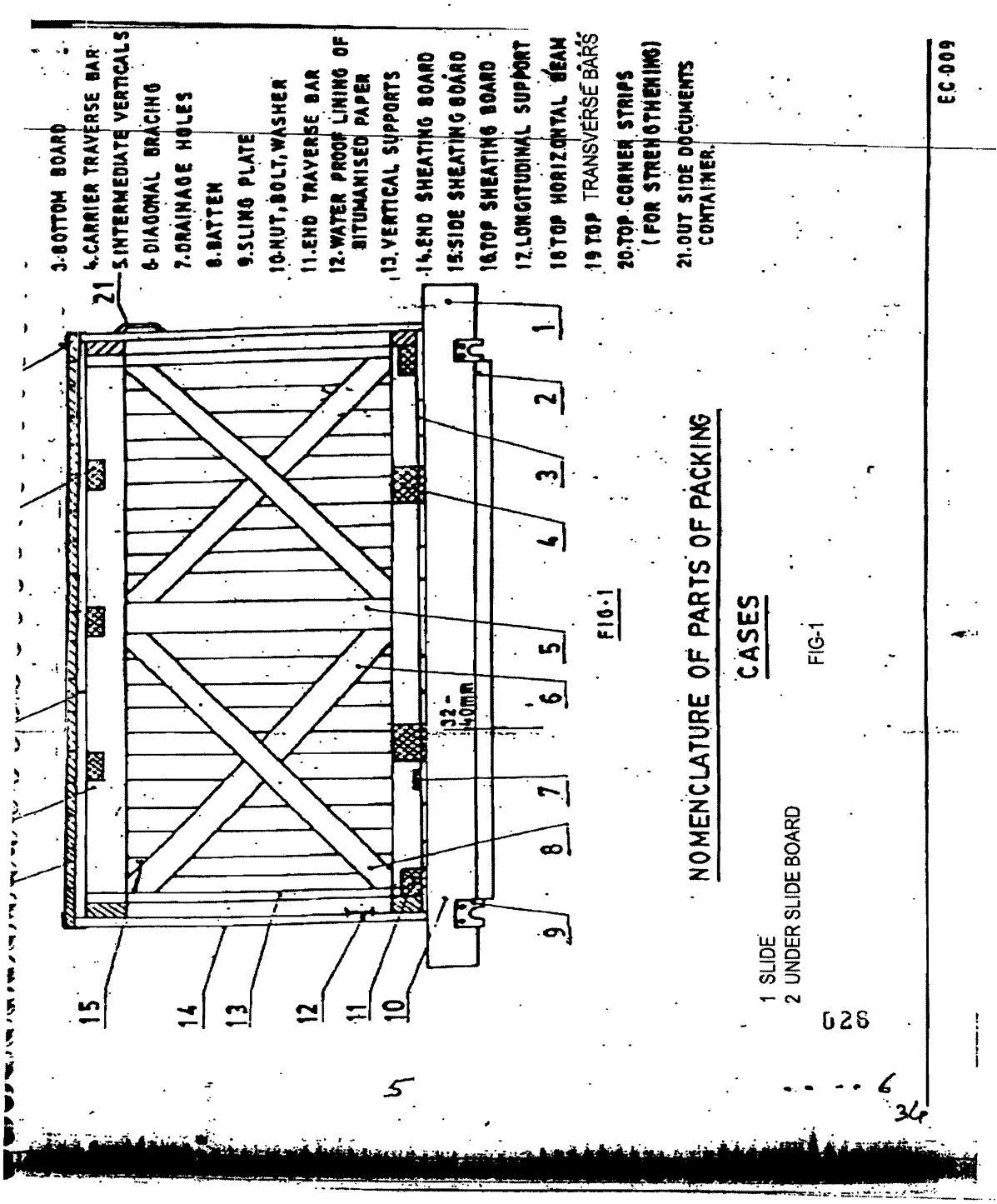

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BOTTOM FRAME ARRANGEMENTS

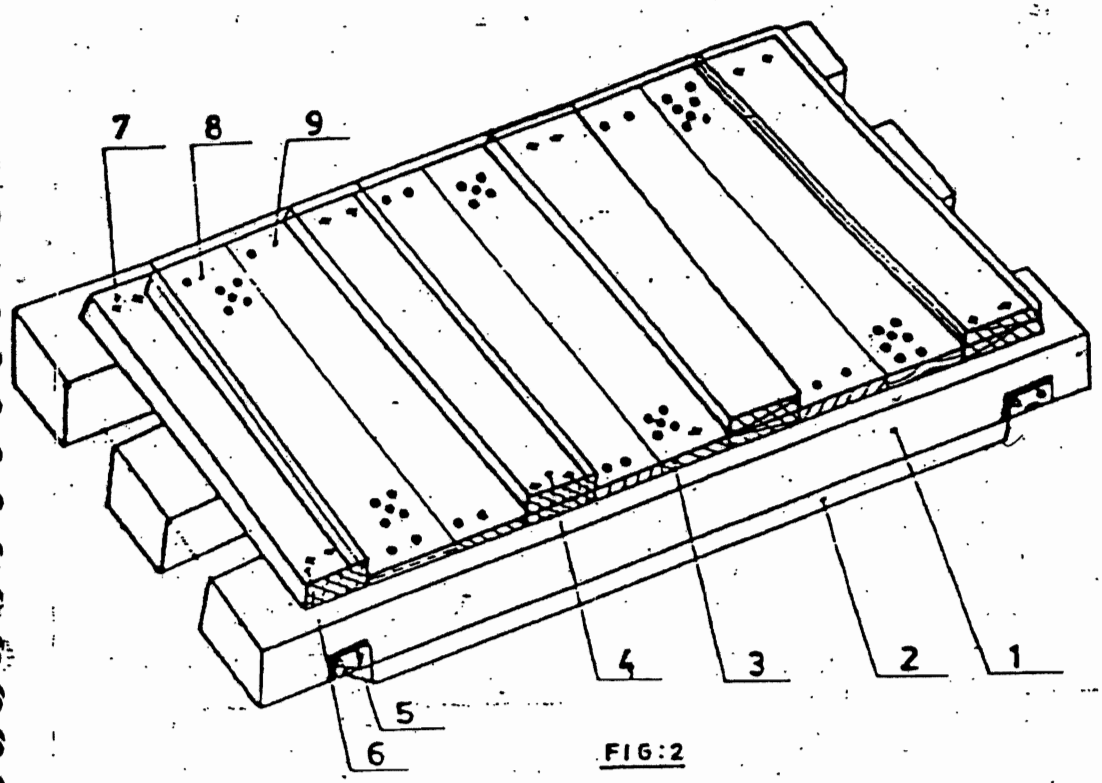

FIG:2

Nos. of slides : Minimum 2 Nos.
For length more than 1800 mm or load more than 1000 kg, Nos. of slides shall be minimum 3 Nos.
For dimensions of slides, refer Table 1
Cross section of end traverse bar; 100 X 100 mm (minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TAVERSE BAR
5. SLING PLATE
6. END TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

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TOP FRAME ARRANGEMENT

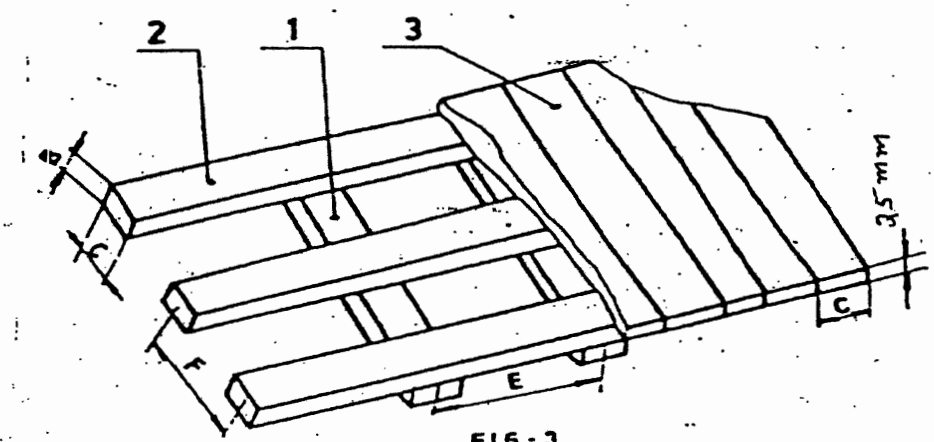
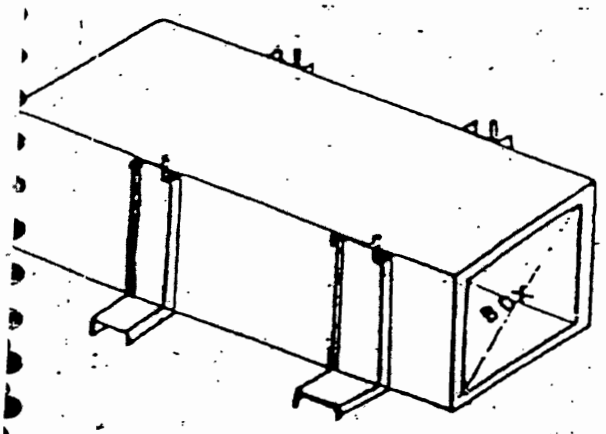


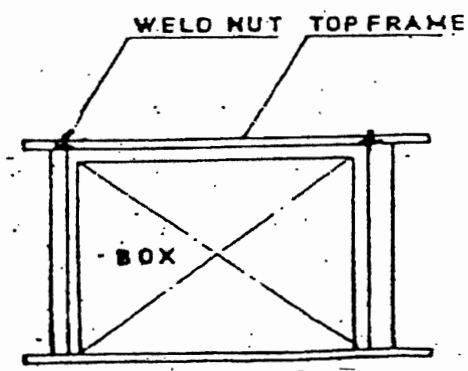
FIG-3

F : 700 t 1000 mm
E : 500 t 900 mm
: 30×100 mm.

1 - Treverse Bers
2 - Horizontal Boans
3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES





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ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

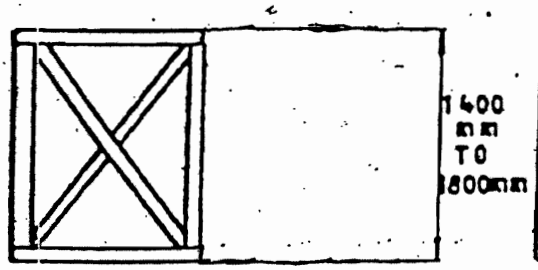

FIG:6

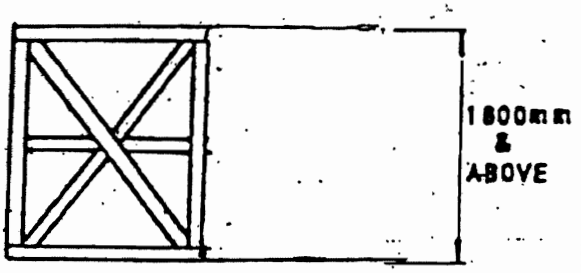

FIG:8

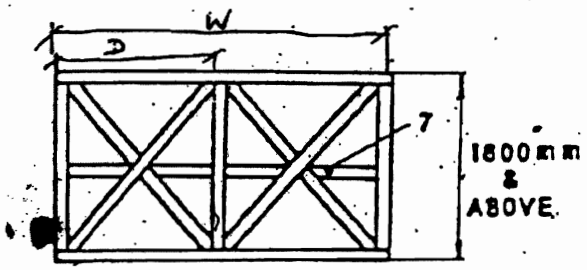

FIG:9

7- Middle Horizontal Support

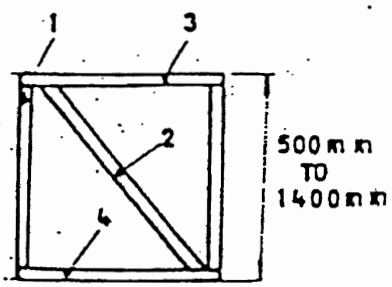

FIG:5

1- Vertical Support

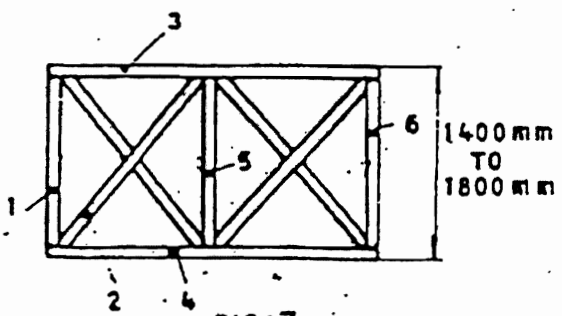

FIG:7

1, 5, 6 - Vertical Support

029

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ARRANGEMENT OF PACKING CASE

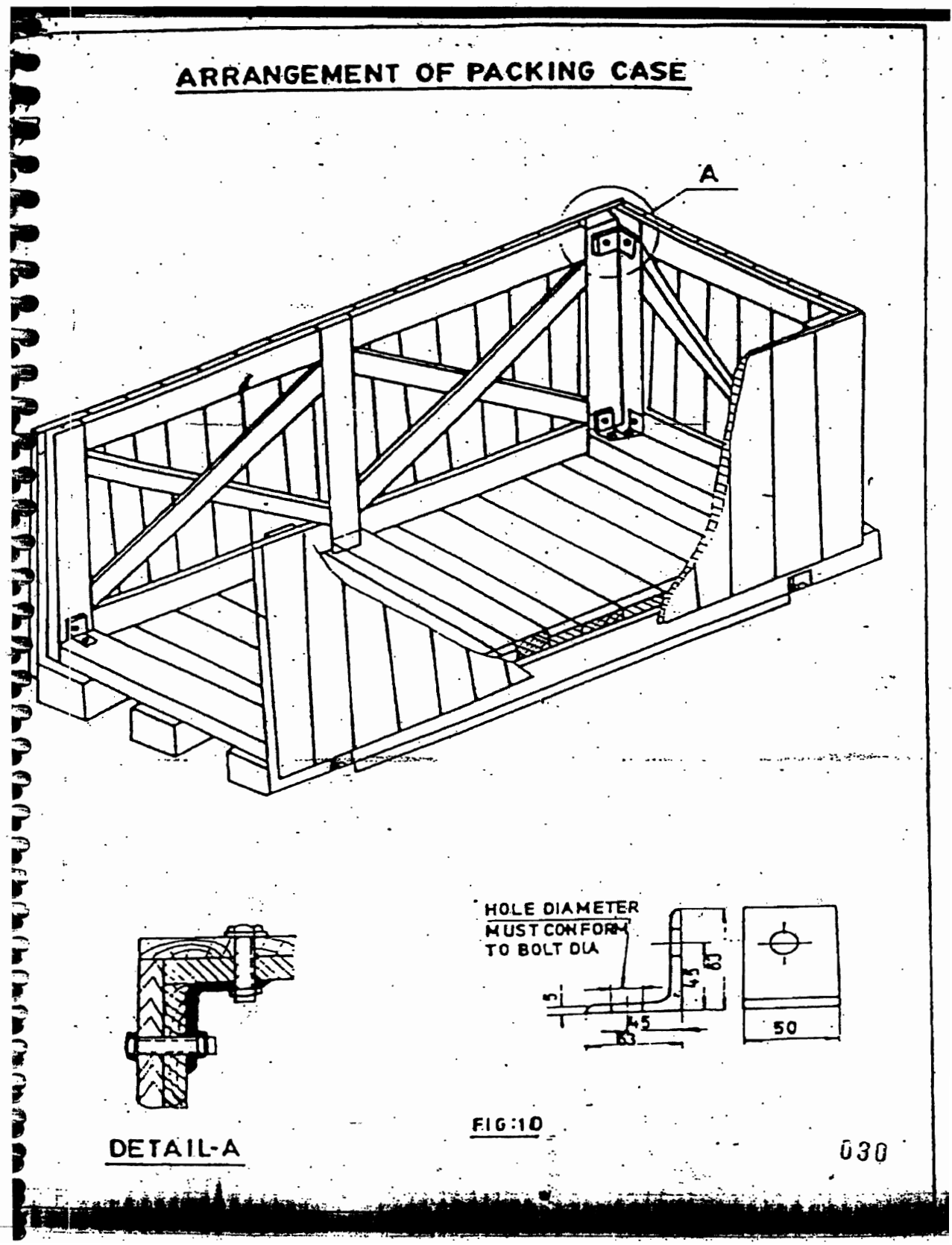

FIG:10

030

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ARRANGEMENT OF SLING PLATE ON CASES

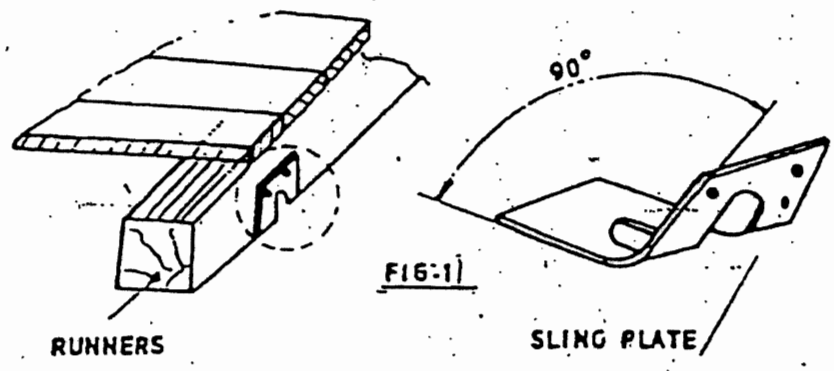

FIG:1

031

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TABLE-1

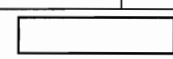
LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c						
500	50 X 100	50 X 100	50 X 100	50 X 100	75 X 100	75 X 100	100 X 100
800	50 X 100	50 X 100	75 X 100	75 X 100	75 X 100	75 X 100	100 X 100
1000	75 X 100	75 X 100	75 X 100	100 X 100	100 X 100	100 X 110	100 X 150
1500	75 X 100	75 X 100	100 X 100	100 X 100	100 X 100	100 X 150	100 X 150
2000	75 X 100	100 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150
2500	75 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150	150 X 150
3000	100 X 100	100 X 150	150 X 150	150 X 150	150 X 150	150 X 150	150 X 150

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Table-2

End and side panels	Width of the panel "W"	Distance between longitudinal support (Dimension "D")						
		600	800	1000	1200	1400	1600	1800
		Cross section b x c				Item 1 to 7		
Fig- 5 to Fig-9	600 to 1200	30 X 100	30 X 100	30 X 100	30 X 130	30 X 130	30 X 130	30 X 130
	1201 to 1600	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130
	1601 to 2000	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130
	2001 to 3000	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	40 X 150
	3001 to 4000	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150

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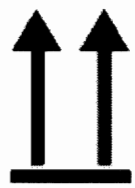
INDICATION MARKS ON CASES/BOXES/CRATES

Designation	Symbol	Explanation
Fragile, Handle with care		The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.
Use no hooks		Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.
Top		The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.
Keep away from heat (solar radiation)		Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.
Protect from heat and radioactive sources		Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.
Sling here		The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side.
Keep dry		Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.

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Center of gravity		This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.
No hand truck here		The absence of this symbol on packages amounts to permission to use a hand truck on them.
Stacking limitation		The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.
Clamp here		Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.
Temperature limitations		According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note.
Do not use forklift truck here		This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.
Electrostatic sensitive device		Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.

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Do not destroy barrier		A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants".
Tear off here		This symbol is intended only for the receiver.

FIG-12

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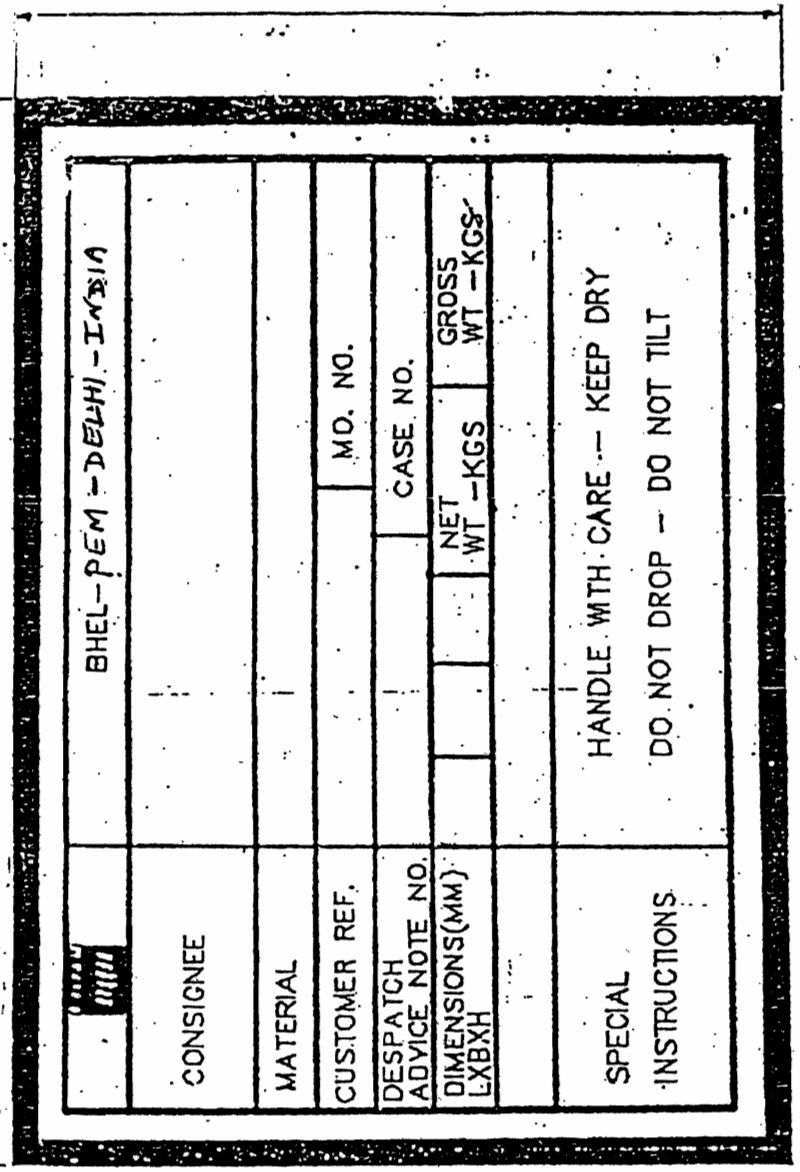

FIG-13: MARKING PLATE

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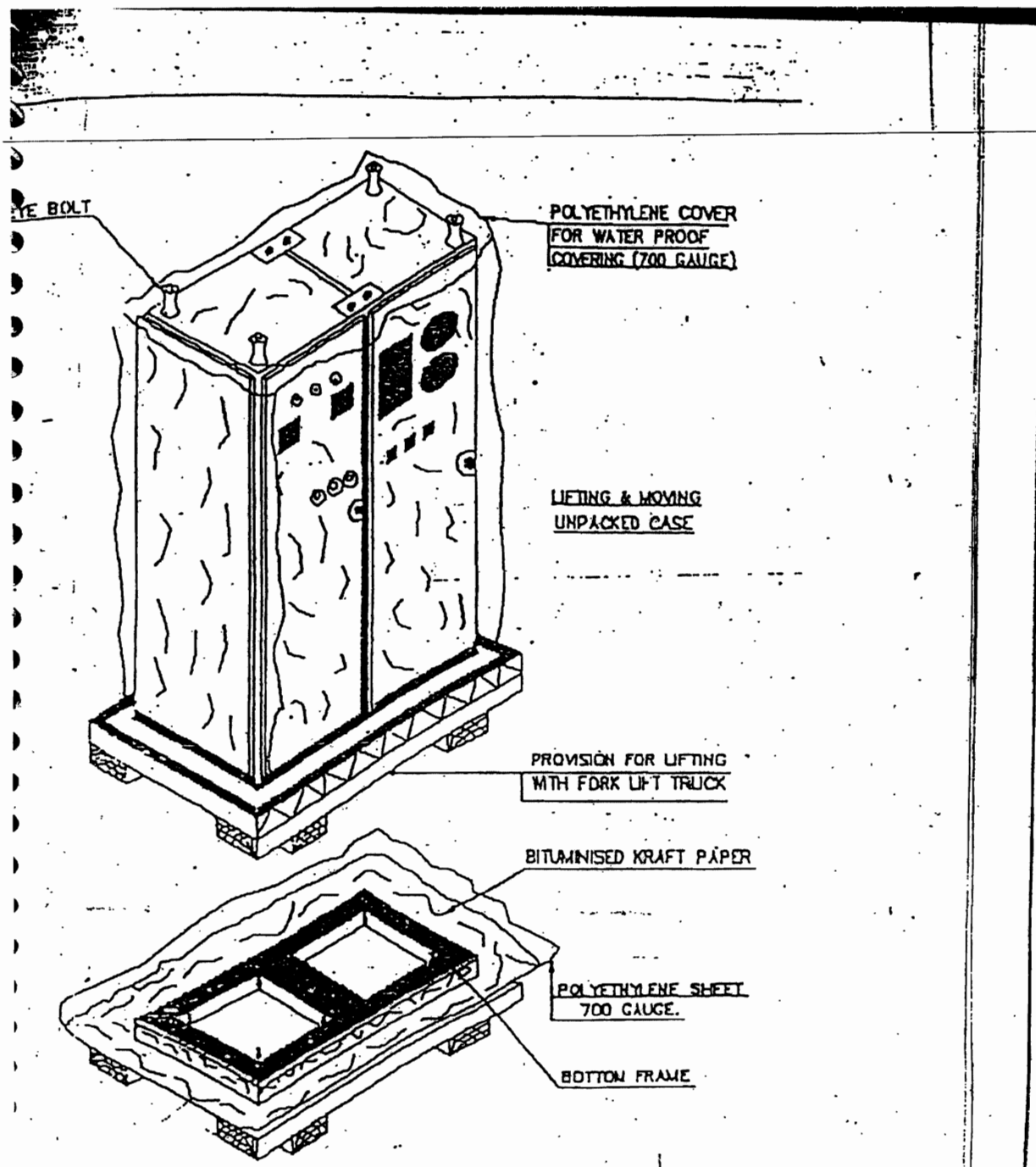

FIGURE–14

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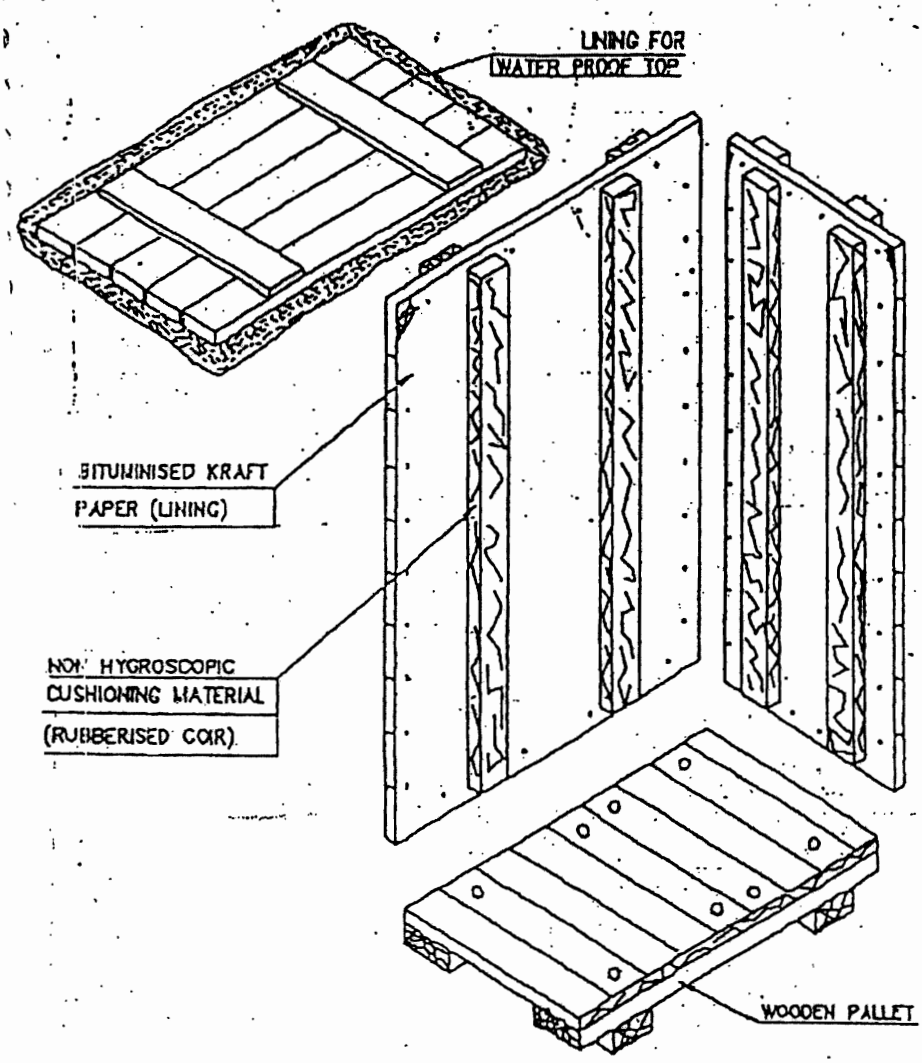

FIGURE-15

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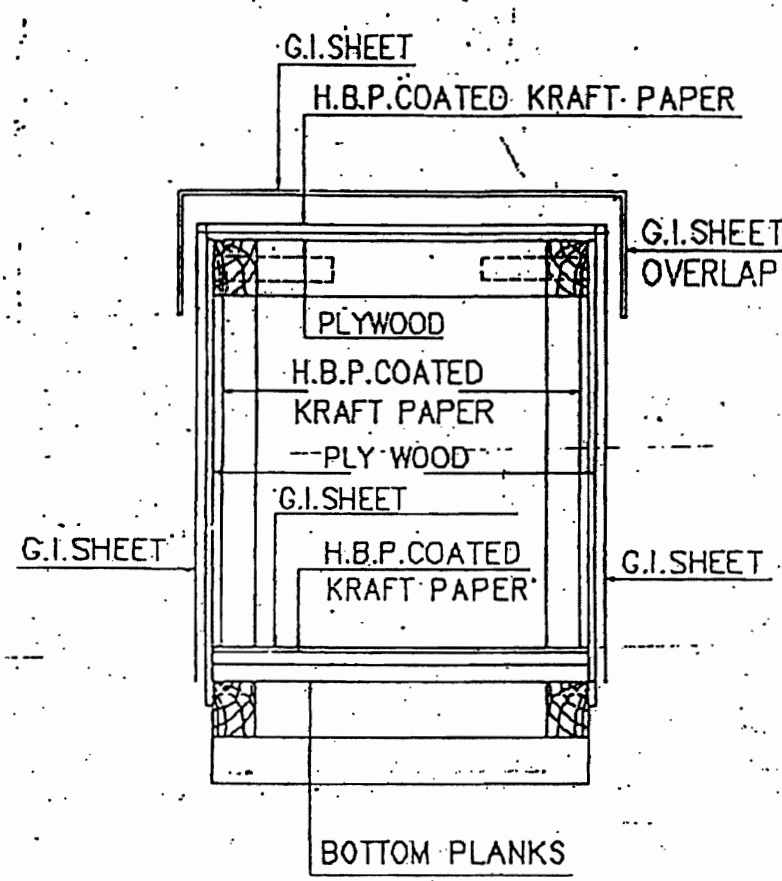

FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET SHOWING LAYERS OF PACKING MATERIALS.

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10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

a) Project Name
b) Purchase Order No.
c) Sl. No. of package
d) Size of mattress (Thickness x Length x Width)
e) Density
f) Wire netting material and size
g) Weight of the package

10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

10.2.1 Type of construction for Eye to Sky packaging

a. Strapping of coil with polyester strap around circumference at one place.

b. Putting paper I. D. Edge protector.

c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.

d. Wrapping the coil with HDPE film.

e. Covering the coil including its build up & bore with masonite / particle board.

f. Putting metallic I. D on coil.

g. Putting O.D edge protector (paper) on coil.

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h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).

i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.

j. Coil is to be tilted to eye-to-sky position.

k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.

l. Fixing the coil with wooden blocks at 4 corners.

m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

10.2.2 Type of construction for Eye to Eye packaging

a. Strapping of coil with polyester strap around circumference at one place.

b. Putting paper I. D. Edge protector.

c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.

d. Wrapping the coil with HDPE film.

e. Covering the coil including its build up & bore with masonite / particle board.

f. Putting metallic I. D on coil.

g. Putting O.D edge protector (paper) on coil.

h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).

i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.

j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.

Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

10.3 Packing Procedure for Online Tube Cleaning System and accessories

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

10.3.1 Packing details:

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

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- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.

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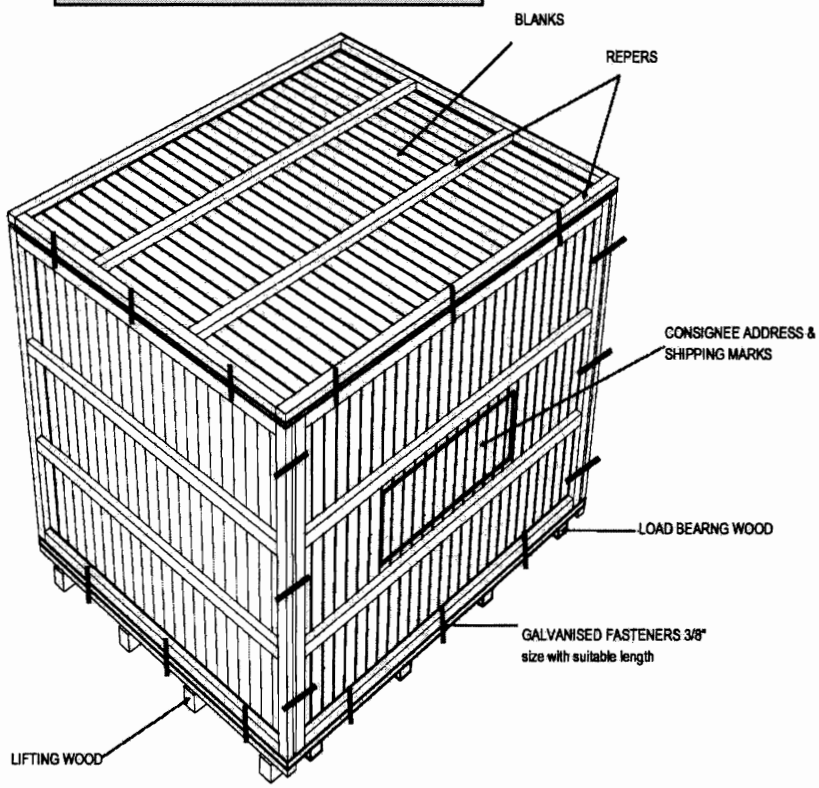
MODEL: FASTNERS TYPE (BASE, SIDE &TOP ATTACHED WITH BOLT, NUT & WASHER)

This Type of case to be used for following items:
1. BALL SEPERATOR
2. BALL COLECTOR SKID



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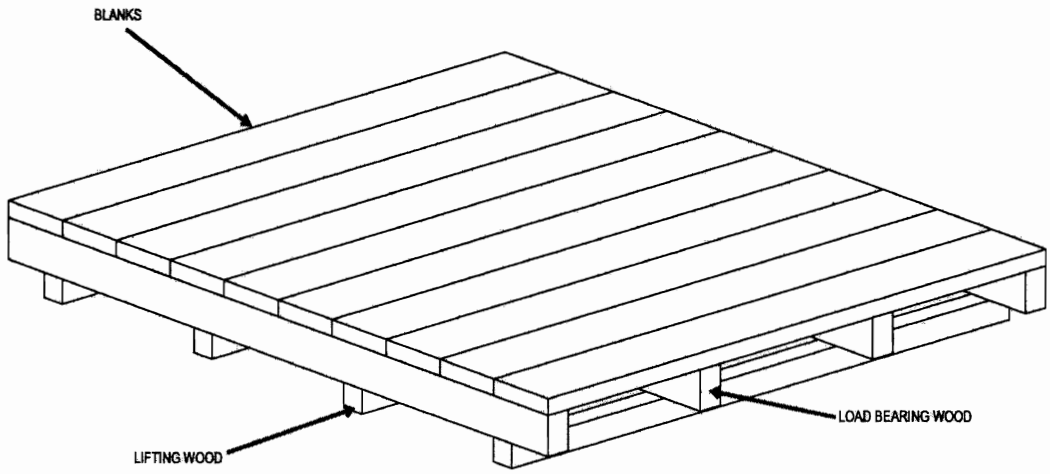
BASE FRAME



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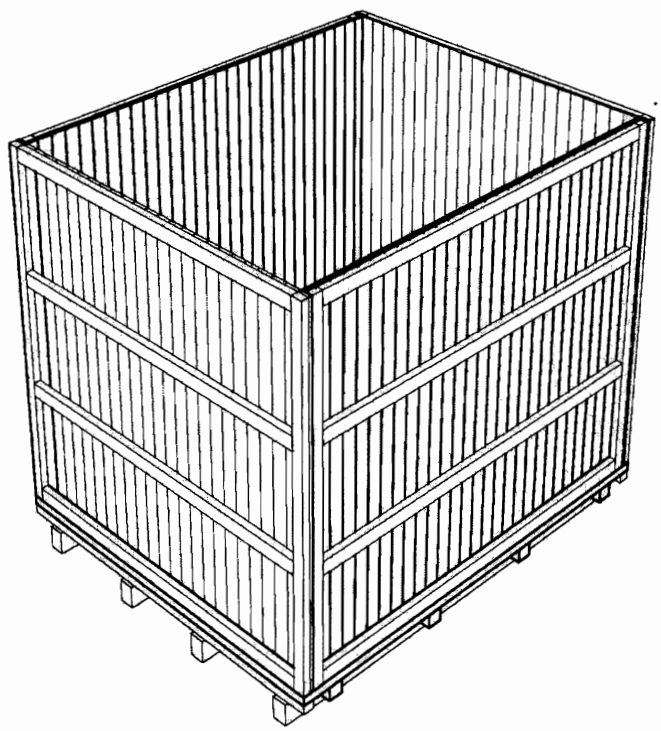
MODEL: FASTNERS TYPE - WITHOUT TOP



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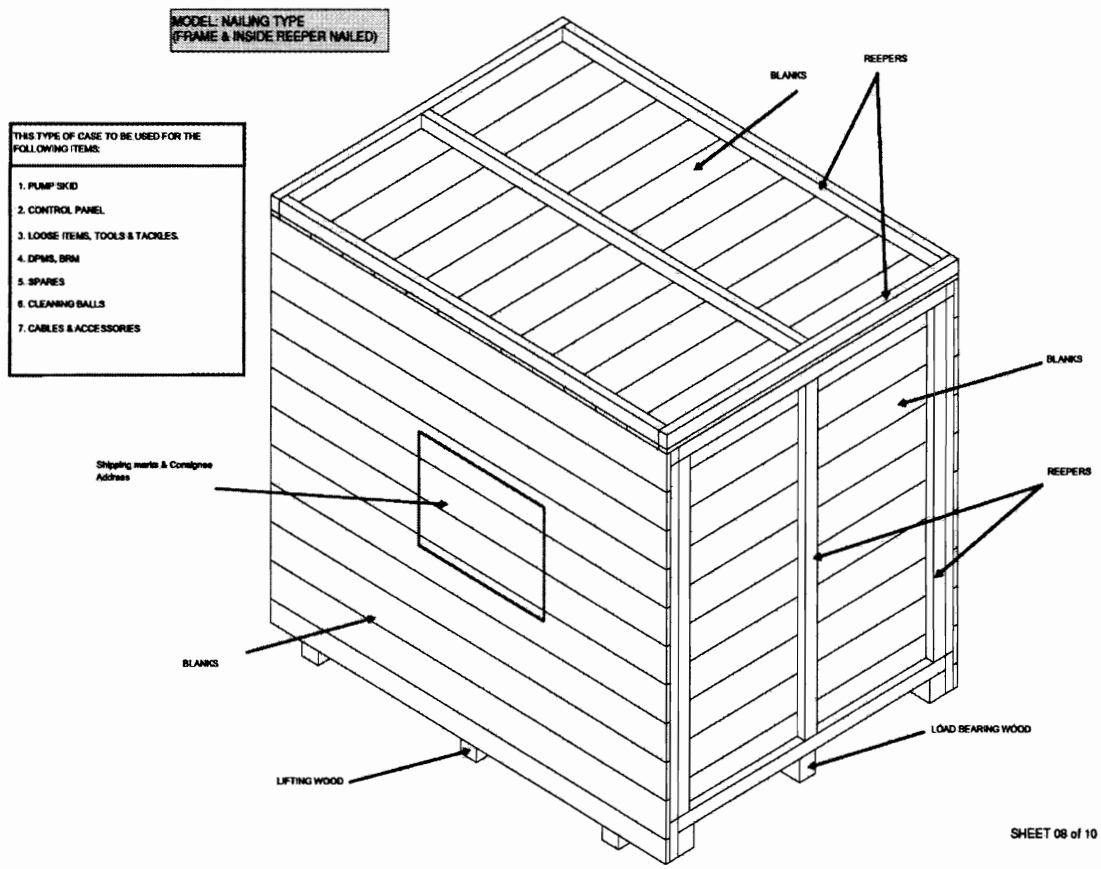

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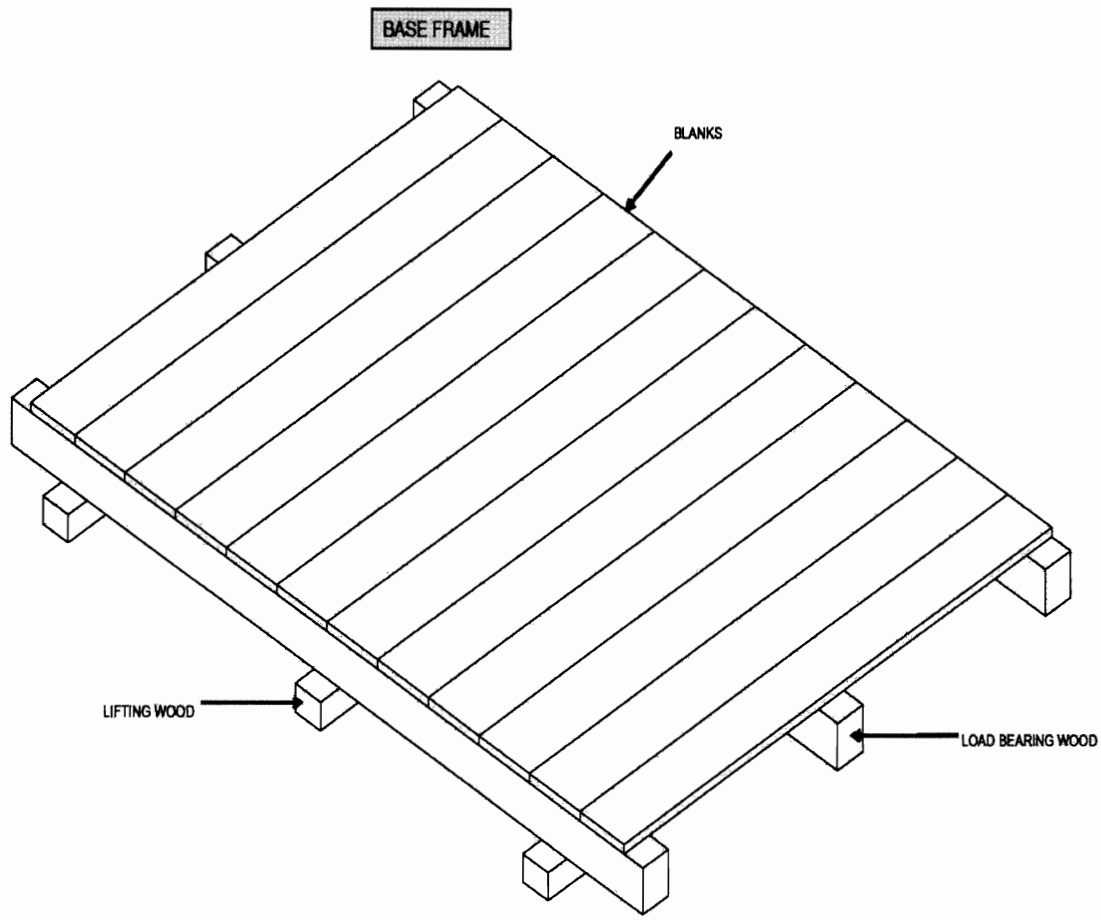

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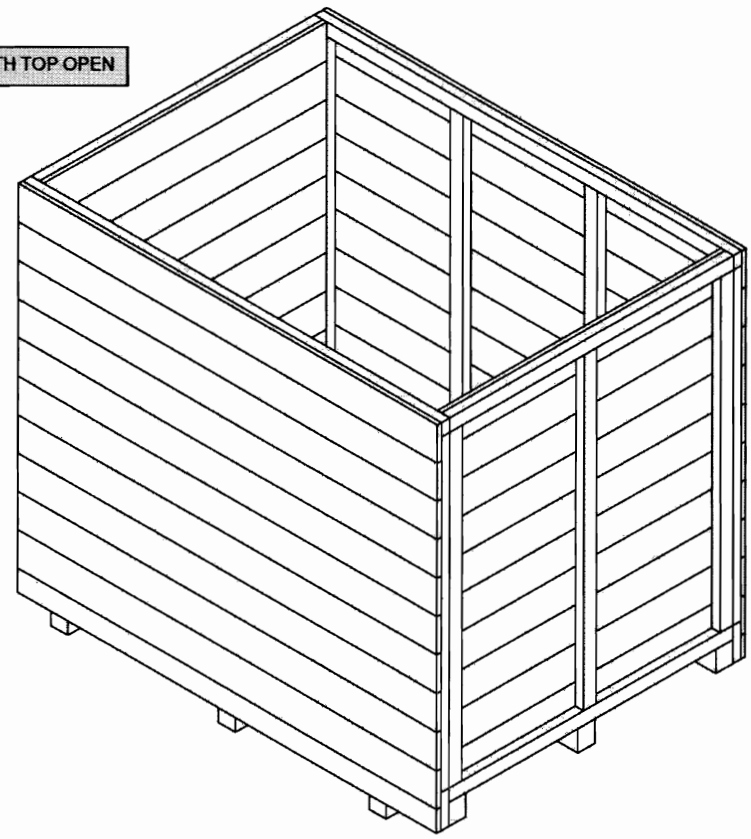
NAILING TYPE MODEL WITH TOP OPEN



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10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.

11.0 PACKING OF ELECTRICAL ITEMS

11.1 CABLES

11.1.1 Type of Equipment
All type of cables..

11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).

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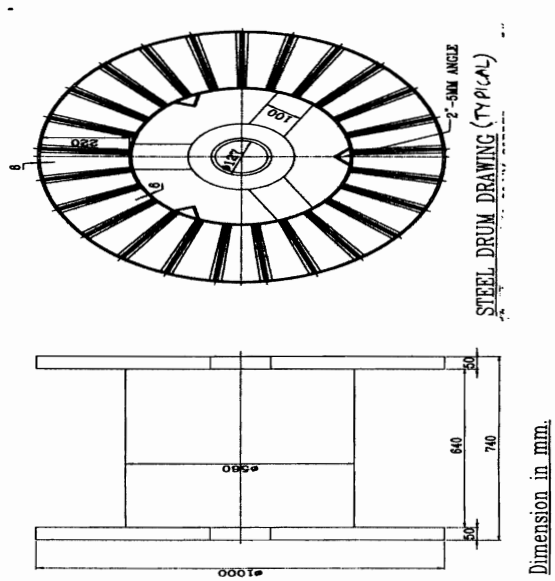

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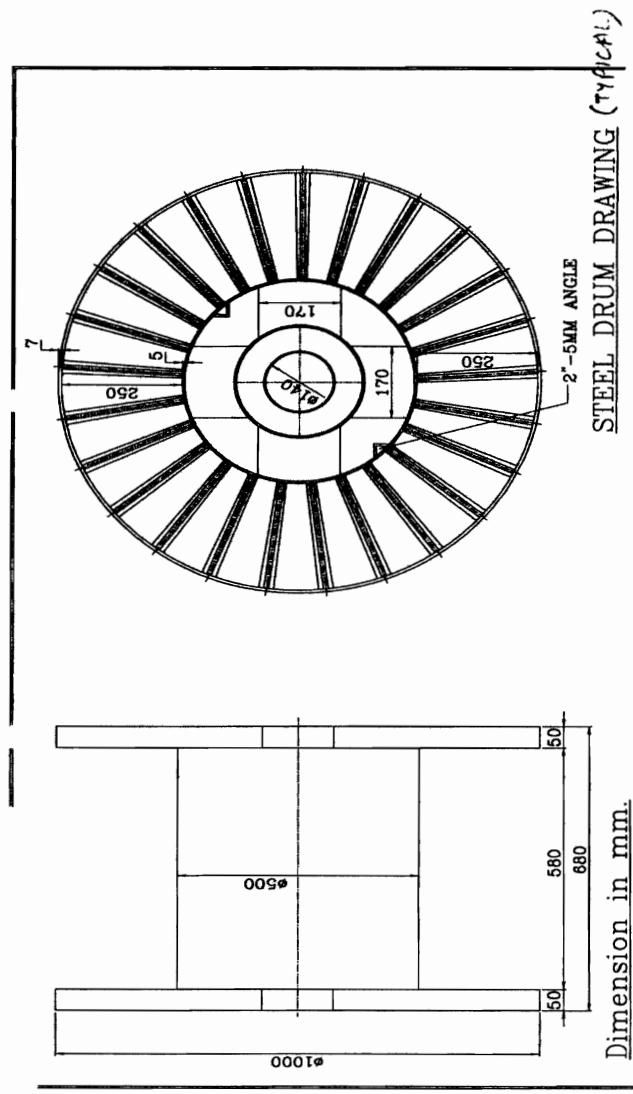

11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

1) All Dimensions are in "mm" unless otherwise stated.
2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
3) Finish of Packing Box Shall be Galvanized.
4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

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6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.

7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes

8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.

9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.

10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc

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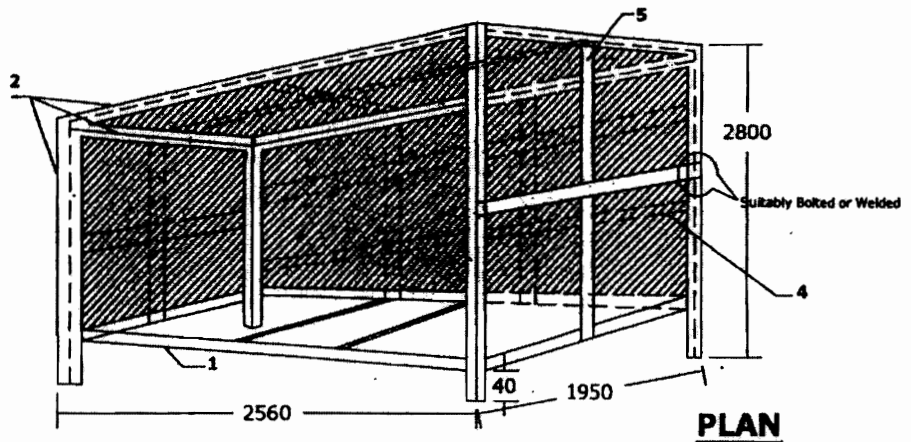
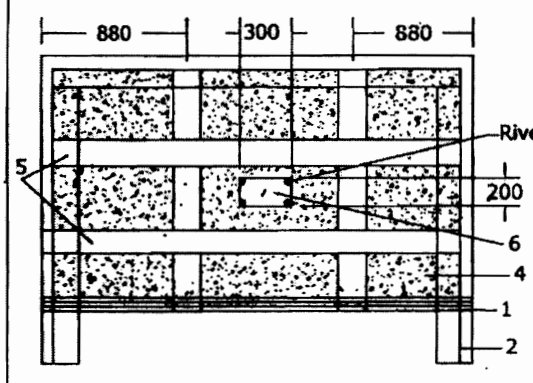
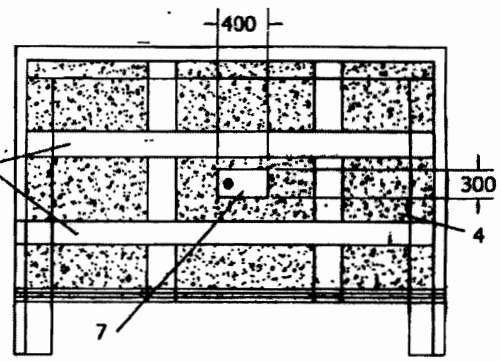
STEEL PACKING (TYPICAL DETAILS)



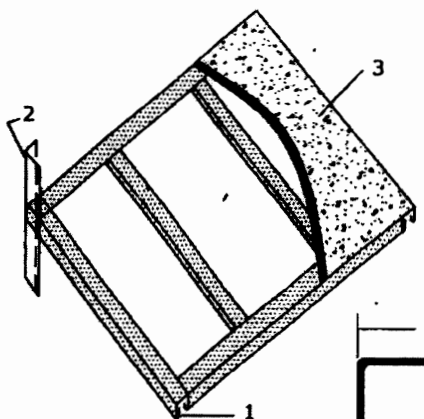
PLAN



FRONT SIDE OF BOX



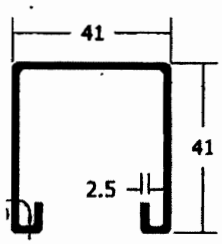
BACK SIDE OF BOX



BOTTOM FRAME ARRANGEMENT

Note:

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Alluminium Plate for Marking.
7. Hinged Inspection Window.



DETAILS OF "C" CHANNEL

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11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

a) Construction of packing case for LIGHTING DIATRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.
b) Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.
c) All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

d) The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.
e) Silica get packed in cotton bags shall be placed at different positions inside the packing.
f) Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMIOSSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMBALES

a) Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
b) Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
c) All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.
d) Silica get packed in cotton bags shall be placed at different positions inside the packing.

11.3.3 For CONDUIT PIPE

As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
b) Then bundle will be wrapped with bitumen coated hessian craft paper.
c) Bundle shall be strapped with steel straps.
d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

11.3.4 For POLES

Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

11.3.5 For STRUCTURAL STEEL

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Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
b) Then bundle will be wrapped with bitumen coated hessian craft paper.
c) Bundle shall be strapped with steel straps.
d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

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PACKING PROCEDURE FOR CONDUIT PIPE

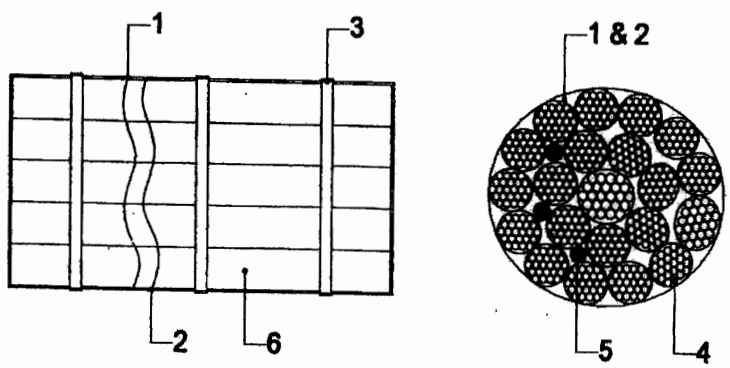

FIGURE "A"

1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.

2) LAYER OF POLYTHENE SHEET.

3) METAL STRAPPING.

4) CONDUIT PIPES.

5) SILICA GEL POUCHES.

6) BUNDLES OF CONDUIT PIPES.

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PACKING PROCEDURE FOR STRUCTURAL STEEL

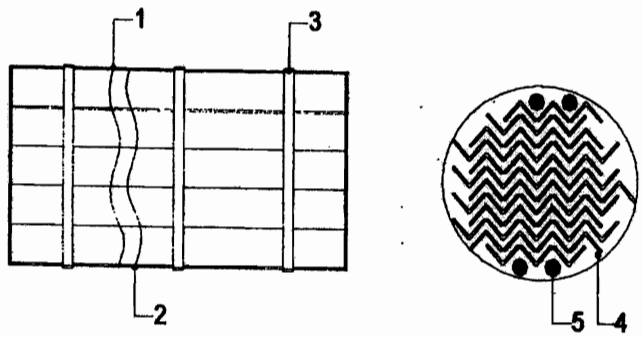

FIGURE "B"

1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
2) LAYER OF POLYTHENE SHEET.
3) METAL STRAPPING.
4) STRUCTURAL STEEL.
5) SILICA GEL POUCHES.

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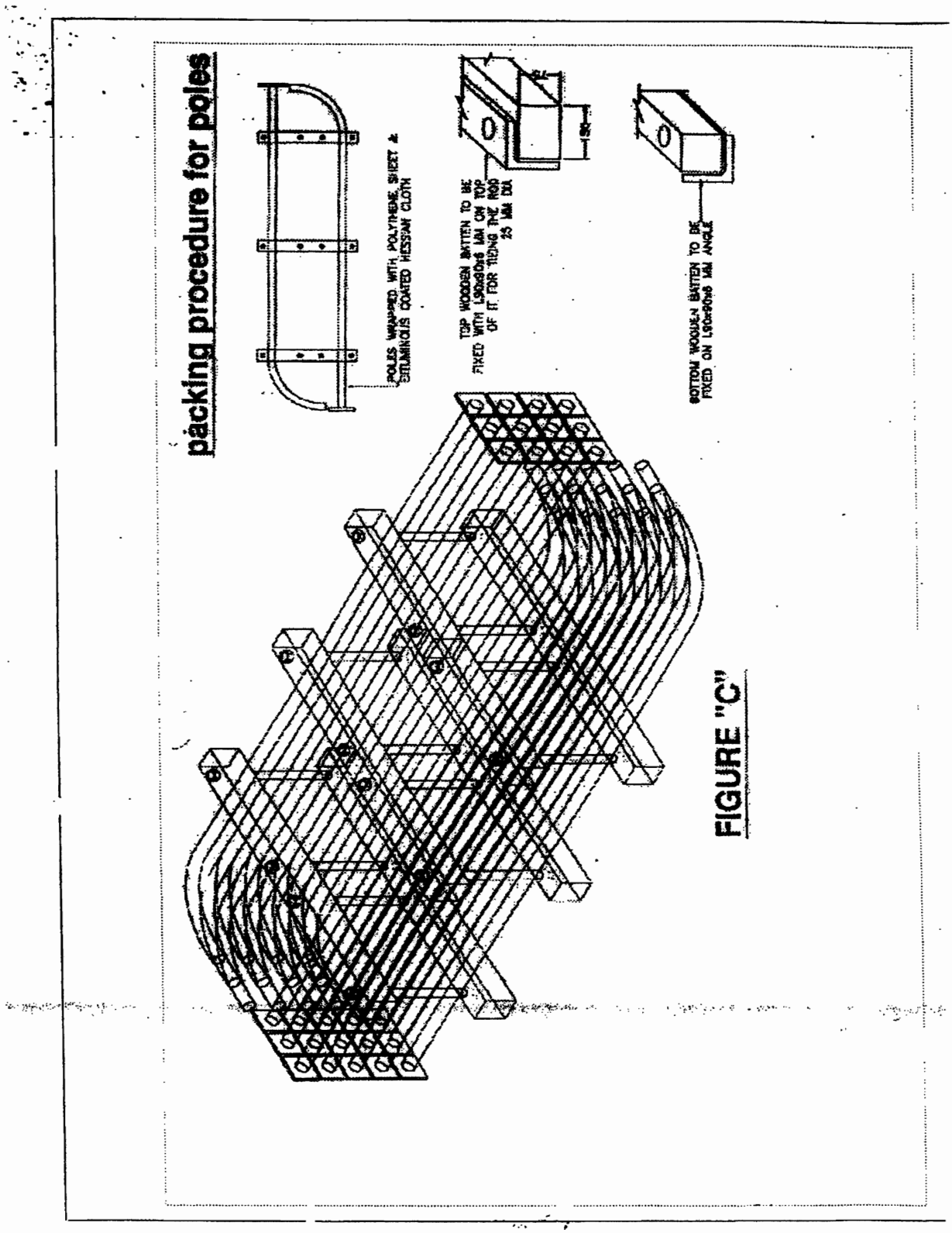

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11.4 PACKING FOR DC BATTERY

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).

b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.

c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)

d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.

e) The battery accessories shall be packed with suitable precautions as follows:

i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.

ii) Hardware items shall be packed in polyethylene bags (Thickness ≥ 0.175mm) with item slip

iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet

iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.

f) Galvanized Steel straps are provided for binding the packing box sides.

g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.5.01 PACKING DETAILS :

a Items shall be packed in case / crates as per the shipping list.

b All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".

c Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

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small / delicate items such as glass thermometer, door keys shall be packed in separate box.

d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.

e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.

f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.

g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.

h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box

i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.

j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.

k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.

l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.

m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

12.0 Containerization

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).
The maximum inside dimensions of containers are to be considered:

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- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
-

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

12.2 Mechanical Constraints

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

Note:

It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.

13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS.
VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.
The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming

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useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.

ANNEXURE – E
TO
INTERNAL ORDER NO. INTORD0489

PACKING & SHIPPING INSTRUCTIONS

1. **All units/ sub vendors/ contractors are strictly advised to comply with packing instructions mentioned in contract documents (GCC clause 65: Packaging & Section V, FTS, Clause B0.3.5 Packaging and transportation).**

2. Special Packing Instructions & Inspection Prior to Dispatch

   - Packing (tare) shall be part of the Equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of Equipment during transportation. In case of Equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the **material and weight characteristics are to be indicated.**

   - All packages to be wrapped in transparent polythene inside the crates for effective weather proofing

   - Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly:

     Destination:
     Package number: BHEL/MTR/BD/XXX/YYYYY where XXX stands for Unit abbreviation e.g. RPT
     YYYYY stands for package no.
     Gross and Net weight
     Dimensions
     Lifting places
     Handling marks and the following delivery marking:

     "BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (Pvt.) LIMITED
     2X660 MW MAITREE SUPER THERMAL POWER PROJECT
     BANGLADESH"
     EPC CONTRACTOR: BHARAT HEAVY ELECTROCALS LIMITED, INDIA

   - Completeness of Contents of each packing case: Concerned CQA/Unit QC/Third Party Inspection Agency shall verify the completeness of contents of each package w.r.t packing list both in terms of quality and quantity before authorising dispatch of the consignment.

   - Packing commensurate with international standards and accepted norms will be ensured by CQA/ Unit QC/Third Party Inspection Agency. Packing has to be **SEA WORTHY** and secure.

   - As far as possible, the packing has to be rectangular in shape for optimum space utilization in the ship and economize on shipping costs. Projections on packages are prohibited.

   - The packing list has to be checked and certified by the Inspection agency (ies) with due signatures.

   - Packages are envisaged to be transported on Vessels/ Barges through Sea/ river water ways and will require transhipment and intermediate storage. Hence, if deemed necessary by respective unit, packages may be enclosed in suitable GI sheets on all sides to prevent any damage during transportation/ transhipment/ storage.

   - No loose items / Gunny bags packing shall be allowed for shipment.

   - Proper pallets and crates are to be used for packing of Oil drums and Structures.

- Routing of Packing Lists: Packing list is an extremely important document, which forms a part of export documentation in connection with the processing of customs formalities. Packing List has to be generated by units/Unit vendors and sent to MEPG and ROD (both at the same time), two weeks in advance, for processing and obtaining shipping bills' clearances and avoiding octroi payment through 'N' form at Mumbai.

- Advance intimation to ROD & MEPG: All supplying units/vendors will give at least 15 days advance intimation to ROD & MEPG along with package details before actual dispatches to arrange for storage/shipping arrangements by ROD and customs invoicing by I0. Information must be sent to consolidate the details and arrange for shipments in time.

- Excise Attestation at Works: To avoid opening of big cases for examination by customs at port of shipment, the supplying unit may arrange to get the packing cases sealed by local excise authorities/ self-certification and the relevant invoices and packing lists to be endorsed from Superintendent, Central Excise. For this purpose, Units should send the packing lists to MEPG at least 2 weeks in advance to enable prepare Shipping Invoices for furnishing to the units for requisite attestation and sending to ROD through fastest means for a smoother and faster customs clearance. Also Units to provide "specification of packing with the indication of the number of cargo packages, type of packing and weight of packing in English" along with the packing list.

- If deemed necessary by respective unit, provision of Inspection Windows of size 6" x 4" (glass perplex) for customs examination for all packages (above 1.5 x 1.5 x 1.5 cu m) involving panels of any kind shall be provided by Unit/Vendors . Care would be taken to ensure that all packages are properly sealed to avoid ingress of moisture, rodents etc. Packing slip folders to be attached in each box.

- Drawings for Heavy Weight/ODC consignment: Any package/item weighing above 20000 kgs and/or size greater than 2.5 X 2.5 X 4 m. detailed engineering documents (at least 4 sets) for all items of the above category will be furnished by respective units to issue shipment enquiries in a proper manner. The drawing has to include centre of gravity of the item clearly (Units to identify such items and notify MEPG as soon as the engineering documents are released).

- Lifting Beams: All heavy lifts for which safe handling is essential at the port of dispatch shall be accompanied by lifting beam on non-returnable basis.

- "Marking for Safe Handling: To ensure safe handling, packing case shall be marked to show the following:

  - ✓ Upright position.
  - ✓ Sling position and Centre of Gravity position.
  - ✓ Storage category.
  - ✓ Fragile components (to be marked properly with a clear warning for safe handling).

Employer, or its authorised representatives or agents shall have the right to examine and audit, during business hours, all books, statements, accounts, correspondence, instructions, specifications, plans, drawings, receipts, memoranda, accounting documents and other records of Contractor and Subcontractors in so far as they are pertinent.

(ii) Contractor shall cause all of its and each Subcontractor's documentation referred to in Clause 64.1 and above in this Clause 64.3 to be preserved and made available for examination and audit for a period of three (3) years after Final Acceptance or three (3) years after the date of termination of this Contract, whichever is earlier.

(iii) The foregoing right of examination and audit shall extend, but shall not be limited to, calculations of unit rates, percentages, per diem charges or other similar fixed amounts or man-hours worked or estimated to be worked which are to provide the basis of reimbursements to Contractor under this Contract and adjustments of the Contract Price.

(iv) The foregoing right of examination and audit shall survive any early termination of this Contract.

64.4 Without prejudice to the foregoing provisions of this Clause 64, the Contractor shall also such accounts in respect of the construction and development of the Works (and provide to the Employer and its representatives), as are required to be maintained (and provided) by the Employer in terms of the Implementation Agreement and the PPA.

65.0 PACKAGING

All equipment and materials and other Plant shall be suitably coated wrapped, or covered and boxed or crated for export shipment and to prevent damage during handling and storage at the Site. Cardboard containers shall be enclosed in a solid wooden container.

Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of the packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the Site.

Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be

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BIFPCL

coated with oxidation preventative compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.

Crates and packing material used for shipping will become the property of Employer, but the Contractor will be allowed to use the same for the Work as needed, but the remaining material shall be turned over to Employer upon completion of the Project.

Provided however, shippers container used for transportation of material shall be returned to the Contractor.

Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship which will be used. Ships with special heavy capacity unloading rigging may be required for large units of equipment. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to the Site.

Each package or shipping unit shall be clearly marked or stenciled on at least two sides as follows:

BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (Pvt.) LIMITED
2X660 MW MAITREE SUPER THERMAL POWER PROJECT
BANGLADESH
(Name of the Contractor)

In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.

Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.

Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.

The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.

Bangladesh-India Friendship Power Company (Pvt) Ltd. BIFPCL

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Wherever necessary besides usual inscriptions the cases shall bear special indication such as "Top", "Do not turn over", "Care', "Keep dry", etc., as well as indication of the centre of gravity (with red vertical lines) and places for attaching slings (with chain marks).

Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire.

Each piece, skid, case or package shipped separately shall be labelled or tagged properly.

66.0 COMPLETION

66.1 All Works under the scope of this Contract shall be completed (that is, a Provisional Acceptance Certificate is issued) on or before the expiration:

(a) For the entire Power Plant excluding Unit no. 2: the Guaranteed Completion Date for Unit No.1; and

(b) For Unit no. 2: the Guaranteed Completion Date for Unit no. 2.

67.0 PRECOMMISSIONG, COMMISSIONING, RELIABILITY TEST RUN AND PROVISIONAL ACCEPTANCE CERTIFICATE (PAC)

67.1 **Pre-Commissioning**

As soon as the Unit or Power Plant (as the case may be) has, in the opinion of the Contractor, been completed operationally and structurally and put in a tight and clean condition as specified in the Technical Specifications whereupon the process for Pre-Commissioning as identified in the Technical Specification shall be followed.

It is clarified that the Pre-Commissioning shall not be undertaken till such time as the following conditions precedent are fulfilled to the satisfaction of the Employer and the Engineer:

(a) the issuance / availability of the individual erection completion certificates in accordance with the Technical Specifications;

(b) the Contractor has completed the rectification of all relevant / material erection punch points (and only minor items not materially affecting the operation or safety of the Unit or Power Plant (as the case may be) shall be subsist); and

Bangladesh-India Friendship Power Company (Pvt) Ltd. BIFPCL

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

DATA SHEET-A/ TECHNICAL REQUIRMENTS FOR SOLID WASTE MANAGEMENT SYSTEM

TECHNICAL SPECIFICATION OF 8 CUBIC METER CAPACITY REFUSE COMPACTOR VEHICLE (RCV) WITH AUTOMATIC COMPACTION CYCLE

The Refuse Compactor Vehicle should be easy to handle and with maximum safety. The RCV should be capable of automatic operation of the Compaction Cycle. The automatic continuous compaction operation is started by pushing a green colored electric push button. The Compaction cycle incorporating the moment of packer plate and carrier plate should operate continuously without the need to operate any push button or hand lever, until the compaction cycle is switched off by pushing a red colored push button. Optional hand lever arrangement for manual operation of Compaction Cycle to be also provided. The Tailgate loading height should not be more than 1.2 Meters from the ground level.

The RCV Container Volume would be 8 M^3. The Tailgate hopper volume will be minimum 1.1 Cubic Meter. The Compaction operation should be able to operate during the travel of the truck.

REFUSE COLLECTION BODY

The refuse collection body should be of 8 M^3 Volume and be in torsion-free steel construction. Load body is to be fabricated from high tensile steel (EN24 or equivalent) to reduce weight and should have welding by CO2 MIG welding process to minimize in built stresses. Thickness of sheets should be as under:

Roof panel thickness – Minimum 3.0 mm
Side Panel thickness – Minimum 4.0 mm
Floor thickness – Minimum 4.0 mm

Bidder shall provide stiffeners of suitable section and thickness to strengthen the refuse collector body.

The tailgate bearing and automatic tailgate locking should be integrated into the rear frame of the body.

The Ejection Plate should run on guide blocks within the lateral longitudinal guides of the boat-type bottom group of the refuse collection body and must be operated by a telescopic hydraulic ram. A hydraulic control unit will regulate the withdrawal of the ejection panel during the loading process, so that the compaction is optimized.

TAILGATE & TAIL GATE HOPPER

Tail gate hopper is to be provided at rear of body and should have capacity to store minimum 1100 litre garbage volume from bins (biodegradable and non-biodegradable) without spillage. This should be made of 6mm thick plate. The profile of hopper should match with travel of packer plate and should be so designed so that it may not bend in any circumstances.

The tailgate shall unlock automatically and raise to permit ejection of refuse from RCV hopper when hydraulic valve is actuated. There should be automatic locking arrangement between tailgate and RCV hopper body. This locking system should be completely leak proof between tailgates and refuse collection body by using double rubber lip seal or equivalent arrangement.

Slide plate – The Slide Plate should be actuated by 2 Hydraulic Cylinders and must run on suitable number of sliding blocks. Material of construction –High tensile steel ST-52 or equivalent.

Packer Plate – The Packer Plate should be actuated by 2 Hydraulic Cylinders.

Material of construction – High tensile steel/DOMEX / HARDOX Steel/EN 24/EN 36 or equivalent.

HYDRAULIC SYSTEM

The RCV shall be equipped with following hydraulic system:

Hydraulic Pump

High Performance, fixed displacement, pin vane design Pump, best suited for mobile application, supplying the pressurized hydraulic oil for telescopic cylinder of Ejection panel, tailgate lifting and closing, bin lifting and tilting, continuous operation of sliding plate and packer plate.

All hydraulic functions are achieved by the below major components:

I. Electro-pneumatic & hand operated mobile control valves with integral load holding check valves to prevent reverse flow through valve when shifting with fast response time (6-8 milliseconds) and low power consumption (10 Watt).

II. Electro Pneumatic mobile control Pressure Sensing Sequence Valves functioning as a pressure signaled, remote pilot operated two-way valve, which operate the automatic compaction cycle by sequencing the continuous operation of the sliding plate and packer plate automatically at present hydraulic pressures.

III. Over center valve creating a back pressure to prevent the load from free falling or over-run during lowering.

IV. 7 Hydraulic Cylinders shall be installed covering following operation
- **a.** 1 three-stage telescopic ram, double-acting for the ejection panel.
- **b.** 2 hydraulic rams, double-acting for the slide plate Double acting Slide-cylinders (for compacting) shall be located outside of the sidewalls. The cylinders are mounted in pushing position.
- **c.** 2 hydraulic rams, double-acting for the packer plate
- **d.** 2 hydraulic rams, double-acting for the tailgate
- **e.** (lifting/lowering and automatic locking)

All Cylinders should be of reputed make: WIPRO / DANTAL / CANARA/HEIL or reputed equivalent make.

The Automatic compaction operation is started by pushing a green colored electric push button. The Compaction Mechanism shall operate continuously till switched off by pushing a red colored push button. The continuous operation of the compaction cycle is to be achieved with the help of pressure sensing sequence valves in the hydraulic circuit.

The hydraulic cylinder tube shall be made of ST52 or equivalent high tensile steel. The piston rod will of corrosion resistant and hard chrome plated material. The gland and piston will be made of EN8 or equivalent material.
Emergency electric stop push buttons are provided on both sides of the Tailgate for safety of working staff. Working light, Rotating Beacon light, backing light, stop light, Direction indicator, Number Plate light and emergency stop provisions to be provided in the RCV.

UNIVERSAL BIN LIFTER

The Universal Bin Lifter is capable of directly lifting and empting the garbage from a DIN Standard Bin of 1100 Ltrs. 660 Ltrs. capacity into the tailgate hopper. The Bin Lifter is also capable of lifting and empting the garbage simultaneously from 2 Nos. DIN Standard Bins of up to 240 Ltrs. Capacity. The bin lifter is also cable of lifting 120 liters DIN Standard bin.

The Bin Lifter shall be provided with 4 hydraulic cylinders i.e. 2 cylinders for leveling and lifting the Bin and 2 cylinders for tipping operations.

The bin lifter as well as bin catcher shall be made up from hot deep tensile steel or equivalent material.

SAFETY FEATURES

Hose burst valve should be fitted to the system to prevent the tailgate descending in the event of the hydraulic failure. Emergency stop switch should be provided to stop all the operation instantaneously in case of emergency. The switch should be provided on either side of the vehicle. This is a statutory safety requirement for Operators / Public. There should be a body prop provided on the tailgate to hold the tailgate in the open position for safety of workshop personnel when entering the body for maintenance or repair.

TRUCK CHASSIS

The equipment is to be offered fully built on 11~12 Ton GVW, wheel base 3800-4200 mm truck chassis with Non-Sleeper's Driver's Cabin and PTO (Power Take Off) unit.

ENGINE

Turbo charged 4 stroke, 4 cylinders, as per latest Bangladesh latest emission standard.

SUGGESTED MAKE OF ITEMS		
1.	PTO	VEHICLE MANUFACTURERS/WIPRO/ EQUIVALENT REPUTED MAKE
2.	PUMP	VEHICLE MANUFACTURERS /DENISON /U.T./WIPRO/ EQUIVALENT REPUTED MAKE
3.	HYDRAULIC CYLINDERS	HEIL/DANTAL/ WIPRO / CANARA/ EQUIVALENT REPUTED MAKE
4.	HYDRAULIC VALVES	WALOIL/BUCHER/ EQUIVALENT REPUTED MAKE
5.	HYDRAULIC HOSES	PARKER/GATES/ EQUIVALENT REPUTED MAKE

REMARKS:

I. Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.

II. These are basic specification of TATA make, however equivalent make and model shall also be acceptable provided that they meet the basic functional requirements as specified above.

TECHNICAL SPECIFICATION FOR VACUUM SUCTION MACHINE MOUNTED ON TRUCK

The Machine is self-contained in all aspects and is suitable for suctioning dry free flowing materials directly into the machine container. The above machine is one of the most powerful and efficient machine of its kind available in the Indian Market, incorporating Cartridge Bag Filters, Centrifugal Blower etc. The offered Machine has the following features:

The machine is fitted with a centrifugal Blower suitable for Municipal Application and can be used for cleaning leaves, litters and road kerb side dust.

BLOWER SYSTEM

The Blower System being used in this machine develops Air flow of 4500 cum/ hr. during vacuum cleaning application. This blower is driven by a separate auxiliary diesel engine mounted on the machine skid. The entire assembly is mounted on a frame with vibration dampers. The Blower Impeller is made out of Hardox and Casing is made out of MS Plate. The Blower capacity shall be selected based upon the application requirement and calculation of the same shall be submitted for approval.

COLLECTOR BODY

The collector hopper has Volume of 3.0 m^3 and is suitable for collecting free flowing materials. The collected material is discharged from the collector body by hydraulic tipping. The collector body rear dump discharge doors have facilities for manual locking and unlocking arrangements. Lifting and lowering of the discharge doors and tilting of the container is being done hydraulically.

FILTER SYSTEM

The Machine incorporates two filtration stages as under: -

Stage -I : High Efficiency Cyclonic Separator
Stage -II : Cartridge Bag Filters with automatic cleaning by reverse air jet blowing.

DIESEL ENGINE

The diesel engine develops 49 HP. The diesel engine is naturally aspirated and is water-cooled with direct injection. The diesel engine is with all necessary standard accessories like fuel tank, fuel filter for feed pump suction line, oil pressure gauge and water temperature gauge. The radiator is industrial type with Air blast, heavy duty type air cleaners. The diesel engine has all standard features/protections, which are required in the satisfactory operation and performance of the Machine.

COMPRESSED AIR SYSTEM

The Machine has in-built air compressor with requisite capacities to meet compressed air requirements for cleaning of filters. The Compressed Air System incorporates air receivers, pressure Relief valve, solenoid valves, purging system etc.

HYDRAULIC SYSTEM

The Vacuum Cleaner has the facility for hydraulic tipping of the container. The rear dump doors of the container have facility of manually operated locking and unlocking arrangements. Similarly, rear dump door closing and opening is also hydraulically actuated. All these hydraulic activities are attained through hydraulic controllers.

SUCTION HOSE

The machine is fitted with a Suction hose of 100 mm dia. and length 5 meters.

MACHINE BODY

The entire body of the Machine chamber is with sound proofing cover and with facility for locking arrangements.

TRUCK CHASSIS

The offered machine shall be mounted on a TATA 407 Truck Chassis, wheelbase min. 3100 mm or Equivalent make & model vehicle with Cabin and PTO.

EMISSION

As per Bangladesh latest emission standards.

REMARKS:

1) Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.
2) These are basic specification of TATA make and model, however equivalent make and model shall also be acceptable provided that they meet the basic functional requirements as specified above.

TECHNICAL SPECIFICATION FOR GARBAGE TIPPER TRUCK

Sr. No	Parameters	Specification Data
1.	Model	Tata LPK407EX/27-3m^3 Garbage Tipper or equivalent make & model
2.	Application	3 cum box tipper body on LPK407EX/27 suitable for carrying Garbage, bricks, Municipal work, Light construction materials, etc.
3.	Engine	
a)	Max. Power	As per manufacturer standard

b)	Max. Torque	As per manufacturer standard
4.	Steering	Power
5.	Tyres	Front- 2, Rear – 4, Spare -1
6.	Weight	
a)	Max. Permissible GVW (kg)	As per manufacturer standard
b)	Max. Permissible FAW (kg)	As per manufacturer standard
a)	Max. Permissible RAW (kg)	As per manufacturer standard
7.	BODY DETAILS	
a)	Body Dimensions (LxWxH in mm)	3175 x 1980 x 475 (approx.)
b)	Material of Construction	Mild steel with suitable reinforcements & required stiffeners (Other than Indian standard)
c)	Hydraulic System	2 stage underbody hydraulic system procured from reputed suppliers(i.e. HEIL/DANTAL/ WIPRO/ CANARA/ EQUIVALENT REPUTED MAKE)
d)	Panel Thickness	Floor – 4mm, Headboard & sides – 3mm
8.	Emission standard	As per Bangladesh latest emission standards.

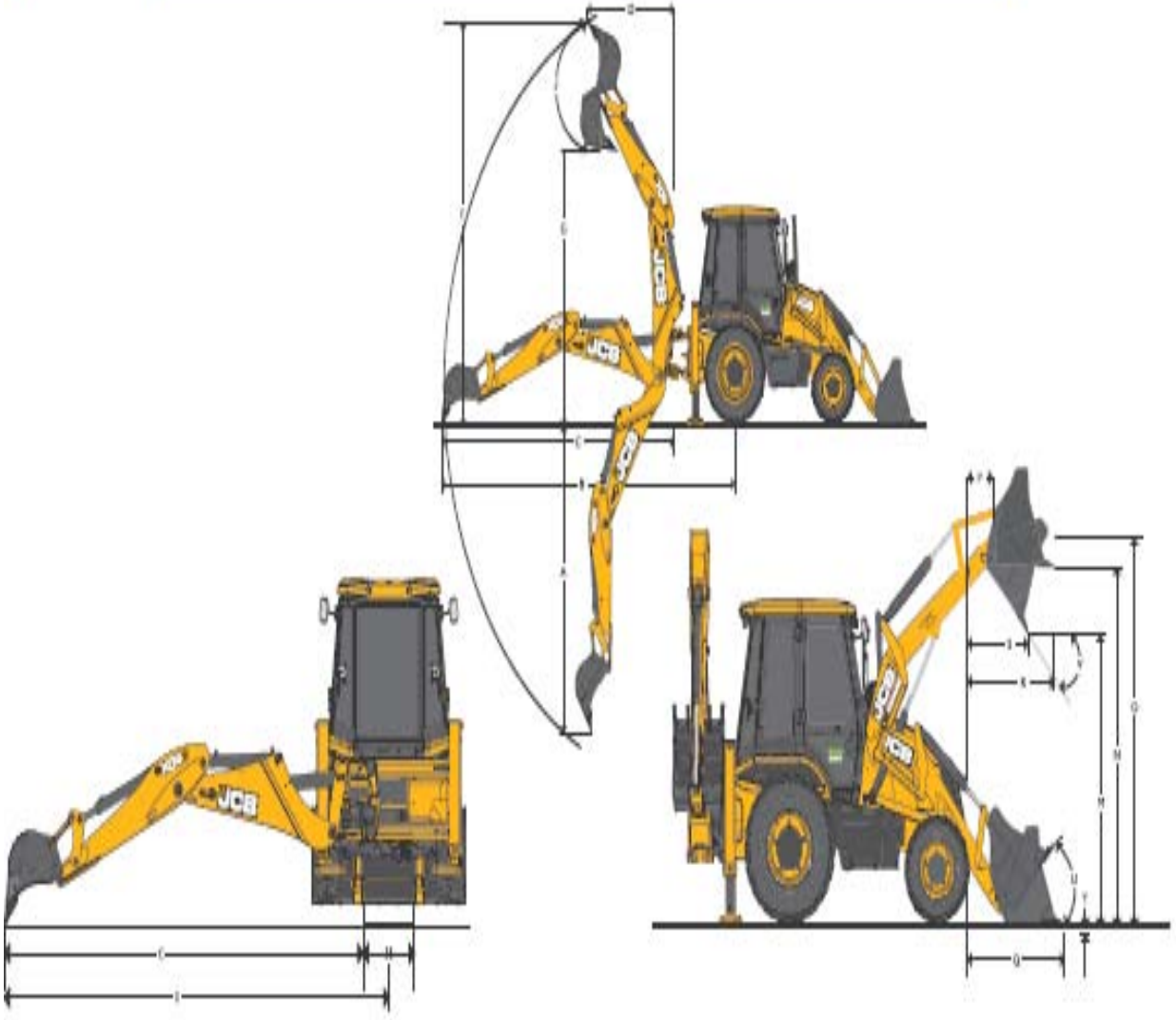
Remarks:

1) The vehicle should have features as mentioned below:
    a. Battery charge indication lamp
    b. Recling and sliding driver seats
    c. Door Handle cum Arm rest
    d. Bottle Holder
    e. Seating Capacity - Driver+2
    f. Seat Material-Vinyl Fabric
    g. Moulded Roof Lining
    h. Engine Compartment Light
    i. Battery charge indication lamp
    j. Seat Belt warning light for driver
    k. Engine Oil Low Pressure Indicator Light
    l. Strongest & Reinforced Ladder type chassis frame
    m. Closed pitch load body
    n. Clear lens Head lamp
    o. Hand Grip on Load Body
    p. Power socket
    q. Digital clock
    r. Reverse beeper
    s. Inner Rear view mirror
    t. High Gradeability
    u. Shortest Turning radius of 5.1 m for easy maneuverability
2) Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.
3) These are basic specification of TATA make and model, however equivalent make and model shall also be acceptable provided that they meet the basic functional requirements as specified above.

TECHNICAL SPECIFICATION FOR MATERIAL HANDLING EQUIPMENT (BACKHOE LOADER – JCB 3DX-XTRA)

	TITLE : **2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT**	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

PERFORMANCE DIMENSIONS



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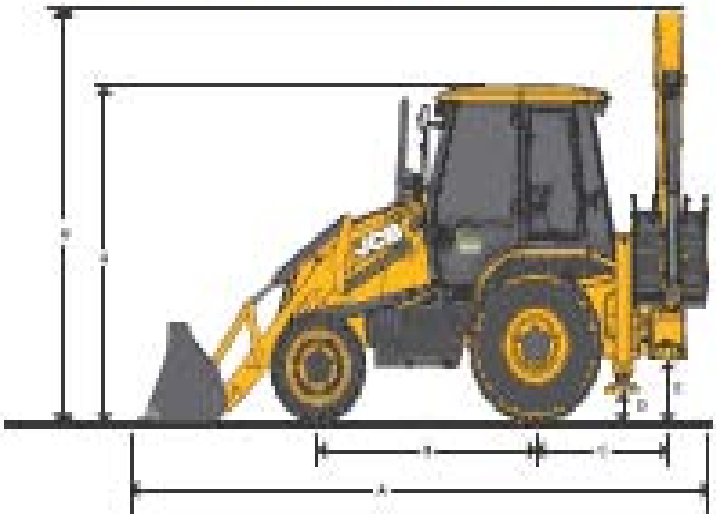
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

STATIC DIMENSIONS



EXCAVATOR PERFORMANCE

			3DX-Xtra
A	Max. dig depth	m (ft-in)	5.05 (16-7)
B	Reach-ground level to rear wheel centre	m (ft-in)	6.93 (22-9)
C	Reach-ground level to slew centre	m (ft-in)	5.61 (18-5)
D	Reach at full height to slew centre	m (ft-in)	2.65 (8-8)
E	Side reach to centre line of machine	m (ft-in)	6.14 (20-2)
F	Max. working height	m (ft-in)	6.01 (19-9)
G	Max. load over height	m (ft-in)	4.35 (14-3)
H	King post travel	m (ft-in)	1.06 (3-6)
J	Bucket rotation - Power	deg	185
	Bucket tear out force	kgf	6,324
	Dipper tear out force	kgf	3,217
	Lift capacity to bucket pivot at full reach (no bucket fitted) (SAE J31) (Data with standard dipper)	kgs	1,584
	Standard bucket capacity	cum (cu.ft)	0.30 (10.6)
	Standard bucket width	m (ft-in)	0.82 (2-8)

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
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LOADER PERFORMANCE

			3DX-Xtra
M	Dump height	m (ft-in)	2.93 (9-7)
N	Load over height	m (ft-in)	3.37 (11-1)
O	Pin height	m (ft-in)	3.64 (11-11)
P	Pin forward reach	m (ft-in)	0.41 (1-4)
Q	Reach at ground	m (ft-in)	1.60 (5-3)
R	Max. reach at full height	m (ft-in)	1.24 (4-1)
S	Reach at full height - Bucket dumped	m (ft-in)	0.93 (3-1)
T	Below ground level dig depth	m (ft-in)	0.12 (0-5)
U	Rollback at ground	deg	43
V	Dump angle	kgf	41
	Shovel break out force	kgf	6,270
	Loader arm break out force	kgf	5,100
	Payload	kgf	1,800
	Standard shovel	cum (cu.ft)	1.1 (38.85)

			3DX-Xtra
A	Overall length	m (ft-in)	6.10 (20-0)
B	Wheelbase	m (ft-in)	2.17 (7-1)
C	Slew centre to rear axle centre	m (ft-in)	1.32 (4-4)
D	Minimum ground clearance	m (ft-in)	0.36 (1-2)
E	Slew ground clearance	m (ft-in)	0.53 (1-9)
G	Height to top of cab	m (ft-in)	2.87 (9-5)
H	Overall height	m (ft-in)	3.90 (11-10)
J	Track width - Rear	m (ft-in)	1.73 (5-8)
K	Track width - Front	m (ft-in)	1.86 (6-1)
L	Width over bucket	m (ft-in)	2.35 (7-9)

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
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ENGINE

JCB 448, naturally aspirated, 4 cylinder, water cooled, Diesel Engine

Displacement : 4.8 litres
Gross power : 56 kW (76 mhp) @ 2200 RPM
Max torque : 305 nm (31.1 kgm) @ 1100 RPM

TRANSMISSION

The JCB synchroshuttle transmission provides superb drive power in all conditions. It consists of a 4-speed, fully synchromesh, smooth shift gear box with integral torque convertor and electrically operated reversing shuttle.

- Easy-to-use, column mounted electric reversing shuttle switch can change machine direction while allowing operator to keep hands on the steering wheel leading to fast cycle time.
- The pedals layout and conventional 4-pattern gear lever with transmission disconnect switch adds to the overall ease of operation. On-the-move gear changes are possbile.
- Torque converter stall ratio is 3.01:1.

AXLES

- **Rear** : Drive axle rigidly mounted, incorporates JCB Max-Trac torque proportioning differential, driven by short propshaft from gear box.
- **Front** : Steer axle, centrally pivoted, with oscillation angle of 16°.

BRAKES

- **Service** : JCB 'Q' brakes, hydraulically actuated, dual line, self adjusting (compensated), oil immersed, multi-disc type on the rear axle, well protected from dirt, water etc. requiring no maintenance. Operated through independent pedals linked together for normal use.
- Two independently operatable foot pedals enable machine to manoeuvre in tight spaces.
- **Parking** : Hand operated, disc brakes on rear axle input disc.

STEERING

Power track steering rod system provides equal turn steering & quick response with less operating force.

- Working pressure 1750 p.s.i. (121 bar)
- Hydraulic supply from independent steering pump.

ELECTRICALS

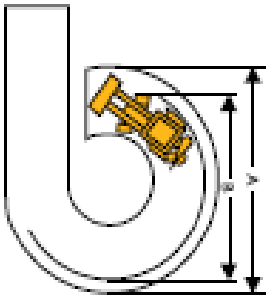
130 Ampere-hour 12 Volts battery system with alternator and full road lighting.

TYRES

Front : 9 x 16 - 16 PR
Rear : 16.9 x 28-12 PR

TURNING CIRCLE

		3DX-Xtra
Inner wheels braked		
A* Outside loader bucket	m (ft-in)	9.7 (31-10)
B Outside wheels	m (ft-in)	6.20 (20-4)
Inner wheels braked		**3DX-Xtra**
A* Outside loader bucket	m (ft-in)	11.0 (36-1)
B Outside wheels	m (ft-in)	8.94 (29-4)



* Standard bucket in travel position

SPEED

Gear	Forward Km/hr	Reverse Km/hr
1st	6.1	6.1
2nd	9.8	9.8
3rd	21.0	Not recommended
4th	40.0	Not recommended

(Standard tyres, with zero torque converter slip@ 2200 RPM)

HYDRAULICS

Filtration through suction strainer and return line "JCB filtromatic filter".

	3DX-Xtra
System pressure (p.s.i.)	3600
Pump flow (lpm) @ 2200 rpm	128

SHIPPING WEIGHT

3DX	3DX-Xtra
7460 kgs	7630 kgs

SERVICE

		System	Service
Hydraulic system	:	120	70
Fuel tank	:	128	-
Engine coolant	:	16.5	15
Engine oil	:	15	15
Transmission	:	17.5	17.5
Rear axle	:	20	20

CABIN

- Tinted cab glasses provide excellent all round visibility & sun protection.
- Music system as standard fitment.
- **Option** of servo operated excavator controls for hassle free operations*.
- **Option** of air conditioning in cabin for rested operator in hot weather conditions*.
- Auto shut off for fuel saving*.
- Plenty of legroom minimises fatigue.
- A fully adjustable suspension seat combined with ergonomically positioned controls and soft touch steering wheel.
- Cab provides easy 'walk through' two door access. Other features include seat belt, large convex rear view mirror, interior light, front screen wiper, cabin fan, front and rear horn, hazard warning system, tool box and helper seat.
- Instrumentation panel is positioned on the right hand side and includes engine speed, engine hours, fuel level, water temperature and mobile charger. Easily visible while both end operation.
- Audio and visual fault warning system for alternator charge, coolant temperature, engine oil pressure, blocked air filter, transmission oil pressure and temperature and hand-brake on.

* On 3DX-Xtra ecoXcellence

LIVELINK

Advanced telematics system that enables you to monitor and manage your machines remotely by providing information on:

Service : Routine maintenance information and alerts

Operation : Health alerts and usage data

Security : Machine location & movement data

OPTIONS (As applicable)

- Excavator buckets
- Capacities - 0.06 mm, 0.09 mm, 0.12 mm, 0.18 mm
- 6 in 1 clam shovel
- Ditch cleaning bucket
- Taper ditching bucket
- Square hole bucket
- Jaw bucket
- Rock breaker
- Ripper tooth
- 4WD*
- JCB telescopic dipper*

  Provides up to 1m of extra reach when compared with the standard dipper. Maximum dig depth, extended 5.77 m. Reach at ground from slew centre, extended 6.53 m. Maximum loadover height, extended 5.05 m. Lift capacity at bucket pivot at maximum extended reach, no bucket fitted 825 kg. Auxiliary valve block enable fitment of JCB telescopic dipper.

*Only on 3DX ecoXcellence

- Smooth Ride System (SRS)
- Heavy duty rear tyres 14x25
- Tipping lever - Speed : 201° bucket rotation
- Tipping lever hook
- **Hydraulic Tool Circuit (HTC)**

  Provision to hydraulically operate hand held tools viz. rock breaker, disc cutter and submersible pump.

2 nos. JCB –3 DX-XTRA or equivalent make and model machines shall be provided each machine shall be provided with 1no. front loader and 1 no. excavator bucket. Dimensions and features mentioned above are approximate for selection of equivalent model.

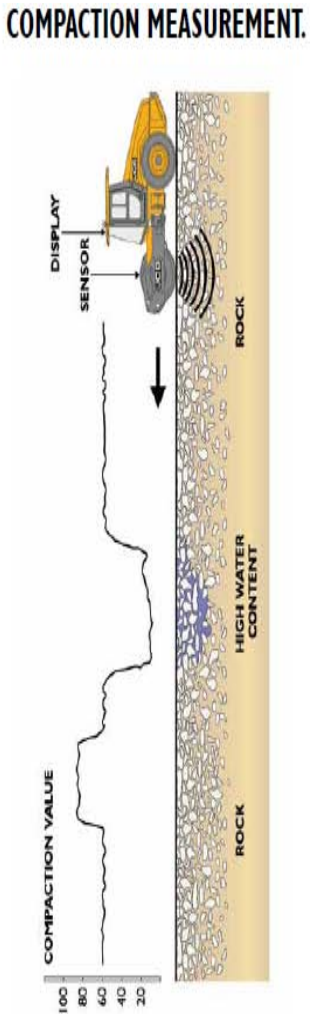
Emission Standard:

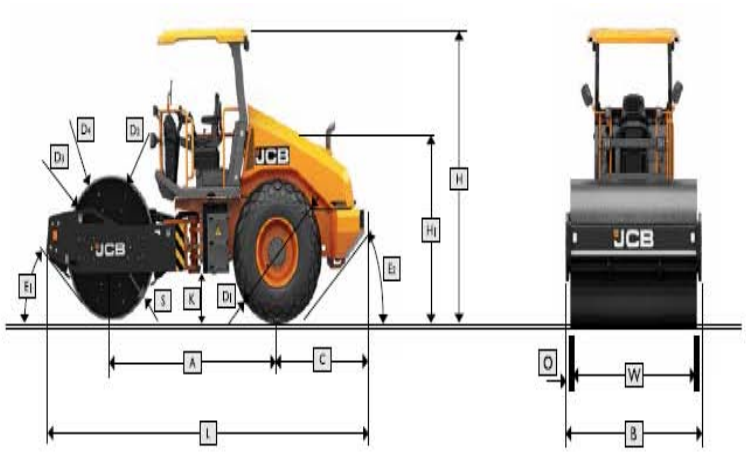
As per Bangladesh latest emission Standard.

Remarks:

1) Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.
2) These are basic specification of JCB make and model, however equivalent make and model shall also be acceptable provided that they meet the basic functional requirements as specified above.

TECHNICAL SPECIFICATION FOR MATERIAL HANDLING EQUIPMENT (VIBRATION COMPACTOR –JCB 116)





STATIC DIMENSIONS		
Dimensions in mm		
A	Wheelbase	2846 mm
B	Overall width	2240 mm
C	Axle to rear face	1517 mm
D1	Wheel diameter	1560 mm
D2	Drum diameter (Smooth drum)	1500 mm
D3	Inner diameter padfoot drum	1500 mm
D4	Outer diameter padfoot drum	1690 mm
E1	Front departure angle	39°
E2	Rear departure angle	34°
H	Total travel clearance	2995 mm
H1	Height to top of seat (Unfold)	2280 mm
K	Ground clearance	443 mm
L	Total travel length	5473 mm
O	Overhang	70 mm
S	Drum thickness	28 mm
W	Drum width	2100 mm

OPERATING DATA			
		JCB116	
Operating weight	kg	11250	
Operating axle load front / rear	kg	6350 / 4900	
Vibration stage		1	2
Exciter frequency	Hz (vpm)	32 (1920)	36 (2160)
Nominal amplitude	mm	1.8	0.8
Centrifugal force	kN	256	147
Centrifugal force / drum width	N/cm	1219	700
Working speed (Forward/Reverse) max.	km/h	6.5	
Travel speed (Forward/Reverse) max.	km/h	11	
Steering lock angle	degrees	± 35	
Vertical oscillation	degrees	± 15	
Inner turning radius	m	3.4	
Tyres		23.1 - 26 / 8 PR	
Number of padfoot			
Height of padfoot			
Gradeability up to (Drum drive)	degrees (%)	18.5 (34)	

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

ENGINE

Four-cylinder, water-cooled, four-stroke, turbo-charged, after-cooled diesel engine.

Make		JCB
Model		JCB Diesel Max TCA-74,
Total displacement	(cm3)	4399
Gross power	(hp)	100
Operating speed / Rated	(rpm)	2000
Starting device		Electric motor
Air cleaner		Two stage dry type
Fuel filter		Cartridge
Emission		As per Bangladesh latest emission standard

PROPULSION

Infinitely variable hydrostatic direct drive by variable displacement motor on rear axle and drum (On drum drive machine), limited slip axle.

EXCITER DRIVE

Electrically-controlled hydrostatic direct drive on drum.

EXCITER

Single-shaft circular exciter with overturning weights.

STEERING SYSTEM

Servo assisted centre articulation with automatic oscillation.

SERVICE CAPACITIES

Fuel	litres	300
Engine oil (Engine)	litres	14
Gear oil (Exciter)	litres	5
Hydraulic oil	litres	80
Coolant / System	litres	21

BRAKING SYSTEM

Service brake: Hydrostatic propulsion system.

Parking brake: Hydraulically-released multi-disk brake on rear axle and drum drive.

Emergency brake: Electrically-controlled, disk brake, on rear axle and drum drive.

ELECTRICAL SYSTEM

Voltage	V	12
Battery capacity	Ah	120
Alternator (Current carrying capacity)	A	90

INDICATORS AND SWITCHES

RPM cum hour meter, fuel gauge, engine temperature gauge, indicators for engine oil pressure, battery charging current, hydraulic oil and air filter condition, parking brake, neutral position control lever, switches for speed range selection, frequency, acoustic back-up alarm, four working lights, head lamps, turn signal, hazard-warning lights.

OPTIONS

ROPS & FOPS cab, ROPS & FOPS canopy~~, compatronic, padded foot drum shell, pressure measuring station.~~

Emission Standard:

As per Bangladesh latest emission standard.

Remarks:

1) Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.
2) 2) These are basic specification of JCB make and model, however equivalent make and model shall also be acceptable provided that they meet the basic functional requirements as specified above.

	TITLE : **2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT**	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

TECHNICAL SPECIFICATION FOR TROMMEL (PERFORATION OF 100 mm)

Sr. No	Parameters	Specification Data
1.	Type	Shaftless Rotary Screen
2.	Material to be handled	Solid Waste (Green and residual waste etc.)
3.	Material temperature	Ambient
4.	Design Capacity	1.5 Ton/hr.
5.	Density	0.5 ton/m^3
6.	Trommel Details	
a)	Trommel body MOC	Mild Steel, Thickness suit to system requirement
b)	Trommel Screen MOC	Mild Steel, 4 mm thick
c)	Perforation size	100 mm
d)	Drive	Motorized
e)	Motor rating	Suitable to meet the system requirement
f)	Power transmission	Through reduction gear
g)	Trommel diameter	Suitable to meet the system requirement
h)	Screening length	As per system requirement (not less than 3.0 m)
i)	Speed (rpm)	As per system requirement
7.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
8.	Bearing	NTN/SKF/Equivalent reputed make
9.	Features	Friction drive with minimum losses due to slippages. Internal cut flights for de-lumping of Solid waste. Easily Replaceable Screen.
	Feed chain conveyor belt	
1.	Material to be handled	Feeding Solid Waste at a pre-specified rate to Trommel
2.	Type	Chain Belt conveyor, ‘Z’ type
3.	Capacity	1.5 Ton / hr.
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	3.0- 3.5 m
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm & 100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	2-3 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make

	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Side Rubber Seal.
	Process/ Undersize chain conveyor belt	
1.	Material to be handled	Solid Waste
2.	Type	Chain Belt conveyor, 'L' type
3.	Capacity	As per process requirement
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	As per process requirement
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain with Required attachment (i.e. K1, K2, M1, M2 and Extended Pins)
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	10-15 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Self-Lubrication system.
	Reject chain conveyor belt	
1.	Material to be handled	Solid Waste
2.	Type	Chain Belt conveyor, 'L' type
3.	Capacity	As per process requirement
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	As per process requirement
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain with Required attachment (i.e. K1, K2, M1, M2 and Extended Pins)
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	10-15 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement

15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Self-Lubrication system.

TECHNICAL SPECIFICATION FOR TROMMEL (PERFORATION OF 20 mm)

Sr. No	Parameters	Specification Data
1.	Type	Shaftless Rotary Screen
2.	Material to be handled	Solid Waste (Green and residual waste etc.)
3.	Material temperature	Ambient
4.	Design Capacity	1.5 Ton/hr.
5.	Density	0.5 ton/m^3
6.	Trommel Details	
a)	Trommel body MOC	Mild Steel, Thickness suit to system requirement
b)	Trommel Screen MOC	Mild Steel, 4 mm thick
c)	Perforation size	20 mm
d)	Drive	Motorized
e)	Motor rating	Suitable to meet the system requirement
f)	Power transmission	Through reduction gear
g)	Trommel diameter	Suitable to meet the system requirement
h)	Screening length	As per system requirement (not less than 3.0 m)
i)	Speed (rpm)	As per system requirement
7.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
8.	Bearing	NTN/ SKF/ Equivalent reputed make
9.	Features	Friction drive with minimum losses due to slippages. Internal cut flights for de-lumping of Solid waste. Easily Replaceable Screen.
	Feed chain conveyor belt	
1.	Material to be handled	Feeding Solid Waste at a pre-specified rate to Trommel
2.	Type	Chain Belt conveyor, ‘Z’ type
3.	Capacity	1.5 Ton / hr.
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	3.0- 3.5 m
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm & 100 mm)

11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	2-3 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Side Rubber Seal.
	Process/ Undersize chain conveyor belt	
1.	Material to be handled	Solid Waste
2.	Type	Chain Belt conveyor, 'L' type
3.	Capacity	As per process requirement
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	As per process requirement
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain with Required attachment (i.e. K1, K2, M1, M2 and Extended Pins)
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	10-15 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/ SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Self-Lubrication system.
	Reject chain conveyor belt	
1.	Material to be handled	Solid Waste
2.	Type	Chain Belt conveyor, 'L' type
3.	Capacity	As per process requirement
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	As per process requirement
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain with Required attachment (i.e. K1, K2, M1, M2 and Extended Pins)

9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm & 100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	10-15 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Self-Lubrication system.

TECHNICAL SPECIFICATION FOR TROMMEL (PERFORATION OF 4 mm)

Sr. No	Parameters	Specification Data
1.	Type	Shaftless Rotary Screen
2.	Material to be handled	Processed organic waste
3.	Material temperature	Ambient
4.	Design Capacity	1.5 Ton/hr.
5.	Density	0.5 ton/m^3
6.	Trommel Details	
a)	Trommel body MOC	Mild Steel, Thickness suit to system requirement
b)	Trommel Screen MOC	Mild Steel, 4 mm thick
c)	Perforation size	4 mm
d)	Drive	Motorized
e)	Motor rating	Suitable to meet the system requirement
f)	Power transmission	Through reduction gear
g)	Trommel diameter	Suitable to meet the system requirement
h)	Screening length	As per system requirement (not less than 3.0 m)
i)	Speed (rpm)	As per system requirement
7.	Structure	Various rolled steel sections (i.e. 125 mm & 100 mm)
8.	Bearing	NTN/SKF/Equivalent reputed make
9.	Features	Friction drive with minimum losses due to slippages. Internal cut flights for de-lumping of Solid waste. Easily Replaceable Screen.
	Feed chain conveyor belt	
1.	Material to be handled	Processed organic waste
2.	Type	Chain Belt conveyor, ‘Z’ type
3.	Capacity	1.5 Ton / hr.
4.	Length	As per process requirement

5.	Width	As per process requirement
6.	Discharge height	3.0- 3.5 m
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	2-3 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Side Rubber Seal.
	Process/Undersize chain conveyor belt	
1.	Material to be handled	Processed organic waste
2.	Type	Chain Belt conveyor, ‘L’ type
3.	Capacity	As per process requirement
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	As per process requirement
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain with Required attachment (i.e. K1, K2, M1, M2 and Extended Pins)
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	10-15 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Self-Lubrication system.
	Reject chain conveyor belt	
1.	Material to be handled	Processed organic waste
2.	Type	Chain Belt conveyor, ‘L’ type
3.	Capacity	As per process requirement

4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	As per process requirement
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain with Required attachment (i.e. K1, K2, M1, M2 and Extended Pins)
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	10-15 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Self-Lubrication system.

TECHNICAL SPECIFICATION FOR TROMMEL (PERFORATION OF 2 mm)

Sr. No	Parameters	Specification Data
1.	Type	Shaftless Rotary Screen
2.	Material to be handled	Processed organic waste
3.	Material temperature	Ambient
4.	Design Capacity	1.5 Ton/hr.
5.	Density	0.5 ton/m^3
6.	**Trommel Details**	
a)	Trommel body MOC	Mild Steel, Thickness suit to system requirement
b)	Trommel Screen MOC	Mild Steel, 4 mm thick
c)	Perforation size	2 mm
d)	Drive	Motorized
e)	Motor rating	Suitable to meet the system requirement
f)	Power transmission	Through reduction gear
g)	Trommel diameter	Suitable to meet the system requirement
h)	Screening length	As per system requirement (not less than 3.0 m)
i)	Speed (rpm)	As per system requirement
7.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
8.	Bearing	NTN/SKF/Equivalent reputed make
9.	Features	Friction drive with minimum losses due to slippages. Internal cut flights for de-lumping of Solid waste. Easily Replaceable Screen.

	Feed chain conveyor belt	
1.	Material to be handled	Processed organic waste
2.	Type	Chain Belt conveyor, 'Z' type
3.	Capacity	1.5 Ton / hr.
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	3.0- 3.5 m
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm & 100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	2-3 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Side Rubber Seal.
	Process/Undersize chain conveyor belt	
1.	Material to be handled	Processed organic waste
2.	Type	Chain Belt conveyor, 'L' type
3.	Capacity	As per process requirement
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	As per process requirement
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain with Required attachment (i.e. K1, K2, M1, M2 and Extended Pins)
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	10-15 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
16.	Features	Fully guided positive drive system. UHMW Liner to minimize friction.

		Central Guide Blocks with horizontal cross members. Self-Lubrication system.
	Reject chain conveyor belt	
1.	Material to be handled	Processed organic waste
2.	Type	Chain Belt conveyor, 'L' type
3.	Capacity	As per process requirement
4.	Length	As per process requirement
5.	Width	As per process requirement
6.	Discharge height	As per process requirement
7.	Belt	Rubber M24 grade, 3 ply , 8 mm thick
8.	Chain	Roller chain with Required attachment (i.e. K1, K2, M1, M2 and Extended Pins)
9.	Chain MOC	Hardened MS
10.	Structure	Various rolled steel sections (i.e. 125 mm &100 mm)
11.	Protective covers	Alloy steel –Anti corrosive
12.	Speed	10-15 m/min
13.	Drive	Electrical Motor
14.	Motor rating	Suitable to meet the system requirement
15.	Power transmission	Through reduction gear
16.	Bearings	NTN/SKF/ Equivalent reputed make
17.	Features	Fully guided positive drive system. UHMW Liner to minimize friction. Central Guide Blocks with horizontal cross members. Self-Lubrication system.

TECHNICAL SPECIFICATION FOR SCREW SHREDDER

Sr. No	Parameters	Specification Data
1.	Type	Screw Shredder
2.	Application	Shreds all form of organic waste
3.	Configuration	Double shaft
4.	Material to be handled	Solid waste
5.	Design Capacity	100-150 kg/ hr.
6.	Cutters	Toothed plated (hardened)
7.	Cutters MOC	Suitable to meet the process requirement
8.	Body MOC	Mild steel
9.	Input Particle Size	500 mm(L)X300mm(W)X20-50mm (thk.)
10.	Output Particle Size	15-20 mm size
11.	Drive	Electrical Motor
12.	Motor rating	Suitable to meet the system requirement
13.	Speed (rpm)	As per system requirement

14.	Gear box	Shaft mounted helical
15.	Shaft Material	EN 8
16.	Bearing	NTN/SKF/ Equivalent reputed make
17.	Protective covers	Alloy steel –Anti corrosive
18.	Structure (As applicable)	Various rolled steel sections (i.e.100 & 50 mm)
19.	Features	High torque Rating. Cutting chamber, hopper, body base support

TECHNICAL SPECIFICATION FOR DENSITY SEPERATOR WITH ASPIRATOR (DESTONER)

Sr. No	Parameters	Specification Data
1.	Type	Density Separator with Aspirator
2.	Application	Separates fine dust and other element from the final product (Compost).
4.	Material to be handled	Compost
5.	Design Capacity	1.5 tons/hour
6.	Configuration	Fluidized bed type
7.	Material of Construction	
a)	Deck	MS fabricated
b)	Fan /Blower	MS fabricated
c)	Cyclone	MS fabricated
8.	Deck length	As per system requirement
9.	Deck width	As per system requirement
10.	Drive	Electrical Motor
11.	Motor rating	Suitable to meet the system requirement
12.	Speed (rpm)	As per system requirement
13.	Gear box (if applicable)	Shaft mounted helical/ bevel
14.	Speed (rpm)	As per system requirement
15.	Bearing	NTN/SKF/ Equivalent reputed make
16.	Shaft	EN8
16.	Structure (As applicable)	Various rolled steel sections (i.e.100 & 50 mm)
17.	Bag house	Fabricated with Filter cloth
18.	Features	Very high separation efficiency Separation of metal, dust and other particles form the final compost

TECHNICAL SPECIFICATION FOR HORIZONTAL/ VERTICAL HYDRAULIC BALE PRESS

Sr. No	Parameters	Specification Data
1.	Type	Horizontal/ vertical
2.	Application	Making bale of Paper, card-board & plastic in single machine

4.	Material to be handled	Paper, card-board & plastic
5.	Design Capacity	1 to 1.5 Tons / Hour
7.	Compactor Body	Carbon steel (20 mm thk.)
8.	Baling chamber	As per manufacturer Standard
9.	Bale size	As per manufacturer Standard
10.	Weight of Bale (Approx.)	As per manufacturer Standard
11.	Electric motor	As per system requirement
12.	Pump	High Pressure Double Vane Pump.
13.	Cycle time (Approx.)	30-60 Seconds
14.	Cover Ram Tonnage	As per system requirement
15.	Main Ram Tonnage	As per system requirement
16.	No. of hydraulic cylinder	As per system requirement
17.	Make of hydraulic cylinder	HEIL/DANTAL/ WIPRO/ CANARA/ EQUIVALENT REPUTED MAKE
18.	Working pressure	As per system requirement
19.	Hard liner plates	To be provided
20.	Shearing blades	To be provided
21.	Oil tank capacity	As per system requirement
22.	Operation	Semi-automatic (Panel Controlled)
23.	Motor rating	Suitable to meet the system requirement
24.	Gear box (if applicable)	Shaft mounted helical/ bevel
25.	Bearing	NTN/SKF/ Equivalent reputed make
26.	Structure (As applicable)	Various rolled steel sections (i.e.100 & 50 mm)

TECHNICAL SPECIFICATION FOR WEIGH BRIDGE

S.N.	**Parameters**	**Specification Data**
1.	Weigh Bridge Type	Electronic Pit Less Type Road Weigh Bridge
2.	Quantity	One (1) No.
3.	Codes & Standards (Load Cell)	OIML R60 or equivalent international standard
4.	Weighing Capacity	20 Tonnes, 9000 mm X 3000 mm platform size of anti-skid steel.
5.	Type of tractors / trucks for weighment	6 wheeler or 10 wheeler
6.	Control Room Size	3 M X 3 M X 4 M (Ht.)
7.	Load Cells Type	Compression type with multi columns or Double ended shear beam type hermetically sealed & vibration resistant working on strain gauge principle

8.	Load Cell Capacity	Minimum capacity of each load cell shall be (2 x capacity of weigh scale) / number of load cells
9.	Over load, Safe	150 % of rated capacity
10.	Over load, Ultimate	200 % of rated capacity
11.	Digital weight indicator	To be provided to display weight
12.	UPS	1 hour backup with Ni-Cd battery
13.	Printer	A-4 size Colored Laser jet Printer with printer stand
14.	Accuracy of system	±0.25 % of maximum capacity (Rated Output)
15.	Load cell protection	IP 68 and tested by a national test house and also have overload parameters
16.	Visual display unit	Based on SMT technology / as per manufacturer standard to be provided in weight indicator
17.	Location of PC / Printer	In the control room near weigh bridge
18.	Totalizer	Minimum 6 digit type to be provided in the weigh bridge
19.	Digital weight indicator	At least 20 mm high character display for backlight LCD display
20.	Display modes	16 mm for message with a) Indicate weight b) Indicate calibration-Auto zero tracking
21.	Indicator	Kg or Tonne
22.	Weighing data storage	Minimum 1000 weighing
23.	Protection	From electromagnetic and radio interference
24.	Traffic Lights	With red and green signal for movement instruction to the vehicle operator along with two motorized barriers
25.	PC Configuration	a. Processor: Core i7 Processor, 3.2 GHz b. RAM: 4GB DDR2 RAM c. Mother Board: Intel Express Chipset d. Graphics: Onboard with min. 512 MB Video Memory e. Hard Drive: 1 no. X 360 GB SATA HDD @ 7200 RPM f. DVD R/W: 1 no. 52X CD RW & 16X DVD RW IDE Combo g. Ethernet Card: 2 nos. X 10/10/1000 MB h. Network Controller: 1 GbE NIC upgraded to 10 GbE i. Serial Port (RS232): 2 Nos. j. Parallel Port: 1 no. k. USB Port: 4 nos. l. Peripherals: 1 no. USB Optical Mouse, 1 no. USB Multimedia QWERTY Keyboard, 1 no. 22'' Color TFT/ LCD Monitor m. OS: Windows 7 n. MS Office 10
26.	Weighment & printouts	1. Name of contractor 2. Date and Time 3. Serial Number 4. Product Code 5. Customer Code 6. Truck Registration Number 7. First (Gross) Weight (I) 8. Second (Tare) Weight (II) 9. Net (Pay load) Weight (III) 10. LXBXH (M) Weigh slip after every weighment (i.e.) I & II weighments.

		Built in clock provide date and time to printer. Facility for totalizing the different material received.
27.	MATERIAL OF CONSTRUCTION	
a.	Platform supporting structure and platform	American Standard (ASTM A36) / European Standard (EN10025S235) / German Standard (ST 37.2) / Japanese Standard (JIS 3101SS400)/ or any other equivalent international standard.
b.	Load Cell	Alloy Steel
28.	Furniture in control room	Computer Table and Chair to be provided by bidder.
29.	Test Weight for Calibration	1 Ton Capacity to be provided by bidder.

TECHNICAL SPECIFICATION FOR LEACHATE TRANSFER PUMPS

LEACHATE TRANSFER PUMPS FOR LEACHATE COLLECTION SUMP		
Sr. No	**Parameters**	**Specification Data**
1.	Number required	Two (2) Number [1W+1S]
2.	Type	Vertical Submersible type
3.	Location	Outdoor
4.	Fluid to be handled	Leachate generated from Waste segregation and windrow composting area
5.	Duty	Intermittent
6.	Rated capacity, each m^3/hr.	Suitable to transfer 100% of Leachate generated within 1 hour or 10 cum/hr. whichever is higher.
7.	Head	Suitable to meet the system requirement
8.	Pump Speed, RPM	1500
9.	Material of Construction	
a)	Casing	Stainless Steel – Gr. 316
b)	Impeller	Stainless Steel – Gr. 316
c)	Shaft	Stainless Steel – Gr. 410
10.	Chain pulley block and handling bracket	To be Provided by bidder.
LEACHATE TRANSFER PUMPS FOR LEACHATE POND		
Sr. No	**Parameters**	**Specification Data**
1.	Number required	Two (2) Number [1W+1S]
2.	Type	Vertical Submersible type
3.	Location	Outdoor
4.	Fluid to be handled	Leachate generated from Waste segregation and windrow composting area
5.	Duty	Intermittent
6.	Rated capacity, each m3/hr.	Suitable to meet the system requirement
7.	Head	Suitable to meet the system requirement
8.	Pump Speed, RPM	1500
9.	Material of Construction	
a)	Casing	Stainless Steel – Gr. 316
b)	Impeller	Stainless Steel – Gr. 316
c)	Shaft	Stainless Steel – Gr. 410
10.	Chain pulley block and handling bracket	To be provided by bidder.
	LEACHATE COLLECTION SUMP OF SWM AREA	

1.	Leachate collection sump of SWM area capacity	10 m^3
2.	MOC	RCC (By BHEL)
3.	Type	Covered at top, below ground
4.	Handrail	To be provided by bidder.
	LEACHATE POND FOR LAND FILL AREA	
1.	Leachate pond capacity	Suitable to meet the system requirement for complete land fill site
2.	Sizing Criterion for capacity	The leachate pond shall have a capacity to receive the average leachate quantity of 20 consecutive days or the quantity after 3 days continuous heavy rainfall, whatever is larger.
2.	MOC	RCC (By BHEL)
3.	Type	Covered at top, below ground
4.	Handrail	To be provided by bidder.
5.	Liner	To be provided by bidder
6.	Liner MOC	HDPE
7.	Liner thickness	Not less than 2.5 mm
	BASAL LINER SYSTEM FOR LAND FILL AREA	
1.	Basal liner system	To be provided by bidder in accordance with Annex-1 of the European Union COUNCIL DIRECTIVE 1999/31IEC on the landfill of waste.
	LEACHATE DRAINAGE SYSTEM FOR LAND FILL SITE	
1.	Leachate collection system capacity	Design & supply for 30 years of land fill site in bidder's scope.
2.	Leachate drainage system	Design & supply for of one cell for 5 years life in bidder's scope
3.	Piping MOC	PVC or suitable material
4.	Valves (as applicable)	PVC or suitable material
	RO BASED LEACHATE TREATMENT SYSTEM	
1.	Capacity	Suitable to meet the system requirement
2.	Configuration	1X100%

Remarks:

1) Painting of all the items shall be as per Annexure –XI of Section I-A of this technical specification.
2) All Valve, piping, fitting, and instrument shall be of minimum PN 10 rating/ minimum class#150 or as per system requirement whichever is higher.

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IA	
		REV. No. 00	DATE : 06.02.2018

TECHNICAL DATA SHEET FOR ELECTRIC HOIST AND CHAIN PULLEY BLOCK

Sl.no	DESCRIPTION	TECHNICAL PARTICULARS
A	**ELECTRIC HOIST**	
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Scope (Qty., Capacity, Lift, Travel Length)	As per specification and layout requirement
3.0	Type of service	Indoor
4.0	Design Ambient temperature	45 deg.
5.0	Design standards	JIS B 9620/ ASME HST-4/ Other equivalent international standard (Indian standards and Chinese standards are not acceptable).
6.0	Duty class	Class II duty equivalent (Suitable for power plant operation).
7.0	Operating speed	
7.1	Hoisting speed	6 MPM
7.2	Trolley speed	15 MPM
8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	
9.1	Construction	Extra flexible plough steel
9.2	Core	Steel/ fibre
9.3	Factor of safety	As per relevant standard.
10.0	Load Hook	C shank with safety latch.
11.0	Gearing	
11.1	Type	Spur / Helical.
11.2	Lubrication	Oil splash/ grease lubricated.
11.3	Bearing type	Antifriction Ball / Roller.
12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Bearing type	Antifriction Ball / Roller
12.3	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.
13.0	BRAKE (HOIST and TROLLEY)	
13.1	Type	DC EM brakes disc type (fail to safety).
14.0	ROPE DRUM	
14.1	Flange / Flangeless	Flanged
14.2	Type of groove	As per manufacturers standard to suit the layout requirement.(Shall be decided during detail engineering)
15	DSL	PVC Shrouded bus bar conductor type DSL
16.0	MOTORS	
16.1	Type	Sq. Cage induction, TEFC, S4 duty, 40% CDF.
16.2	Number of start	150 starts / hr.
16.3	Class of insulation	Class “F” and temperature rise limited to class B.
16.4	Type of enclosure	TEFC
16.5	Degree of protection provided for enclosure	IP-54/55 (indoor/outdoor)
16.6	Margin	15% over maximum continuous load demand
17.0	Control panel	Hoist mounted

18.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.	
19.0	LIMIT SWITCHES	Hoisting	Trolley
19.1	Type	Snap action, self-actuating type	Lever type
20.0	Power cables	1.1KV grade, FRLS, XLPE insulated. Minimum size 2.5 mm sq. for Cu.	
21.0	Control cable	1.1KV grade, FRLS, PVC insulated. Minimum size 1.5 mm sq. for Cu.	
22.0	Flexible trailing cable	1.1KV grade, EPR insulated	
23.0	Control Voltage	110 V	
B	**MANUAL HOIST (CHAIN PULLEY BLOCK)**		
Sl.no	DESCRIPTION	TECHNICAL PARTICULARS	
1.0	Type	Hand operated chain pulley block	
2.0	Scope (Qty., Capacity, Lift, Travel Length)	As per specification and layout requirement	
3.0	Type of service	Indoor	
4.0	Design Ambient temperature	45 deg.	
5.0	Design standards	JIS B 8802/ASME HST-2/ Other equivalent international standard (Indian standards and Chinese standards are not acceptable)	
6.0	Duty class	Class II duty equivalent (Suitable for power plant operation)	
7.0	Hoisting Mechanism		
7.1	Type	Hand operated gear transmission	
7.2	Type of gear	Spur / Helical	
7.3	Load Chain	Link type	
7.4	Hand Chain	Link type	
7.5	Load Hook	C shank with safety latch.	
8.0	Trolley & Bridge Drive		
8.1	Trolley type	Geared (Manually operated)	
8.2	Drive Chain	Link type	
8.3	Type of gear	Spur / Helical	
9.0	Method of lubrications	Grease	
10.0	Brakes	Ratchet and pawl arrangement along with screw and friction disc type	

SUB SECTION IB

SPECIFIC TECHNICAL REQUIREMENTS - ELECTRICAL

	TITLE: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IB	
		REV. No. 00	DATE : 06.02.2018

1. EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER

a. Services and equipment as per “Electrical Scope between BHEL and Vendor”.
b. Any item/ work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
c. Supply of mandatory spares as specified in the specifications of mechanical equipment’s.
d. Electrical load requirement for SOLID WASTE MANAGEMENT PACKAGE.
e. All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f. Various drawings, data sheet as per required format, quality plans, calculations, Type test & Routine test reports & certificates, operation and maintenance manuals, complete technical literature with catalogues etc. shall be furnished as specified at contract stage. All documents shall be subject to customer /BHEL approval without any commercial implications to BHEL.
g. All electrical equipment (Motors, cables, cabling material etc.) shall meet requirements of specification B0 “General Technical Specification”.
h. All materials, components and equipment covered under this specification shall be procured, manufactured as per the requirements of specification B0- “General Technical Specification”.
i. For motors, BHEL standard quality plan for Motors (55KW & ABOVE) enclosed with the specification shall also be complied.
j. Acceptance of motor less than 30kW is based on COC of manufacturer & bidder confirming as follows:
It is hereby confirmed that the above mentioned motor/ motors was/ were manufactured taking care of BIFPCL specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting kVA/kW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing/ data sheets.
k. Acceptance of motor rating between 30kW & 50kW is based on BIFPCL review of Routine Test reports as per relevant IEC by main bidder along with COC of manufacturer & bidder conforming as follows:
It is hereby confirmed that the above mentioned motor/ motors was/ were manufactured taking care of BIFPCL specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting kVA/kW, temp. rise, distance between centre of stud & gland plate, space heater and tested in accordance with approved drawing/ data sheets.
l. The sub-vendor list for various electrical items is subject to BHEL/ Customer approval without any commercial implications.
However, bidder to note that sub-vendor list attached with the specification is only indicative & shall be finalized with L1 bidder before placement of LOI.
m. Bidder to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
n. Cable BOQ worked out based on routing of cable listing provided by the Bidder for “both end equipment in bidder’s scope” shall be binding to the bidder with +10 % margin to take care of slight variation in routing length & wastages.

2. EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3. DOCUMENTS TO BE SUBMITTED ALONG WITH BID

a. The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/ no deviation certificate.
b. No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc. is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

REV: 00

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: ELECTRIC HOISTS FOR SOLID WASTE MANAGMENT PACKAGE

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW MAITREE SUPER THERMAL POWER PROJECT

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V (3ph, 4W) supply feeder only up to isolating switches for hoist. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in EH supplier's scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc.).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

REV-0, DATE: 21.08.2017

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE :SOLID WASTE MANAGMENT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660MW MAITREE STPP, BANGLADESH

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) 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. Any other voltage level (AC/DC) required will be derived by the vendor.
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 BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Cable tray to individual load from main cable tray route shall be in vendor's scope & shall be through 100/ 50 mm FRP cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Cable glands shall be double compression Tinned brass conforming to BS: 6121. 2. Copper Cable lugs for control cable termination shall be PVC insulated/ sleeved type. The Material for lugs will be tinned copper only. Lugs for control cable shall be insulated & terminal shall be pin type/ flat type/ ring type / U type to suit terminal provided at panels.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IEC: 61386-1.

REV-0, DATE: 21.08.2017

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE :SOLID WASTE MANAGMENT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660MW MAITREE STPP, BANGLADESH

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

REV-0, DATE: 21.08.2017

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE :SOLID WASTE MANAGMENT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660MW MAITREE STPP, BANGLADESH

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination without cost implication.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

NOTES:
1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

	LOAD DATA (ELECTRICAL)	JOB NO.		ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	2X660 MW MAITREE SUPER THERMAL POWER PROJECT	NAME		DATA FILLED UP ON
		SYSTEM / S	SOLID WASTE MANAGMENT	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

	TITLE	SPECIFICATION NO.
	LV MOTORS	VOLUME II B
		SECTION II
	DATA SHEET-A	REV NO. 00 DATE 21.08.2017
		SHEET 1 OF 1

1.0	Design ambient temperature	:	45 ^{o}C
2.0	Maximum acceptable kW rating of LV motor	:	<160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree of Protection	:	IP55
5.0	Type of Cooling	:	TEFC/CACA/TETV
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +4% TO –6%)
	c) Combined voltage & freq. variation	:	10%
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 90kW & Above (Breaker controlled)	:	50 kA for 1 sec
	o Below 90kW (SFU/MCCB+: Contactor controlled)		50 kA for 0.20 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
9.0	Power cables data	:	Shall be given during detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during detailed engg.
11.0	Space heater supply	:	240 V, 1Φ, 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
13.0	Tests	:	As per motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	Continuous duty LT motors up to 160 KW Output rating (At 45 deg.C ambient temperature), shall be Premium Efficiency class-IE3

- **For further detailing please refer specification B0- “General Technical Specification”**

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 1 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IEC STANDARD/SPE	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IEC STANDARD	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 2 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IEC STANDARD	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

BHEL	**QUALITY PLAN**		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 3 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IEC STANDARD	RELEVANT IEC STANDARD	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IEC OR OTHER STANDARDS	RELEVANT IEC OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	

BHEL	PARTICULARS	BIDDER/VENDOR	
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	SIGNATURE		
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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 4 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE & MODEL	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

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भेल एच ई पी	**QUALITY PLAN**		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

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BHEL	**QUALITY PLAN**		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 6 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS (NOT APPLICABLE IN CASE OF VPI)	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 7 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT (IF APPLICABLE)	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	MFG SPEC.	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IEC STD.	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IEC STD.	MFG SPEC. RELEVANT IEC STD.	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IEC STD.	MFG SPEC. RELEVANT IEC STD.	Log Book	2		1	

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	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 8 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IEC-60034/ BHEL SPEC./ DATA SHEET	IEC-60034/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IEC-60034-14/ IEC-60034-9	IEC-60034-14/ IEC-60034-9	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IEC STD.	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	IEC-60034-05	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IEC-60034 & DATA SHEET	IEC-60034 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	VDE-0165/0170/0171	VDE-0165/0170/0171	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :	
		BIDDER/ : VENDOR	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE	
	SHEET 9 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION	VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. IN CASE OF INSPECTION BY CUSTOMER/BHEL OR NOMINATED AGENCY, QUANTUM OF CHECK WILL BE ONE MOTOR OF EACH TYPE.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)/PACKAGE/SYSTEM CONTRACTOR
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

SUB SECTION IC

SPECIFIC TECHNICAL REQUIREMENTS – CONTROL AND INSTRUMENTATION

	TITLE: 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: I	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION: IC	
		REV. No. 00	DATE : 06.02.2018

1. **The Contractor shall provide complete Instrumentation** for control, monitoring and operation of entire system for solid waste management package. The requirements given are to be read in conjunction with detailed Technical specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre bid clarification. In absence of any pre bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial and time implication.
2. **SOLID WASTE MANAGEMENT SYSTEM (SWMS)** shall be **microprocessor based system. Redundant microprocessor with hot stand-by shall be in Bidder's scope.**
3. **For microprocessor based system:** The 24 V DC systems shall consist of 2 sets of power supply with each set consisting of 1 x 100% battery charger, 1 x 100% batteries for 1 hour duty and 1 x 100% DC distribution board. Intelligent Battery health management system shall be provided for each set of 24VDC power supply system and UPS batteries (except mini-UPS). All battery systems shall be provided with a manual discharge resistance bank. Refer **Cl. No. B0.6.19.7-Power supply and fusing** under section IA-Customer's general technical specification – B0).
4. The quantity of instruments/analysers for the system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.
5. Redundancy of instruments /sensors shall be provided by bidder as follows: - For important parameters which are concerning the safe operation of the generation units, triple redundancy shall be applied; for interlock and alarm signal, double redundancy shall be supplied.
6. The scope of C&I cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.
7. Electrical Actuators shall be with integral starter (For detail please refer Cl. No. B0.6.19.16 under section IA-Customer's general technical specification – B0).
8. Bidder to include all the fittings, root valves, accessories and valve manifolds required for the package instruments. All fittings shall use metric threads.
9. All instruments shall be terminated on JB/LIR in field and both instrument and JB/LIR are in bidder scope.
10. The specifications for instruments/analysers mentioned in the specification are minimum requirements. All datasheets of instruments/analysers including Vendor submitted datasheets shall subject to customer/owner approval.
11. All transmitters & electronics items including JBs will be explosion proof / intrinsically safe as per hazardous area classification.
12. PG/DPG/PS/PT/LT/LS etc. shall have chemical/diaphragm seal.
13. All transmitters shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART). Each Temperature element shall be complemented with temperature transmitters, compensating cable, JB/LIE/LIR & other erection hardware. All transmitters shall be fitted with a local analog/ digital indicator displaying appropriate physical units which may be read clearly from an easily accessible position.
14. Instruments must have separate tapping lines. Sharing of the same tapping pipe for redundant instruments or various different instruments is not acceptable.
15. Instruments & its accessories shall be complied with weather of the Coastal Area.
16. As a general rule, measuring points and measuring equipment for critical protection shall be separate from and not combined with measuring equipment for the automatic control equipment.
17. The instrumentation and control equipment shall have high electro-magnetic and radio frequency interference immunity and shall not be affected by portable radio transmitters operated in the vicinity of the equipment. Any limitations shall be stated.
18. All instruments shall be protected by cases. The cases shall have enclosure classification not less than IP 42 according to EN 60529 when mounted indoors in totally enclosed rooms with provision for limited ingress of dust, IP 54 else in an enclosed building and IP 55W for mounting outdoors.
19. All the equipment's are to be provided as per ambient temperature of 45 degree Celsius. Electronic instruments shall not be located close to hot lines, vessels or other hot equipment. Ambient temperatures exceeding 80°C shall not result in calibration difficulties or rapid deterioration of electronic components.
20. The solenoid operated valves, if any, shall have limit switches for open/close feedback. Solenoid valves that do not exceed the drive control module power limit may be energized directly from the drive control module. The coils of the interposing relays shall be connected with freewheeling diodes.

21. All pneumatic operated regulating control valves (if any) shall be envisaged with smart positioner. (For detail please refer Cl. No. B0.6.19.15 under section IA-Customer's general technical specification – B0).

22. The junction boxes for termination of instruments /actuator limit switches/solenoid valve limit switches etc. are in bidder's scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 metres) and trunk cable.

23. 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL at a single point, further distribution to various instruments/ Equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.

24. Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V D.C only. In all cases redundancy in power modules shall be considered.

25. Bidder to note that all the transmitters/instruments supplied by Bidder shall be LIE/LIR mounted. The LIE/LIR shall be preassembled and provided by Bidder. Also no instruments / analysers & JBs/ LIE/LIR should be protruding on the walkway.

26. Instrument installation and accessories required and same shall be in Bidder's scope. The requirement indicated in the 'Instrument Installation Diagram', enclosed elsewhere in this specification, is minimal.

Vendor submitted 'Instrument Installation Diagram' shall be subject to customer approval during detail engineering without any commercial and time implication. For instruments for which Installation Diagram is not attached, vendor's Installation Diagram for such items will also be subject to customer approval during detail engineering without any commercial and delivery implication.

27. Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.

28. Each valve/instrument shall be fitted with a stainless steel or aluminium nameplate indicating the valve/instrument service and reference number in accordance with the approved equipment coding system.

29. The equipment shall be of modern, compact design incorporating the latest developments in proven technology. All instruments whether for local indication or remote transmission shall be of good quality and shall have an accuracy and repeatability appropriate to their duty.

30. Bidder shall provide Cable Schedule in BHEL excel format which shall be provided during detailed engineering. Also, Cable Interconnections for Complete System shall be in Bidders' scope. DCS side details for hardwired signals shall be furnished by BHEL during detailed engineering.

31. Generally equipment shall be supplied from one composite range of measurements and control equipment as marketed by a reputable manufacturer of international standing and shall have a minimum of three years operational use on similar projects.

32. For codes & standards refer detailed specification. Indian standards are not acceptable.

33. Local representative of C&I related BOI supplier shall be available in India/Bangladesh.

34. Training as per clause no: B0.3.7 of section-1A to be provided shall be in vendor's scope.

35. The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with the VGB guideline RDSPP (Reference Designation System for Power Plants - KKS system).

36. Sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required.

37. Drawings/Documents and data to be furnished after award of the contract shall be in line with MDL furnished elsewhere in the specification.

38. Microprocessor shall have the facility to synchronize its time with BHEL supplied GPS. Necessary Hardware (IRIG-B port) for same at µP end to be provided by bidder. The cable connecting µP and GPS shall be in BHEL scope.

39. Redundant Microprocessor communication shall be provided for communication between microprocessor and DCS through serial link with OPC Compliant for monitoring /Control. For detail, please refer Microprocessor Architecture Diagram.

40. All furniture (tables, chairs etc.) required for Microprocessor operator HMI/GUI shall be in bidder's scope. Chairs shall be capable of being adjusted for height and position of backrest. One table and chair shall be provided for each operator station and separate table for each printer.

41. Apart from specific design requirement for solid waste management System. Design of various systems/ sub-systems and all equipment will also strictly meet the stipulation of Part B0 of customer technical specification.

42. All documents, including the installation and operation and maintenance manuals as well as the related software shall be in fluent, legible English. In addition, operation and maintenance manuals shall be translated into **Bangla** and provided as paper copies and in electronic format.

Notes:

1. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
2. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.
3. In case of any discrepancy in Sub-Section-IC and Sub-Section-IIC of the specification, Sub-Section-IC shall prevail.

2 X 660 MW MAITREE STPP

LIST OF DELIVERABLES (C&I) FOR SOLID WASTE MANAGMENT PACKAGE

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	SCH. SUBMISSION WEEK FROM LOI	Resubmission after incorporating comments
1	PE-V0-421-XXX-I900	SYSTEM CONFIGURATION FOR SWMS (Solid Waste Management System)	A	5	1 week
2	PE-V0-421-XXX-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A	5	1 week
3	PE-V0-421-XXX-I902	CONTROL SCHEME/LOGIC DIAGRAM	A	6	1 week
4	PE-V0-421-XXX-I903	HMI PICTURES/PLANT SCHEMATICS	A	7	1 week
5	PE-V0-421-XXX-I904	INSTRUMENT SCHEDULE with set points	A	10	1 week
6	PE-V0-421-XXX-I905*	I/O LIST (ANALOG & BINARY) *	A	5	1 week
7	PE-V0-421-XXX-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A	5	1 week
8	PE-V0-421-XXX-I907	FIELD JB/LIE/LIR,DRIVES TERMINATIONS	A	11	1 week
9	PE-V0-421-XXX-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc. along with CATALOGUES	A	10	1 week
10	PE-V0-421-XXX-I909	QUALITY PLANS (INSTRUMENTS, VMS, etc.)	A	6	1 week
11	PE-V0-421-XXX-I912	INSTRUMENT HOOK-UP DRAWING	A	6	1 week
12	PE-V0-421-XXX-I913	THERMOWELL SIZING CALCULATION	A	10	1 week
13	PE-V0-421-XXX-I914 *	CABLE SCHEDULE & INTERCONNECTION *	A	12	1 week
14	PE-V0-421-XXX-I915 *	O & M MANUAL *	A	12	1 week
15	PE-V0-421-XXX-I916	ANNUNCIATION & SOE LIST	A	8	1 week

NOTES:

1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc.
SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

	TITLE : **2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT**	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: II	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION:	
		REV. No. 00	DATE : 06.02.2018

SECTION II

GENERAL TECHNICAL REQUIREMENTS
SUB SECTION IIA - GENERAL TECHNICAL REQUIREMENTS - MECHANICAL
SUB SECTION IIB - GENERAL TECHNICAL REQUIREMENTS - ELECTRICAL
SUB SECTION IIC - GENERAL TECHNICAL REQUIREMENTS – CONTROL AND INSTRUMENTATION

	TITLE : **2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT**	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: II	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION: IIA	
		REV. No. 00	DATE : 06.02.2018

SUB SECTION IIA

GENERAL TECHNICAL REQUIREMENTS – MECHANICAL

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: II	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION: IIA	
		REV. No. 00	DATE : 06.02.2018

CODES AND STANDARDS

2.2.1 List of codes and standard are given below for bidder's adherence. Bidder to note that Chinese Standards and codes are not allowed for any items/ equipment. In case bidder proposes any IS code, it shall be verified by reputed institutions like IIT that the proposed code is equivalent or superior to the codes mentioned above. Comparison report shall be established and provided to BHEL/Owner for information. Such report shall highlight the main items of the code, including material composition, material properties, design clauses and others as required. Report shall identify deviations of both codes and give justification for this deviation. No cost or time implication will be acceptable for any delay on account of non-acceptance by customer of justification for deviation by bidder. In case equivalence is not established, bidder has to provide material as per specified codes only. In case International standards like IEC or ISO is available, this shall be followed.
Equivalent or better international standards, are also acceptable for design of items/ equipment. Bidder to select international codes and standards accordingly for all items/ equipment being covered under this technical specification though specifically not included in the list below.

- Design code for Pressure vessels- ASME Sec VIII Div. I- Latest Edition**.**
- Design Code for Metering/ dosing pumps – API: 675
- Design code for Centrifugal pumps for general refinery service- API: 610
- Design code for Horizontal Centrifugal Pumps - Hydraulic Institute Standards (HIS), USA, ASME 73.1B
- Design code for End-suction centrifugal pumps (rating 16 bar) - ISO 2858 (2nd Edition)
- Technical specifications for centrifugal pumps- ISO 5199:2002(EN)
- SS pipes - ANSI B36.19
- Carbon steel piping -ASME 31.1, ANSI B16.9, ANSI B16.11, ASME B 16.11 & ANSI B 16.25, ANSI B 16.28.
- Flange Dimensional Standard –ASME B16.5
- Standard for Fasteners – ASME B 18.2.1/ASME B18.2.2
- Standard for Gaskets –ASME B16.20
- Steel pipes and fittings provided with butt welding ends - ANSI B 16.25
- Steel Pipe fittings socket welded (of size 50 Nb and below) - ANSI B 16.11
- Low pressure piping (water lines Pipes up to 150 Nb) - ANSI B 36.10/ASTM-A-53/API-5L/ANSI B 36.19.
- Low pressure piping (water lines Pipes above 150 Nb) - AWWA-C200/ANSI B 36.10/ASTM A-53.
- Low pressure piping (Instrument air, Service air lines and Drinking water lines) - ASTM A 53 type E Grade B/ANSI B 36. 10/
- Flange Drilling standard -ANSI B 16.5.
- Piping system fabrication -ANSI B 31.1
- Pipe fittings (Such as reducers and tees) - ANSI B-16.9
- Coating and wrapping- AWWA-C-203
- Integral bypass valve, with socket weld end (50 mm Nb and below, then gate or globe type of forged construction) - ANSI B-16.11
- Design standard for Cast steel gate valves with butt weld ends- ANSI B 16.25
- Design standard for Cast Steel Valve (Gate/Globe/Check 65 NB size & above) - ANSI B16.34
- Design standard for Forged Steel Valves (50 mm NB & below - Gate/Globe/Check) - ANSI B16.34
- Design standard for Angle Globe Valve- ASME B16.34
- Design standard for Safety Valve (Alloy Steel & Carbon Steel) - ANSI B16.34, ASME SEC-VIII Div -I
- Pressure relief valve- ANSI B16.34
- Design standard for Cast iron and carbon steel butterfly valves - BS-5155/EN-593/ AWWA-C-504/API-609
- Design standard for Dual plate & Flap type check valves - API-594
- Design standard for Lift check Valve –BS EN ISO: 15761
- Design standard for cast iron globe valves- BS: 5152
- Design standard for globe valve Manual (SS)-BS: 1873
- Design standard for Copper alloy globe/globe stop and check and gate valves - BS-5154
- Design standard for Cast iron check valves for general purpose- BS-5153
- Design standard for Steel gate valves- API-600
- Design standard for Diaphragm Valve –BS EN13397:2002(EX BS: 5156)
- Testing standard for Diaphragm valve –BSEN 12266-1 (EX BS: 6755)
- Design standard for Flanged end Ball Valve –BS EN ISO: 17292 (BS: 5351)

- Design standard for Screwed end Ball Valve –BS EN ISO: 17292 (ASME B16.34)
- Design standard for Socket Welded Ball Valve –MSS-SP-110
- Standard for Valves face to face and other relevant dimension- ANSI B 16.10
- Standard for End connections of valves Socket welding (SW) - ANSI B 16.11
- Standard for End connections of valves Butt Welding (BW) - ANSI B 16.25.
- Standard for End connections of valves threaded (SC) - ANSI B 2.1
- Standard for End connections of valves Flanged (FL) - ANSI B 16.5& AWWA-C-207(steel flanges), ANSI B16.1 (Cast Iron flanges)
- Valves inspection Test - API-598, API-527, API-526
- Testing Standard for Ball valves (Flanged & Screwed) - EN 12266-1
- Testing standard for Socket welded Ball valve –MSS-SP-72
- Testing standard for lift check valve –BS EN 12266
- Cast Iron Gate valves (40 NB to 600 NB) – BS EN 1171

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LOW PRESSURE PIPING, VALVES AND FITTINGS

LOW PRESSURE PIPING

1.00.00 EQUIPMENT SIZING CRITERIA

1.01.00 All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

1.02.00 For all L.P. piping system covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated elsewhere. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.

1.03.00 Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:

a) **Water Application**

		Water Velocity in m/sec		
	Pipe Size	**Below 50 mm**	**50-150 mm**	**200 mm & above**
(a)	Pump suction	------	1.2-1.5	1.2-1.8
(b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
(c)	Header	------	1.5-2.4	2.1-2.4

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:

(i)	Carbon steel pipe	100
(ii)	C.I Pipe/ Ductile Iron.	100
(iii)	Rubber lined steel pipe	120
(iv)	Stainless steel pipe	100

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.

(b) **Compressed Air Application**

Compressed air 15.0 m/sec.(under Average Pressure & Temp. conditions)

1.04.00 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.

1.05.00 Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.

1.06.00 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.

1.07.00 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.

1.08.00 High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.

1.09.00 Material of construction for pipes carrying various fluids shall be as specified elsewhere.

1.10.00 Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.

1.11.00 Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.

1.12.00 Threaded joints shall be provided with Teflon sealant tapes.

1.13.00 Following types of valves shall be used for the system/service indicated.

SYSTEM	TYPES OF VALVES					
	Butterfly	Gate	Globe	Check	Ball	Plug
Water	x	x	x	x	x	
Air		x	x	x	x	
Drains & vents		x	x	x		
Fuel oil (if any)		x	x	x	x	x

1.14.00 Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (p&ids). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.

2.00.00 **TECHNICAL SPECIFICATION**

2.01.00 **GENERAL**

Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc.

2.02.00 **Pipes and fittings**

2.02.01 All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.

2.02.02 Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.

2.02.03 Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during

operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.

2.02.04 Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).

2.02.05 Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.

2.02.06 The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.

2.02.07 Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.

2.02.08 For rubber lined ERW pipes, beads shall be removed.

2.02.09 Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.

2.02.10 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.

2.02.11 For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.

Transient analysis /surge analysis where ever specified and required shall be conducted in order to determine the location , number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.

2.03.00 **Material**

2.03.01 Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified, The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.

2.03.02 No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.

2.03.03 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.

2.03.04 All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.

2.03.05 Material of construction for pipes carrying various fluids shall be as follows:

Sl No.	Type of Fluid	Material
1.	i) Ordinary Water (Raw Water, Clarified Water, CW blow down water etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)	IS-2062 Gr.-B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.
2.	i) Demineralised water, ii) Alkaline solution (ECW system chemical dosing) iii) Equipment cooling water piping from overhead tank to suction header of DMCW pumps.	Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below
3.	i) Drinking (potable) water ii)Compressed air (Instrument & service air)	ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.
4.	(Condensate) spill water	ASTM A 106 Gr. B

2.03.06 In water lines, pipes upto 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr.B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.

2.03.07 Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr.B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).

2.03.08 In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.

Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.

2.03.09 Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).

2.03.10 Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.

2.03.11 Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.

2.03.12 If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.

2.04.00 **Piping layout**

2.04.01 Piping shall be grouped together where practicable and routed to present a neat appearance.

2.04.02 Piping routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of various equipments.

2.04.03 Over head piping shall have a normal minimum vertical clearance of 2.5 meters above walkways and working areas and 8m above roadways/railways. When several pipe lines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible be located at one third span from supports. if the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.

2.04.04 Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipes and submit to Employer for approval.

2.04.05 All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment etc. Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.

2.04.06 Piping shall generally be routed above ground but where specifically indicated/approved by the Project Manager the pipes may be arranged in trenches or buried. Pipes at working temperature above the ambient shall however not be buried.

2.04.07 Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialties.

2.04.08 All local instruments shall be located on pipe lines as to render them observable from the nearest available platforms.

2.04.09 Openings provided in the wall for pipelines must be closed with bricks and mortar with 10-12 mm clearance between brick work and pipe after taking care of insulation

and thermal movement, if any. The clear space must be filled with felt or asbestos or approved filling compound.

2.05.00 **Slope/Drains and Vents**

2.05.01 Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes.

2.05.02 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

2.06.00 **Pipe Joints**

In general all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.

2.06.01 **Screwed**

(a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS: 554 unless specified otherwise.

(b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be joined by welding. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free

ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.

(c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.

(d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing.

(e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.

2.06.02 **Welded**

(a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.

2.06.03 **Flanged**

(a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.

(b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.

(c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

2.07.00 **Bends/elbows/mitre bends/ Tees/ Reducers & other fittings**

2.07.01 For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11.Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1).

However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.

2.07.02 For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.

2.07.03 For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.

2.07.04 Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes upto and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.

2.07.07 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

2.08.00 **Flanges**

2.08.01 Flanges shall be slip on type. Welding of flanges in tension is not permitted.,

2.08.02 All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 (316 for Sea water application, if any) or equivalent.

2.09.00 **Specific technical requirement of laying buried pipe with anti corrosive treatment**

The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.

2.09.01 **Trenching**

(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822.

(b) Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained.

(c) The free working space shall conform to IS: 5822. The trench shall be excavated so as to provide minimum cover of 1000mm between the top of the pipe and finished grade.

(d) Prior to lowering and laying pipe in any trench, the bidder shall backfill and compact the bottom of the trench or excavation in accordance with is: 5822 to provide an acceptable bed for placing the pipe.

(e) Coating and Wrapping shall be done as under

2.09.02 **Preparation and cleaning of piping**

(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. This cleaning operation shall be immediately followed by priming with the mechanical priming machine.

(b) Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.

(c) The cleaning and priming operation shall be carried out at site. The entire pipe length shall be cleaned but the ends of the pipes shall be left without coating for a distance of 230mm for joints, which shall be coated manually at site after laying, welding and testing the pipe.

(d) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.

2.09.03 **Coating and wrapping**

(a) Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:

(1) Coating primer (coal tar primer)

(2) Coating enamel (coal tar enamel)

(3) Wrapping materials.

(b) All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.

(c) Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat

(d) Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of. Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.

(e) Total thickness of completed coating shall not be less than 4.0 mm.

(f) Alternatively, the anti-corrosive protection can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal

tar primer preferably in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total thickness of the finished protective coating shall be 4.0 mm minimum.

2.09.04 **Trench bed preparation and back filling**

Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.

2.09.05 **Laying of galvanized steel (GI) pipes**

All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste.

All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and " anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.

2.10.00 **Cleaning and flushing**

2.10.01 All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.

2.10.02 Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done in such a manner that the coating on MS pipe is not affected.

2.10.03 After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.

2.10.04 All compressed air pipe work shall be cleaned by blowing compressed air.

2.11.00 **Surface preparation and painting**

Pipes shall be cleaned both internally and externally thoroughly by blast-cleaning or power tool cleaning method as indicated above.. In case of oil piping, cleaning will have to be done by pickling. No painting is required on stainless steel pipe /

equipment surface, galvanized pipe surface or galvanized steel surface. However, necessary color banding for identification as per color code shall be done. External surface of piping shall be cleaned and prepared as indicated below.

2.11.01 **Primer painting**

(a) After the surface is prepared two coats of red oxide (zinc chromate/zinc phosphate) primer conforming to IS-2074/IS-12744 or equivalent shall be applied. Primer coat shall be immediately applied without any time lag after the surface preparation.

(b) Any equipment which has been given the shop coat of primer shall be carefully examined after its erection in the field and shall be treated with a touch up coat of primer wherever the shop coat has been abraded, removed or damaged during transit/erection, or defaced during welding.

2.11.02 **Finish painting**

(a) Paint to be used shall be synthetic enamel paint conforming to IS-2932 or equivalent. Finish painting shall be carried out in three coats consisting of one intermediate coat and two finishing coats. Dry film thickness (DFT) of painting inclusive of primer thickness shall be at least 150 micron.

(b) The primed surface shall be cleaned of dust/dirt/grease etc. without scratching or in any way damaging the primer coat. The intermediate coat shall be allowed to dry before applying the finish coat or as recommended by paint manufacturer.

(c) Paint shall be applied by brushing. It shall be ensured that brush marks are a minimum and the requirements of workmanship is as specified in IS-1477.

(d) Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted.

(e) No painting shall be done in frost/foggy weather or when the humidity is high to cause-condensation on the surface to be painted.

(f) The dry film thickness (DFT) after the painting shall not be less than 150 microns.

2.11.03 **Other requirements**

(a) Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.

(b) The color of the finish paint shall be as per approved color-coding.

(c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.

(d) The dry film thickness of paint shall not be less than 0.15 mm.

2.11.04 Color code for identification

The pipes shall be color painted/banded for identification as per the approved color-coding scheme and shall be generally as per IS-9404.

2.12.00 **Specification for hangers and supports**

2.12.01 All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.

2.12.02 While designing supports for rubber lined pipes special consideration should be given. Any kind of welding on these pipes is not allowed after rubber lining.

2.12.03 Hanger for piping 65mm Nb and larger and all spring support assemblies regardless of size shall be completely engineered in conformance with the provisions of power piping code ANSI B 31.1.

2.12.04 Hangers, saddles, supports etc. shall be fabricated from plates/pipes sections conforming to ASTM A 53/IS: 2062/IS: 226/or equivalent. They shall be designed to provide the required supporting effects and allow pipe line movements as necessary. The structural steel work shall be as per IS: 800/BS: 4360. Insulation protection saddles shall be used at support point of all insulated piping.

2.12.05 The support shall be so interspaced as to minimize sagging of the pipes and to keep them with in permissible limits where pipes are full with the conveying media.

2.12.06 The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.

2.12.07 All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.

2.12.08 At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.

2.12.09 All components of hangers/supports shall be provided with two coats of primer (red oxide paint) at shop before dispatch to site. After erection they shall be given finish coat of Long Oil Synthetic enamel to IS: 2932 of total DFT 100 to 140 microns. CLH

& VLH will be primed with Epoxy Zinc rich primer of 50 micron followed by finish painting of Aliphatic Acrylic Polyurethane or equivalent of DFT 65 microns.

2.13.00 **Design/Construction/Material Particulars of Gate/ Globe/Check Valves/ Globe Stop Valve/Butterfly valve**

2.13.01 **GENERAL**

(a) All valves shall be suitable for the service conditions i.e flow, temperature and pressure, at which they are required to operate.

(b) The valves as well as all accessories shall be designed for easy disassembly and maintenance.

(c) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.

(d) All rising stem valves shall be provided with back seat to permit repacking (of glands) with valves in operation. All valves shall preferably be of outside screw and yoke type.

(e) All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the hand wheel. In case where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced.

(f) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.

(g) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. For valves of size 350mm and above either bevel or spur gearing shall be provided to facilitate manual operation.

(h) The valves coming in vacuum lines shall be of extended gland type and/or water sealed.

(i) The actuator-operated valves shall be designed on the basis of the following:

(1) The internal parts shall be suitable to support the pressure caused by the actuators;

(2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.

(3) All actuator-operated valves shall be provided with hand operated gearing mechanism also.

(4) All actuators operated valves shall open/ close fully within time required by the process.

(j) Valves coming under the purview of IBR shall meet IBR requirements.

(k) Gate/sluice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items:

(1) Hand wheel

(2) Position indicator (for above 50 mm NB valve size)

(3) Draining arrangement wherever required.

(l) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction.

(m) Check valves shall be used for non-return service. They shall be swing. check type or double door (Dual plate)check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB

(n) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.

(o) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.

(p) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.

(q) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided.

Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer.

(r) All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.

(s) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.

2.13.02 **VALVE BODY MATERIAL**

Valve body material for various services shall be as follows:

Valve body material for water application like circulating water, Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) & drinking water shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below.

For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water: SS body and disc along with SS internals.

Condensate: Cast Carbon Steel / Forged Carbon Steel.

2.13.03 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

Standards and Codes

AWWA-C-504	Rubber seated butterfly valves.
BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.

IS-778	Gun-metal gate, globe and check valves for general purpose.
BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.
IS-780	Sluice valves for water works purpose (50-300 mm size)
IS-2906	Sluice valves for water works purpose (350-1200 mm size)
IS-5150	Cast iron wedge and double disc gate for general purpose.
BS-5152	Specification for cast iron globe valves.
BS-5153	Cast iron check valves for general purpose.
IS-5312	Swing check type reflux (non-return) valves.
ANSI B 16.34	Standard for valves.
API-594	Standard for Dual-check valves.
API-600	Steel gate valves.
ANSI-B-16.10	Valves face to face and other relevant dimension.
API-598	Valves inspection test.

2.13.04 **End Connections**

The end connections, shall comply with the following:

Socket welding (SW) - ANSI B 16.11

Butt Welding (BW) - ANSI B 16.25.

Threaded (SC) - ANSI B 2.1

Flanged (FL) - ANSI B 16.5& AWWA-C-207(steel flanges), ANSI B 16.1 (Cast Iron flanges)

2.13.05 All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).

2.13.06 All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.

2.13.07 All gun metal body valves shall have screwed ends.

2.13.08 All flanged end valves/specialties. shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints.

2.14.00 **Check Valves**

2.14.01 Check valves shall comply with the following characteristics:

(a) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);

(b) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.

(c) In the case of swing check valves, the body seat shall be inclined at such an angle from the vertical as will facilitate closing and prevent chatter.

2.14.02 Drilling on flanges of flanged valves must correspond to the drilling on flanges of the piping system on which the valves are to be installed.

2.14.03 All flanged valves intended for installation in steel piping systems shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class.

2.14.04 Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.

2.15.00 **Globe Valves**

2.15.01 The globe valves shall have the following characteristics:

Straight conveyed flow.

Right angle

Preferably, the valves shall be of the vertical stem type.

2.15.02 Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.

2.15.03 The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.

2.15.04 For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.

2.15.05 All motorized globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.

2.16.00 **Gate valves**

All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc and rising stem type.

2.17.00 **Air Release Valve**

(a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.

(b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.

(c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass.

(d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.

2.18.00 **Butterfly valves**

2.18.01 **Design/Construction**

(a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. In such a case, however, the bidder will have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition.

(1) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable

(2) The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.

(3) For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.

(4) The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information.

(5) The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration.

(6) The operating mechanism shall be mounted directly on or supported from the valve body.

(7) All valves shall be complete with:

Position indicator (located in a visible place)

Arrow indicating the flow direction;

Adjustable mechanical stop limiting devices to prevent over

Travel of valve disc in open/close position.

All valves shall be "tight shut off"

(8) Hand operated valves shall have the following

Local hand controls

The hand controls shall close the valve with clockwise rotation.

The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions.

The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation.

Hand wheel shall be made of malleable iron with arms and rims of adequate strength. The hand wheel of diameters 300mm or less shall be provided with handles for ease of operation.

Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.

Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.

Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

2.18.02 **Material of Construction (Butterfly Valves)**

Materials and other design details shall be as indicated below :

(a) **Cast Iron Butterfly Valves**

Body & Disc	ASTM A48, Gr. 40 with 2% Ni/ IS: 210. Gr. FG-260, with 2% Ni and epoxy coated
Shaft	BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.
Seat ring	18-8 Stainless steel
Seal	Nitrile Rubber

(b) **Stainless Steel Butterfly Valves**

Body & Disc	ASTM A 351, Gr. CF8M / ASTM-A-182-Gr.304.
Shaft	ASTM A 182, Gr. 316 / ASTM-A-479 Gr.316/Equivalent
Disc & Seat Rings	EPT/BUNA-N/Neoprene

(c) **Carbon steel Butterfly Valves**

Body & Disc	ASTM A 216, Gr. WCB
Shaft	ASTM A 182, Gr. 304 / ASTM-A-479 Gr.304/Equivalent
Disc & Seat Rings	EPT/BUNA-N/Neoprene

2.18.03 **Proof of Design Test (Type Test) for Butterfly Valves**

Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the

absence of which actual P.O.D. test shall be conducted by the bidder in the presence of Employer's representative.

All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504.

2.19.00 **MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)**

(a) The materials shall generally comply with the following:

(1) **Cast Steel Valves**

Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105
Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105
Trim.	ASTM A 182 Gr. F6 or Equivalent

(2) **Stainless steel valves**

Body & Bonnet	ASTM A 351 Gr. CF 8M/ ASTM A 182 Gr. 304
Disc	-do-
Trim.	ASTM 182 Gr. F. 316 /ASTM-A-479Gr.316 / ASTM A 351 Gr. CF 8M

(3) **Cast iron valves**

Body & bonnet	BS 1452 Gr. 14/ IS-210 Gr. FG 260
Seating surfaces and rings	13% chromium steel/ 13% Chrome overlay
Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260
Hinge pin for non-return valves	AISI 316

	Stem for gate globe valves	13% chromium steel or Equivalent
	Back seat	13 % chromium steel / 13% Chrome overlay

(4) **Gun Metal valves**

Body and bonnet	IS 318 Gr. 2/ Equivalent Standard
Trim.	-do-

(b) Cast iron body valves shall have high alloy steel stem and seat.

(c) Material for counter flanges shall be the same as for the piping.

2.20.00 **Float operated valves**

(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.

(b) DESIGN AND CONSTRUCTION FEATURES

The following design and construction feature of the valve shall be the minimum acceptable.

(c) Valves shall be right-angled or globe pattern.

(d) Valves shall be balance piston type with float ball.

(e) Leather liner shall not be provided.

(f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats.

(g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.

(h) The valves shall have flanged connections.

2.21.00 **PAINTING OF VALVES:**

Two (2) coats of primer followed by three (3) coats of enamel of approved color

code/shade (usually same as that of connected piping) shall be applied to all exposed surfaces except stainless steel surface, Galvanized steel surface and gun metal surface at shop as required to prevent corrosion, before dispatch. The use of grease/oil other than light grade mineral oil, for corrosion protection is prohibited. The total DFT of paining shall be 150 micron (minimum). If during transport, unloading/unpacking or erection at site any part of the painted surface gets damaged, the same shall be made good by the contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.

2.22.00 **Tanks and Accessories**

2.22.01 The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803/IS804/IS 805/ IS 2825/ API 650/ IS 4049/ IS 4682 (part-I) and IS 4864 to 4870/ ASME B & PV code Sec.-VIII as the case may be.

2.22.02 **DESIGN AND CONSTRUCTION**

(a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS:803 & API 650.

(b) Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement.

(c) Design temperature of vessels shall be 10 deg.C higher than the maximum temperature that any part of the vessel is likely to attain during the course of operation.

(d) Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.B (or equivalent).

(e) The joint efficiency factors to be adopted for design calculations shall be in accordance with the specified design code.

(f) Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.

(g) The material for flanges shall be of ASTM A 105/ IS-2062 Gr.B.

(h) For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.

(i) Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessel consisting of more than two sections longitudinal seams shall be offset.

(j) Tanks shall be provided with float operated level indicators/level gauges/level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.

(k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing dm water, alkaline water or power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO2 absorber vessel shall be provided with the initial fill of chemicals. Similarly for equipment cooling water overhead tank, the overflow & drain from tank shall be combined together and shall be led to nearest drain (at zero level) via. a seal-trough so as not to come directly in contact with atmosphere.

(l) Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.

(m) Tank supporting arrangement as approved by Employer shall be provided with all plates/angles/joints/flats and supporting attachment including lugs, saddles, legs etc.

(n) Piercing nozzles/pipes from tank body / dish ends shall be adequately compensated as per relevant code.

(o) Tank fabrication drg. and design calculations shall be approved by the Project Manager.

2.22.03 **Corrosion protection**

(a) A corrosion allowance, applicable to surface in contact with corrosive media, when required, shall be taken into consideration.

(b) Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.

(c) Each tank shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.

(d) Epoxy-coating shall be provided on the inside of vessel in three coats (minimum) resulting in total thickness of not less than 200 micron in which ever case required, such as equipment cooling water overhead tank, sodium hydroxide tank, condensate surge tank etc.

.2.22.04 **Cleaning & Painting**

(a) Inside surface of all tanks shall be protected by anti-corrosive paints as required.

(b) For tanks/vessel requiring epoxy painting, all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.

(c) Outside surfaces of all vessels shall be provided with two coats of primer with three (3) coats of epoxy minimum 100mm DFT resin based paint of approved color.

2.23.00 **RUBBER EXPANSION JOINTS**

2.23.01 All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.

2.23.02 The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.

2.23.03 The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.

2.23.04 The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.

2.23.05 Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.

2.23.06 Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipe lines.

2.23.07 The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the'

duck' shall be either a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.

2.23.08 The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.

2.23.09 All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.

2.23.10 The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges.

2.23.11 All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.

2.23.12 Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.

2.23.13 Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.

2.23.14 Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless Steel material.

2.24.00 **STRAINERS**

2.24.01 **Simplex type**

The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition shall not exceed 1.5 MCW at full flow. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The material of construction of various parts shall be as follows:

(a)	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)
(b)	Strainer Element	Stainless steel (AISI 316)
(c)	End connection	Screwed upto 50 mm Nb, and Flanged above 50 mm Nb

2.24.02 **Duplex type**

(a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.

(b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. B and internally epoxy-painted above 50 mm NB.
Strainer element	Stainless steel (AISI 316)
End connection	Screwed up to 50mm Nb, and Flanged above 50 mm Nb. Gasket shall be of full face type

(c) The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.

(d) The size of the strainer and the flow direction will be indicated on the strainer body casting.

(e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.

2.24.03	Three shop coats of paint preceded by two coats of primer shall be applied to all exposed surfaces as required to prevent corrosion.. All parts shall be adequately protected for rust prevention. The use of grease or oil other than light grade mineral oils for corrosion protection is prohibited.

NOTE: Wherever IS codes are mentioned, bidder to provide equipment/ items as per equivalent or better international standards/ codes.

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PRESSURE AND STORAGE VESSEL

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1.00.00 GENERAL

1.01.01 This chapter covers the design guidelines of Pressure and Storage vessels/ tanks.

1.01.02 Process requirements of these vessels shall be governed by the requirements of the solid waste management Package, which will determine their design conditions. Following sections only indicate some of the minimum requirements which must be met, and the actual design of these vessels/ tanks shall be better than these, if that is required from process considerations.

2.00.00 GENERAL DESIGN FEATURES

2.01.00 **Design**

2.01.01 Design of all pressure vessels shall conform to ASME Section VIII or acceptable equivalent international standard. Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 10% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pumps suction if any. Design pressure of condensate service vessels is indicated elsewhere in this specification. For all other pressure vessels, design pressure shall be at least 8 Kg/cm² (g).

2.01.02 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to API 650/ Equivalent International standard.

2.01.03 Design of all horizontal cylindrical atmospheric storage tank containing water, acid, alkali and other chemicals shall conform to BS: 12285/ Equivalent International standard.

2.01.04 Design temperature of all pressure vessels and storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.

2.01.05 In case, tank is subjected to vacuum; the same shall be taken care in designing the tank.

2.02.00 All vessels / tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end. Vessel / tanks ends shall be of dished design and constructed by forging, pressing or spinning process. Conical or flat ends shall not be accepted. All dished ends shall be stress relieved.

2.03.00 All the atmospheric tanks shall have sufficient free board above the “Level High”/”Normal Level” as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the “Level High”/”Normal Level” for all the tanks except for the DM tanks for which a minimum height of 300 mm shall be provided over the “High Level”. Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of the tank. Wall thickness of atmospheric tanks shall not be less than 6 mm.

2.04.00 Vessels coming under preview of IBR shall be designed accordingly.

2.05.00 Interior surfaces of all tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.

2.06.00 All welds on inner tank surface shall be free of voids, gaps craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding. Inside weld seams shall be ground flush and smooth applicable for corrosion resistant coating or lining.

2.07.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps, craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.

2.08.00 Weld splatter shall be removed.

2.09.00 All welding shall be performed by ASME qualified welders under Section-IX of ASME Boiler and Pressure Vessel code and welding electrodes shall be as per relevant Codes/Standards viz. AISC Section 1.17 etc.

2.10.00 The plates for cylindrical tanks shall be accurately formed in bending rolls to the diameters called for, and the completed shells be concentric and plump. Plates shall be cold-rolled by plate bending machine in a number of passes to true curvature and joined by welding.

2.11.00 Vessels seam shall be so positioned that they do not pass through vessel connections.

3.00.00 MATERIAL OF CONSTRUCTION

3.01.00 All pressure vessels shall be fabricated from carbon steel plates to SA-285C or SA- 516 Gr. 70 and lined internally. All atmospheric tanks shall be fabricated of steel and lined internally.

4.00.00 APPURTENANCES

4.01.00 **Manholes**

4.01.01 All the pressure vessels and horizontal type storage tanks shall be provided with manhole of 500 mm diameter minimum size, preferably at the top head, complete with cover plate, lifting handle, davit cap, nuts, bolts, gaskets etc. to ensure leak tightness at the test pressure.

4.01.02 The vertical type storage tanks shall be provided with a manhole of 500 mm dia on the top cover, if the diameter of the tank is 1200 mm or more.

4.01.03 All the vessels and tanks shall be normally provided with a six inch gasketed handhold located near the bottom of the straight side.

4.01.04 The required lining/coating for the inside surface of the manhole/handhole, nozzle and cover plate of the manhole/handhole shall be same as that of the respective vessel/tank.

4.01.05 **Sight Glasses**

All the vessels mentioned shall be provided with pad type sight glasses on their vertical sides. Locations of these sight glasses shall be as follows:

4.01.06 One with the centre line at the normal level of the bed top, and one near the bottom of the straight side, for each of these vessels.

4.02.00 **Lifting Lungs**

All vessels of diameter 1200mm or greater shall be provided with a minimum of 4 lifting lugs. Smaller vessels shall be provided with at least 2 lifting lugs.

4.03.00 **Vessels Supports**

Adequate supporting arrangements like straps, saddles, skirt rings, or legs of steel shall be provided to transfer all loads to the respective skid structures.

4.04.00 **Vessel Internals**

The internals for pressure Vessels shall be designed for a low pressure drop to promote uniform distribution and flow through the vessels and to withstand the full design pressure of the vessel in both directions.

Specification requirements for vessel internals are as follows:

4.05.00 **Inlet water and Regenerant Distributors**

Hub and laterals with diffuser splash plates or header and perforated laterals. Material of construction shall be type 316 stainless steel, except for acid service which shall be of Hastelloy B.

4.06.00 **Underdrains**

Same as above with screened laterals with internal perforated pipes, and rubber-lined false bottom. For resin separation/regeneration/mixed resin vessels, it may have fully screened bottom (NEVA – clog type with para Septanurse screen, fully supported by subway grid, or equal).

4.07.00 For lined vessels, they shall also be lined in the same manner as the internal surfaces of these vessels. For the caustic diluent heating/storage tank, they shall be of type 304 stainless steel construction.

4.08.00 **Internal Fasteners**

All internal fasteners shall be of type 316 stainless steel and heavy duty locknuts shall be used throughout.

4.09.00 **Piping Connections**

All lined vessel connections and connections in unlined vessels 25 NB and larger shall be to ANSI 300 lb class. Flat face flanges shall be used throughout. Nozzle material shall be ASTMA-106. Grade B. schedule 80 pipe. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full-face gaskets.

4.10.00 All vessel connections in unlined tanks smaller than 25 NB shall be screwed to ANSI 2.1 for schedule 80 pipe.

4.11.00 **Resin Traps**

Outlets of each of the condensate polisher service vessel and the waste effluent header of the common external regeneration facility, shall be provided with a resin trap. These resin traps shall be a minimum, conform to the following:

4.11.01 The resin trap shells shall be of steel construction and lined internally with saran or Polypropylene. The internals for all traps shall be johnson well screen type, of 316 stainless steel in both directions, resin traps located in processes effluent lines shall have a screen opening that does not exceed 120 percent of the associated process vessel under drain screen opening. Resin traps located in waste effluent headers shall have a screen opening of approximately 60 mesh.

4.11.02 Each resin trap shall be fully piped and valved for in place manual back flushing.

5.00.00 SPECIFIC DETAILS

5.01.00 **Alkali Diluent Heating – Storage Tank (Hot water tank)**

This vessel shall be sized to hold a minimum of 5000 liters of 80 deg C demineralized water required for the regeneration of condensate polisher. In sizing this vessel, preheating of the anion resins shall not be considered as a requirement. The cold water feed line shall enter the tank through or near the top head and extend downward to within 15 cm of the tank bottom. Recovery time shall not exceed 4 to 5 hours.

All tank internals, including the inlet water tail pipe, shall be fabricated of type 304 stainless steel.

5.02.00 **Atmospheric Tanks**

Wall thickness of these tanks shall not be less than 6mm.

5.03.00 **Resin Injection Hopper**

The supplier shall provide a hopper type tank for resin make-up, using water slurry, to the condensate polishing systems. This make-up system will constitute a portion of the condensate polishing external regeneration system. The resin hopper shall have a conical bottom and a flat top. The top shall have a piano type hinged port, having a lifting handle, of sufficient size for easy resin loading. The resin shall discharge through a bottom connection to a water ejector for transport. Water shall be added to the hopper to assist in the resin transfer. The ejector discharge shall be to the resin separation-cation regeneration vessel. Demineralized water shall be used throughout for the resin transfer. Piping of the resin make-up system shall be the responsibility of the Bidder as a part of the external resin regeneration system.

a) **Capacity**

The resin make-up hopper tank shall be sized to handle up to 150 liters of as received new resin per single injection.

b) **Material**

The resin make-up hopper tank shall be fabricated of mild carbon steel having a minimum thickness of 6mm and lined.

5.04.00 **Chemical preparation and day tanks**

These shall be vertical cylindrical tanks. They shall be of carbon steel fabrication, lined and provided with full height level gauges right up to the overflow levels.

The alkali preparation tank shall be provided with a dissolving basket of type 316 stainless steel constructions, and a motorized slow speed stirrer mounted eccentrically to the tank by a bracket fixed to the side wall. The stirrer shall have impellers of type 316 stainless steel.

The alkali day tank shall be provided with an airtight cover complete with a breather arrangement, to prevent absorption of carbon dioxide from the atmosphere by the alkali solution contained in it. The overflow connection shall also be provided with a suitable seal for this purpose.

The tanks for ammonia solution (if applicable) shall also be provided with similar arrangements to prevent escape of ammonia vapor to outside.

5.05.00 **LINING**

All internal lining of vessels provided under this specification shall be of natural rubber, meeting the following minimum requirements.

5.05.01 **Hardness**

Lining used may be soft rubber having a shore durometer reading or 4070 on the D scale, or semi-hard rubber having a durometer reading of 4570 on the D scale. Variations in hardness of the rubber lining between the different areas of a specific tank shall be within +/-5 durometer reading.

5.05.02 **Chemical Resistance**

The lining material shall be suitable for prolonged service in the chemical environment described below:

a) Hydrochloric acid, 2 to 8% concentration, at temperature from 10 deg C to 50 deg C.

b) Sodium hydroxide, 1 to 4% concentration, at temperature from 30 deg C to 50 deg C.

c) 100 to 500 mg /l of sulphuric and hydrochloric acid combined. Ratio of concentration of these two acid 1 : 5 to 5 : 1 and temperatures from 10 deg C to 40 deg C.

d) 1 to 10mg/l of sodium hydroxide at temperature from 10 deg C to 40 deg C.

The linings will be subjected to the condition (a) or (b) for intermittent periods of approximately one hour out of eight hours, and to conditions (c) or (d) remainder of the time.

5.05.03 **Thickness**

The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

5.05.04 **Surface Preparation**

Prior to rubber lining all surfaces must be prepared in the following manner.

a) Degrease surface prior to blasting.

b) The surface is to be blasted with steel grit or sharp silica sand to a white and bright metal surface.

c) All traces if grit and dust should be removed with a vacuum cleaner or by brushing. Care must be taken to avoid contaminating the surface.

d) Immediately after blasting and removal of grit, the first coat of primer or cement shall be applied and allowed to dry.

5.05.05 **Protection**

After the lining is completed the vessels shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation erection, etc. They shall not also be stored in direct sunlight. No further welding or burning shall be carried out on the vessel, after application of the lining.

All lining projecting outside of the vessel, shall be protected adequately from mechanical damages during shipment, handling, storage etc.

Suitable warning, indicating the special care that must be taken with respect to these lined vessels, shall be stenciled on their outside surfaces with the letter at least 12mm high.

Example:

“Warning – Tank is lined”

“Do not weld or Burn”

“Do not Store in Direct Sunlight” etc.

6.00.00 FABRICATION

6.01.00 The vessel ends for storage tanks of vertical type shall have flat bottom. However, the ends of horizontal storage tanks, and all the pressure vessels shall be dished design of Tori-spherical type designed.

6.02.00 The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.

6.03.00 All the joints (circumferential / longitudinal) shall be continuous butt welded, inside and outside. Connection shall be flush with inner surface of tanks and welded continuously on both sides of shell. Sharp inside edges shall be rounded to a minimum 3 mm radius.

6.04.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of the engineers. Welding shall not be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.

6.05.00 All pressure vessels and storage tanks except Demineralised water (D.M.) shall be fabricated complete and tested at manufacturer's works to ensure better workmanship.

6.06.00 **Tank Connections**

6.06.01 Bidder shall furnish all pipe material required for tank connection for the process requirement. In addition to these, additional connections, if required by the Owner for the inter-connection of their piping, instrumentation etc. shall also be provided. Such additional requirement will be intimated to the successful Bidder later and Contractor shall provide these fittings to match with the Owner's items. Adequate pipe support attachments in the external surface of the tank/vessel shall be provided for Owners pipes for all the vessels/tanks. All lined vessels connections shall be conforms to ANSI 300 lb class. Nozzle material shall be ASTM-106 Grade B, Schedule 80.

6.06.02 All flanged connections should be supplied complete with matching counter flanges, nuts bolts and gasket materials. The flange design, (thickness and drilling etc.) shall match with the interconnected piping flanges.

6.06.03 Bolts and nuts to be used externally to the vessels shall be of hexagonal head. However, internal fasteners if any, shall be of SS-304 or Hastalloy-B as per the duty conditions.

6.06.04 Gaskets shall be of full face type.

6.06.05 Sight glasses shall be provided for the tanks/vessels as specified in the standard specification. The material for sight glass shall be high quality transparent PLEXIGLASS of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.

6.07.00 **Vessels Supporting Lifting Lugs**

6.07.01 Adequate supporting arrangements like straps, saddles, skirt boards, pillars etc. shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.

6.07.02 All vessels of internal, diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with at least two (2) lifting lugs.

6.08.00 **Special Accessories Storage Tanks**

6.08.01 Vessel internals wherever required shall be provided as detailed out elsewhere in the specification.

6.08.02 All the pressure vessels and tanks shall be provided with drain connections along with drain valves of suitable size. Further all the atmospheric storage tanks shall be provided with over flow connection designed for the filling rate of the respective tank.

6.08.03 All the pressure and tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure/vacuum is not created in the tank during maximum filling/drain-off rate. The maximum draw off rate for the DM storage tanks shall be intimated later to the successful bidder.

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6.08.04 Various instrumentation and the fittings required for the same shall be supplied as elaborated in data sheets.

6.08.05 Carbon dioxide absorber shall preferably be located at ground level. The vent and overflow lines of Acid measuring tanks shall be provided with fume absorber using suitable packing material, such as pall rings/raschig rings.

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VERTICAL PUMPS

1.00.00 ACCESSORIES:

All the pumps under this specification shall be complete with following standard/special accessories.

1.01.00 STANDARD ACCESSORIES:

a. Pump motor coupling along with coupling guard
b. Common base plates for pump and motor.
c. Lubrication system along with all internal piping, valves, fittings, specialties etc. as required.
d. Counter flanges for suction/ discharge nozzles along with fixing nuts, bolts and gaskets.
e. Anchor bolts, nuts, seating steel works, etc. as necessary for mounting the pump-motor unit on civil foundations.
f. Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ Accessories.
g. Suitable drain connections with isolating valves as applicable.
h. Set of “Special” Tools & Tackles for Pumps and motors, if any.
i. Erection and commissioning spares, “on as required” basis.
j. Bidder shall provide various drawings, data, calculations, test reports/ certificates, Operation and maintenance manuals, As-built drawings, etc. as specified and as necessary.

2.02.00 SERVICES INCLUDED IN BIDDER’S SCOPE:

2.02.01 The pumps shall be guaranteed to meet the performance requirements as specified vide Datasheet – A and also for trouble free operation after commissioning.

3.00.00 TECHNICAL REQUIREMENTS:

3.01.00 The pumps shall be Electric motor driven.
3.02.00 The Pumps shall conform to HIS
3.03.00 Vertical type pumps with maximum 1500 rpm.
3.04.00 Minimum efficiency of vertical pump will be 40%.
3.05.00 No negative tolerance shall be permitted in rated capacity & TDH.
3.06.00 No negative tolerance shall be permitted in efficiency at rated capacity.
3.07.00 The shut off head of pumps shall be at least 115% of pump rated TDH.
3.08.00 The pumps shall be capable of developing the required total head at rated capacity for continuous operation. The pumps shall operate satisfactorily at any point on the Q-H Characteristic curve over a range of 0% to 130% capacity and shall be suitable for continuous operation between 30% to 130% capacity.
3.09.00 Selection of the pumps shall be such that the design point shall be met even with negative manufacturing tolerance.
3.10.00 The total head capacity curve shall be continuously rising towards the shut off, the pumps shall preferably be non-overloading type and stable.
3.11.00 The pumps shall be capable of running over the entire range of NPSH conditions required without any noise, vibration or cavitation.
3.12.00 The pumps shall be of stiff shaft design. The minimum internal clearances should be sufficiently more than the max. Static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.
3.13.00 Pumps and motors shall run smooth without undue noise and vibration. The vibration shall be within 75 microns for pump - motor set. The noise level shall be limited to 85 dB at distance of 1.0M.
3.14.00 High reliability of the pumps is an essential requirement and therefore it gets weight age over its efficiency. It is therefore essential that the bidder choose a standard proven model from the range of pumps manufactured.
3.15.00 If water handled by pump is dirty/ not suitable for lubrication/ cooling, the bidder shall provide requisite strainer/ filters, tanks, motorized valves, etc. after the tap off for the required service, the arrangement provided shall be subject to Purchaser's approval.

4.00.00 **OTHER REQUIREMENTS**:

4.01.00 The materials of construction for various components specified are the minimum Requirements indicated in datasheet – A/ Sub section IA and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

5.00.00 **PAINTING FOR PUMPS:**

a) The surface of SS, Gun metal, brass, bronze and non-metallic component shall not be applied with any painting.

b) The Steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shop blasting etc. as per the agreed procedure.
For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primes of min. thickness of 50 microns followed up with under coat of Synthetic Enamel paint of min. thickness of 50 microns shall be applied. the top coat shall consist of two coats each of min. thickness of 50 microns of synthetic enamel paint and thus total thickness shall be min. 200 microns.

6.00.00 **PERFORMANCE REQUIREMENTS**

6.01.00 Pump (s) shall preferably be designed to have the best efficiency at the specified duty point. Further, the pumps (s) shall be suitable for continuous operation at any point within its 'range of operation'.

6.02.00 under all circumstances, the 'range of operation' of the pump (s) shall exclude any unstable operating zone of the head-capacity curve.

7.00.00 **DESIGN AND CONSTRUCTION**

Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories. General design and constructional features of the pumps shall be as follows:

7.01.00 **BOWL ASSEMBLY**

7.01.01 This will be either a single, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of handling fluid.

7.02.00 **IMPELLER SHAFT, LINE SHAFT AND HEAD SHAFT**

7.02.01 Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft. Critical speed of the shaft shall be sufficiently away from the pump operating speed and in no case shall lie between 90% and 110% of the rated speed.

7.02.02 Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall chamfer at the edges.

7.02.03 Line shaft may be single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacture. For screwed coupling, directions shall permit tightening of the joint during pump operation.

7.02.04 Replaceable shaft sleeves shall be furnished at applicable location, particularly under stuffing box and at other locations, as considered necessary.

7.03.00 **BEARINGS**

7.03.01 **SHAFT BEARINGS**

Adequate number of properly designed bearings shall be provided for smooth and trouble free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self-lubricated. In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump.

7.03.02 **THRUST BEARING**

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating Components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load. Thrust bearing shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handing fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system. Cooling of the thrust bearing, if necessary, shall be done by the handing fluid/external Water, depending on the fluid handled. Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement.

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: II	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION: IIA	
		REV. No. 00	DATE : 06.02.2018

HORIZONTAL CENTRIFUGAL PUMPS

1. **SCOPE**

This specification covers the design, material, construction features, manufacture, and inspection, testing the performance at the Vendor's / Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

2. **DESIGN REQUIREMENTS**

The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve over the operating range of 40% to 120% of the duty point. The maximum efficiency of pump shall be preferably be within +/- 10% of the rated design flow as indicated in the data sheets.

The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

SPEED	**Antifriction Bearing**	**Sleeve Bearing**
1500 rpm and below	**75.0 micron**	**75.0 micron**

The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment.

The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

3. DESIGN CONSTRUCTION

Design and construction of various components of the pumps shall conform to the following general specifications. for material of construction of the components, data sheets shall be referred to.

Pump Casing

Pump casing shall have axially or radially split type construction. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as

required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

Impeller

Impeller shall be closed, semi-closed or open type, and it shall be designed in conformance with the detailed analysis of the liquid being handled.

The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

Impeller/Casing Wearing Rings

Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

Shaft

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

Shaft Sleeves

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.

Shaft sleeve shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

Bearings

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

Stuffing Boxes

Stuffing box design should permit replacement of packing without removing any part other than the gland.
Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing

boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

Mechanical Seals

Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

Pump Shaft Motor Shaft Coupling

The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

Base Plate

A common base plate mounting both for the pump and motor shall be provided. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

Assembly and Dismantling

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

4. DRIVE MOTOR (PRIME MOVER)

The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps are specified, the actual motor rating is to be selected by the tenderer considering overloading of the pumps in the event of tripping of operating pumps.

5. TESTING FOR HORIZONTAL CENTRIFUGAL PUMPS

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of applicable Codes and Standards. The particulars of the proposed tests shall be submitted to the Owner for approval before conducting the tests.

Hydrostatic Tests

All pressure parts shall be hydraulically tested at 200% of pump rated head or at 150% shut off head whichever is higher. The test pressure shall be maintained for 1/2 hr. and no leakage shall be permitted. While arriving at the above pressure, the maximum suction head specified in Data Sheet shall be taken into account.

Performance Tests

All the pumps shall be tested in the Manufacture's Works at rated speed for capacity, efficiency and brake

horse power. Pumps shall be given running test over the entire operating range covering from the shut off head to the maximum flow. The duration of test shall be minimum one (1) hour. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standards or as applicable equivalent**.**

The test shall be preferably conducted with the actual motor being furnished.

Only those pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and excessive vibration is observed during the performance test. Otherwise strip down examination is limited to bearing inspection only.

The pump accessories e.g. the thrust bearing, couplings etc. shall be subjected to tests as per manufacturer's standards.

Mechanical Balancing

All rotating components of the pumps shall be statically balanced. In addition to static balancing, rotating components of the pumps shall be balanced dynamically at or near the operating speed. Tenderer shall furnish acceptance norm for this test.

Visual Inspection

Pumps shall be offered for visual inspection by the bidder before shipment. The components of the pumps shall not be painted before inspection.

NPSH Test

NPSH test shall be conducted with water as medium if required. NPSH shall not be mandatory in case type test certificates are furnished for the similar rating of pumps.

Noise and Vibration Measurement

Noise and vibration shall be measured during the performance testing at shop as well as during the site test.

The noise level shall not exceed 85 dBA. Noise level measurement will be made as per applicable internationally acceptable standard. The measurement shall be carried out with calibrated integrating sound level meter meeting the requirement of IEC:651 or BS:5969. Sound pressure level will be measured all-round the pump and motor set at a distance of one meter from the nearest surface of the machine and at a height of 1.5 m from the floor level. A minimum of six (6) points should be covered for measurement. The measurement shall be done with a slow response on the A-weighted scale. The average of the A-Weighted sound pressure measurements expressed in decibels to a reference 0.0002 microbars shall not exceed the specified value.

The tests shall be carried out on the machine operating at rated speed and as near as possible to the rated power. Corrections for background noise and correction on account of test environment will be considered in line with applicable standard. For this purpose all the additional data required should necessarily be collected during the test.

Vibration check will also be done as per HIS. Vibration would be checked at thrust bearing locations on horizontal, radial and vertical direction. The acceptance limits would be as per HIS. The instrument used would be IRD 308 or equivalent with velocity pick-up. Vibration limits to be specified as per the speed of the pump.

Material Test Certificate

Material of the various pump components shall be tested in accordance with the relevant standards. Test certificates for these shall be furnished for the Owner's approval.

Where stage inspection is desired by BHEL/customer all material test certificates shall be correlated and

verified with the actual material used for construction before starting fabrication by BHEL/customer's inspector who will stamp the material. In case mill test certificate for the material are not available, the supplier shall carry out physical and chemical tests at his own cost from a testing agency, approved by BHEL/Customer, as per the requirement of specified material standard. The sample for physical and chemical testing shall be drawn up in presence of BHEL/Customer's inspector who shall also witness the testing.

Non Destructive Testing

- UT shall be carried out on shafts of diameter more than 50 mm.
- DP tests shall be carried out on shaft and impeller.
- No weld repair shall be allowed on cast iron.

Field Testing

After installation, the pumps offered shall be operated to prove satisfactory performance as individual equipment as well as a system run. If the performance at site is found not to the requirements then the equipment shall be rectified or replaced by the Vendor, at no extra cost to the Owner. The procedure of the above testing will be mutually agreed between the Owner and the contractor. Noise and vibration tests shall also be repeated at site.

Based on observation of the trial operation, if modifications and repairs are necessary, the same shall be carried out by the contractor to the full satisfaction of the engineer and then the performance and guarantee tests to be repeated at site as per relevant clauses of the specification.

SUB SECTION IIB

GENERAL TECHNICAL REQUIREMENTS - ELECTRICAL

MOTOR DATA SHEET TO BE FILLED BY BIDDER DURING DETAILED ENGINEERING

CLAUSE NO.	Bidder's Name ……..

DE-	LT MOTORS	
A.	GENERAL	
1.	Manufacturer & Country of origin. (Shall be as per approved QA make)	
2.	Equipment driven by motor	
3.	Motor type	
4.	Quantity	
B.	DESIGN AND PERFORMANCE DATA	
1.	Frame size	
2.	Type of duty	
3.	Type of enclosure /Method of cooling/ Degree of	
4.	Applicable standard to which motor generally	
5.	Efficiency class as per IS	
6.	(a)Whether motor is flame proof	Yes/No
	(b)If yes, the gas group to which it conforms as per	
7.	Type of mounting	
8.	Direction of rotation as viewed from DE END	
9.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)	
10.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	
11.	Maximum continuous load demand of driven	
12.	Rated Voltage (volts)	
13.	Permissible variation of :	
	a. Voltage (Volts)	
	b. Frequency (Hz)	
	c. Combined voltage and frequency	
14.	Rated speed at rated voltage and	
15.	At rated Voltage and frequency:	
	a. Full load current	

CLAUSE NO.	Bidder's Name ……..

	b. No load current	
16.	Power Factor at	
	a. 100% load	
	b. NO load	
	c. Starting.	
17.	Efficiency at rated voltage and frequrecy,	
	a.100% load	
	b. 75% load	
	c. 50% load	
18.	Starting current (amps) at	
	a. 100 % voltage	
	b. 85% voltage	
	c. 80% voltage	
19.	Minimum permissible starting Voltage (Volts)	
20.	Starting time with minimum permissible voltage	
	a. Without driven equipment coupled	
	b. With driven equipment coupled	
21.	Safe stall time with 100% and 110% of rated	
	a. From hot condition	
	b. From cold condition	
22.	Torques :	
	a. Starting torque at min. permissible voltage(kg-	
	b. Pull up torque at rated voltage.	
	c. Pull out torque	
	d. Min accelerating torque (kg.m) available	
	e.Rated torque (kg.m)	
23.	Stator winding resistance per phase (ohms at 20	
24.	GD2 value of motors	

CLAUSE NO.	Bidder's Name ……..

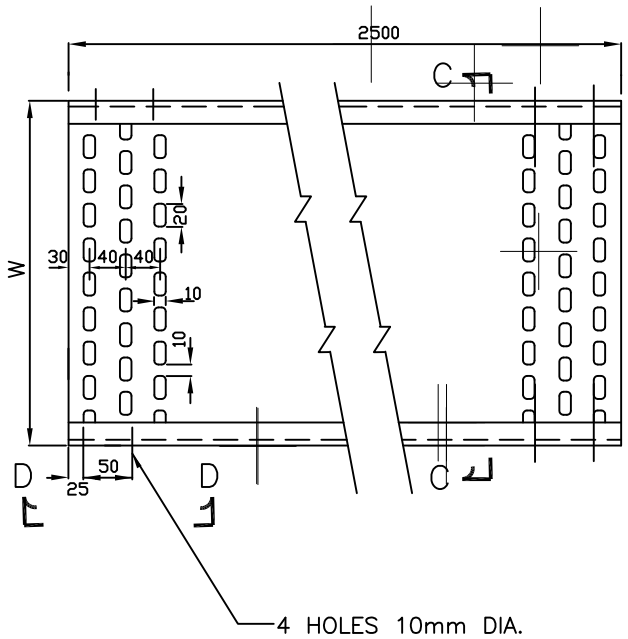
25.	No of permissible successive starts when motor is in hot condition	
26.	Locked Rotor KVA Input	
27.	Locked Rotor KVA/KW	
28.	Vibration limit :Velocity (mm/s)	
29.	Noise level limit (dBA)	
C.	**CONSTRUCTIONAL FEATURES**	
1.	Stator winding insulation	
	a. Class & Type	
	b. Winding Insulation Process	
	c. Tropicalised (Yes/No)	
	d. Temperature rise over specified maximum ambient temperature of 50 deg C	
	e. Method of temperature measurement	
	f. Stator winding connection	
2.	Main Terminal Box	
	a. Type	
	b. Location(viewed from NDE side)	
	c. Entry of cables(bottom/side)	
	d. Recommended cable size(To be matched with cable size envisaged by owner)	
	e. Fault level (MVA),Fault level duration(sec)	
	f. Cable glands & lugs details (shall be suitable for	
3.	Type of DE/NDE Bearing	
4.	Motor Paint shade	
5.	Weight of	
	a. Motor stator (KG)	
	b. Motor Rotor (KG)	
	c. Total weight (KG)	

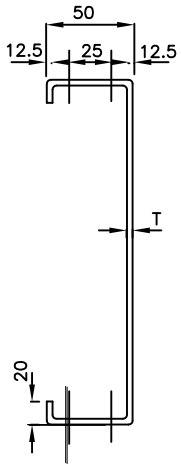
CLAUSE NO.	Bidder's Name ……..

D.	**List of accessories.**	
1.	Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)	
2.	Terminal Box for Space Heater (Yes/No)	
3.	Speed switch (Yes/No)	
4.	Insulation of bearing (Yes/No)	
5.	Noise reducer(Yes/No)	
6.	Grounding pads	
	i) No and size on motor body	
	ii) Nos on terminal Box	
7.	Vibration pads	
	i) Nos and size	
	ii) Location	
8.	Any other fitments	
E.	**List of curves.**	
1.	Torque speed characteristic of the motor	
2.	Thermal withstand characteristic	
3.	Starting. current Vs. Time	
4.	Starting. current Vs speed	
5.	P.F. and Effi. Vs Load	
F.	**Additional Data to be filled for each rating of DC Motor**	
1.	Rated armature voltage (Volt)	
2.	Rated field excitation (Amp)	
3.	Permissible % variation in voltage	
4.	Minimum Permissible Starting voltage (volt)	
5.	At rated voltage	
	i)Full load Armature current.(Amp)	

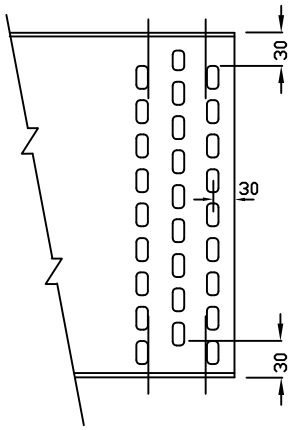
CLAUSE NO.	Bidder's Name ……..

	ii)Full load Field current (Amp)	
	iii)No load Armature current (Amp)	
6.	Full load Field current (Amp)	
7.	No load Aramature current (Amp)	
8.	Minimum permissible field current(Amp) to avoid	
	i) Maximum permissible voltage	
	ii) Rated voltage	
	iii) Minimum Permissible Voltage	
9.	Resistance (indicative Values) in ohm	
	i)Armature winding(Arm + IP + Series) at 25	
	ii) Field Winding at 25 deg. C	
10..	Inductance (indicative values)	
	i) Armature winding	
	ii) Field winding	
11	Value of trimmer resistance (ohm) to be connected in series with the shunt field to	
	i) 220 V DC	
	ii) 250 V DC	
	iii) 187 V DC	
12	Value of the external resistance (ohm)required to be connected in series with armature during starting only	
13	Technical data sheet for external resistance box	
14	GA drawing of motor	
15	Starting time calculation	
16	Starter resistance design calculation	
17	Electrical connection diagram of motor	

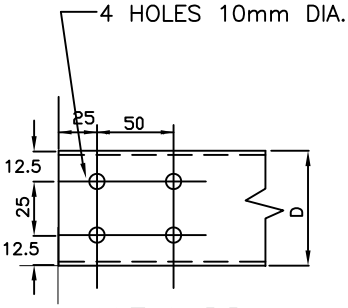




SECTION–CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS

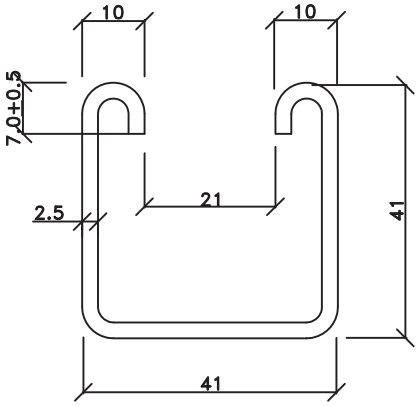


VIEW–DD
(100,50W TRAYS)

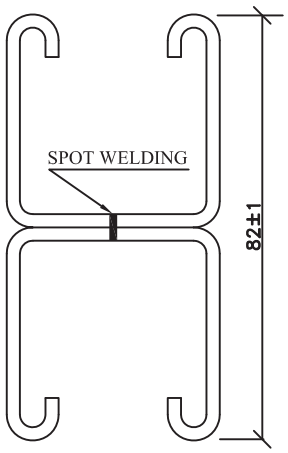
TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY

BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	DWG. NO.



SINGLE CHANNEL C1



DOUBLE CHANNEL C2

TWO LENGTHS OF SINGLE CHANNEL
SPOT WELDED BACK TO BACK
AT 75MM C/C

NOTE:

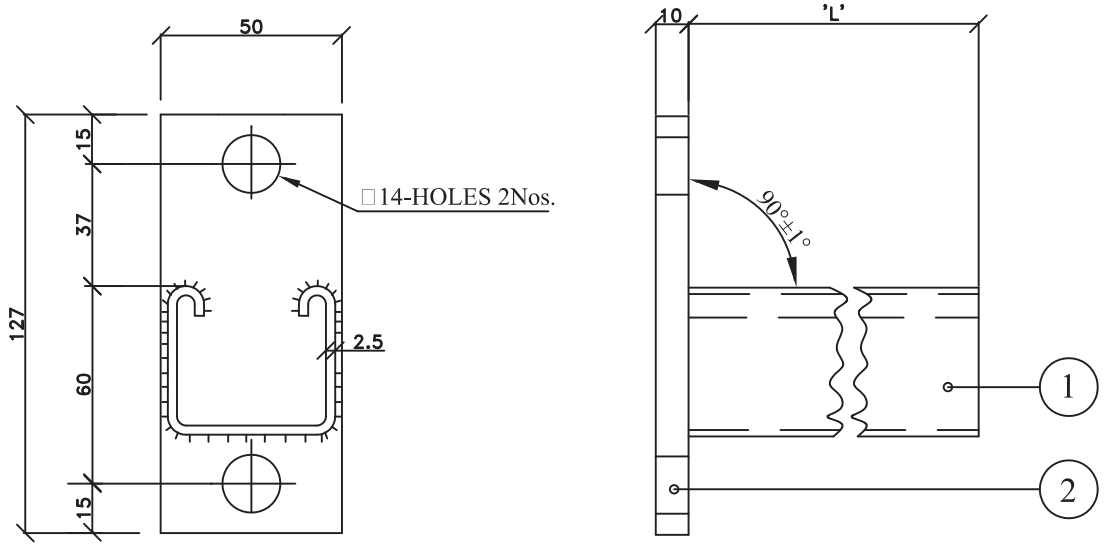
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. PROFILE TOLERANCE ±0.5 mm

R1

बीएचईएल BHEL

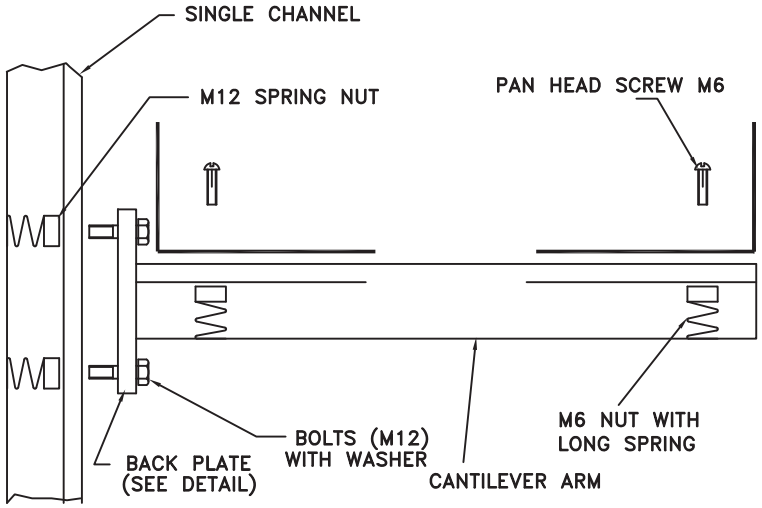
TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM



CANTILEVER ARMS

TRAY WIDTH IN MM	CANTILEVER ARM LENGTH (L) IN MM
150	200
300	350
450	500
600	650



TYPICAL ASSEMBLY OF CHANNEL SUPPORTS AND CABLE TRAY

M12 HEX BOLT & WASHER–2NOs.
M12 SPRING NUTS–2NOs.
M6 PAN HEAD SCREWS & WASHER–2NOs.
M6 SPRING NUTS–2NOs.

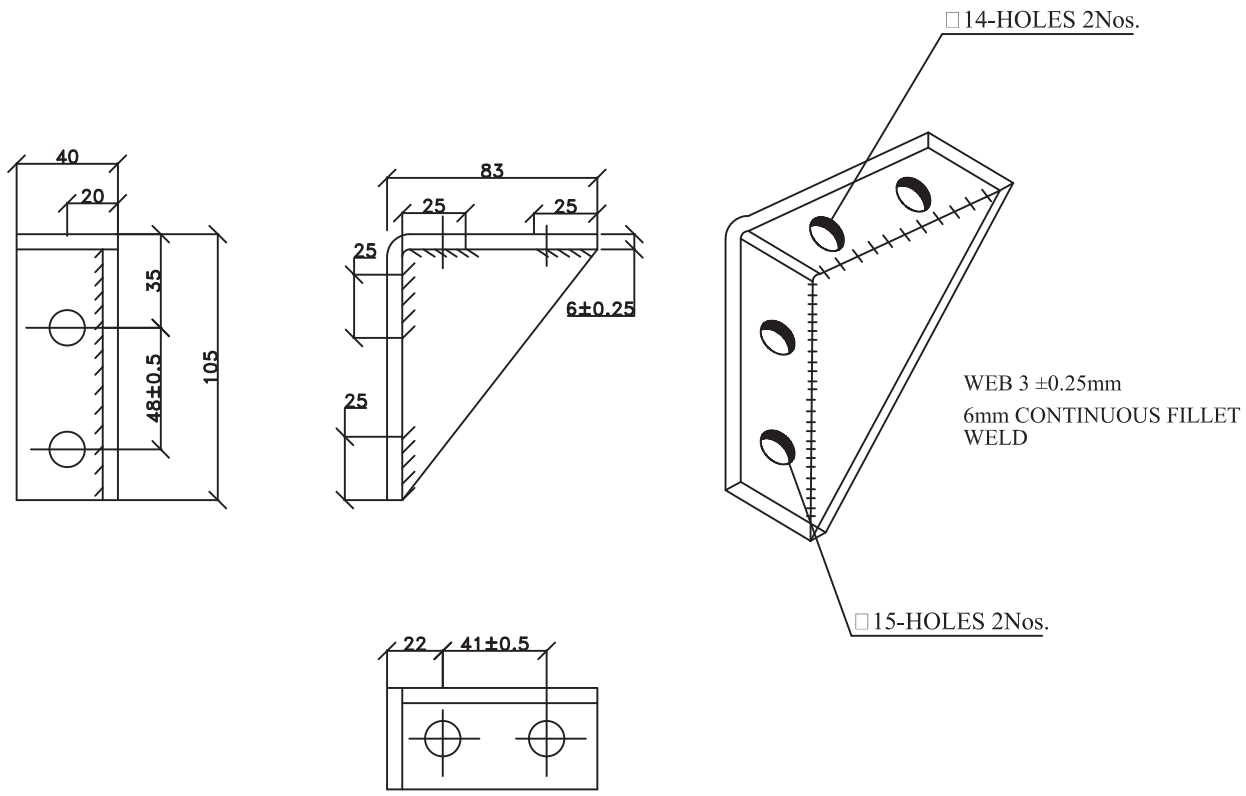
NOTES :

1. ALL DIMENSIONS ARE IN mm.
2. ITEM NO.1 MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062
3. MATERIAL :MILD STEEL AS PER IS-2062/
4. FINISH : HOT DIP GALVANISED AS PER IS:2629/
5. TOLERANCE ON THICKNESS AS PER IS:1852/
6. ALL FABRICATION TOLERANCES ARE ± 1.0mm

R1

TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM



90^0 ANGLE FITTING HL1

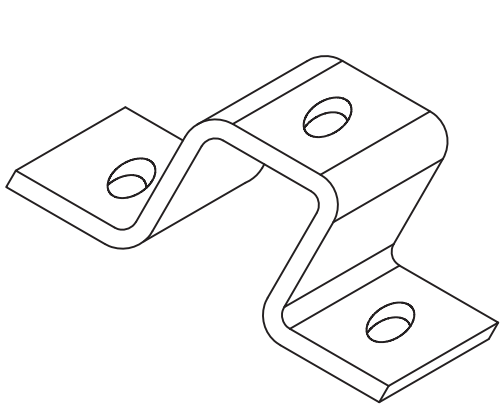
ANCHOR FASTENER–2NOs.
SPRING NUT & WASHER–2NOs.

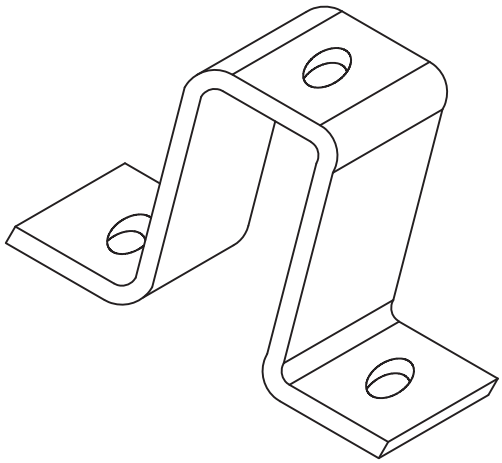
NOTES :

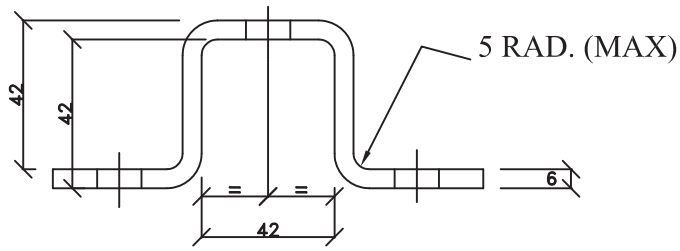
1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES ±1.0 mm
3. MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629 R1
5. TOLERANCE ON THICKNESS AS PER IS:1852

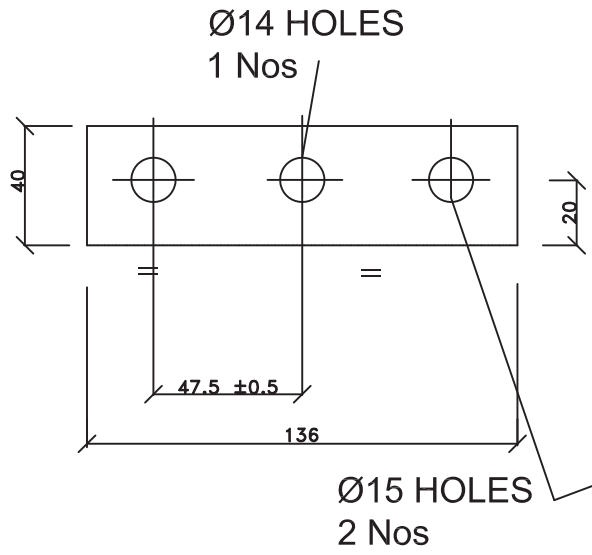
TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM

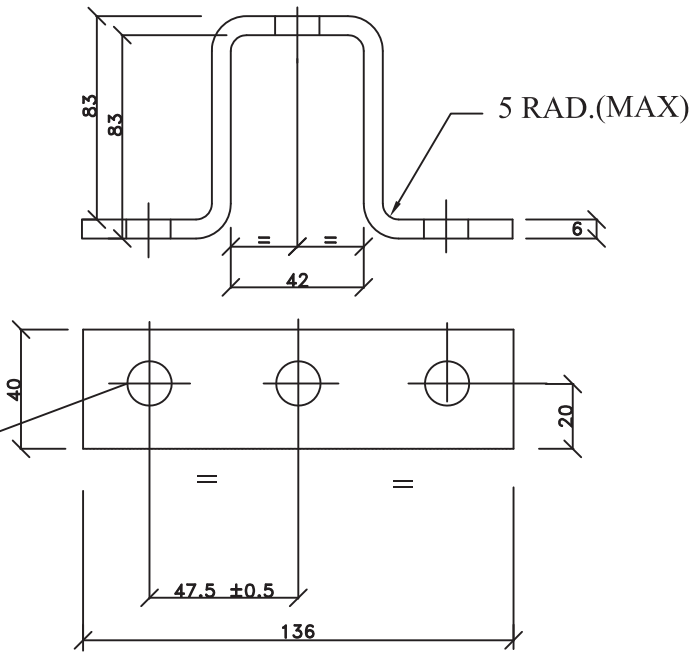








CLAMP FOR SINGLE CHANNEL CC1



CLAMP FOR DOUBLE CHANNEL CC2

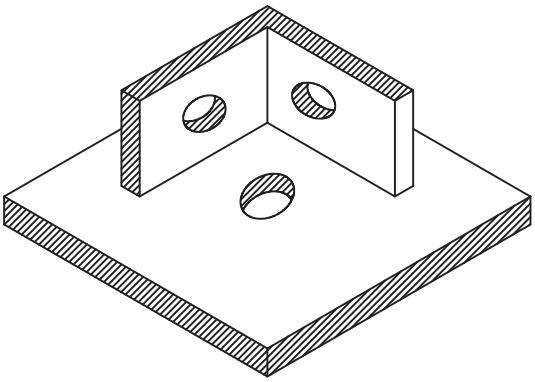
NOTES

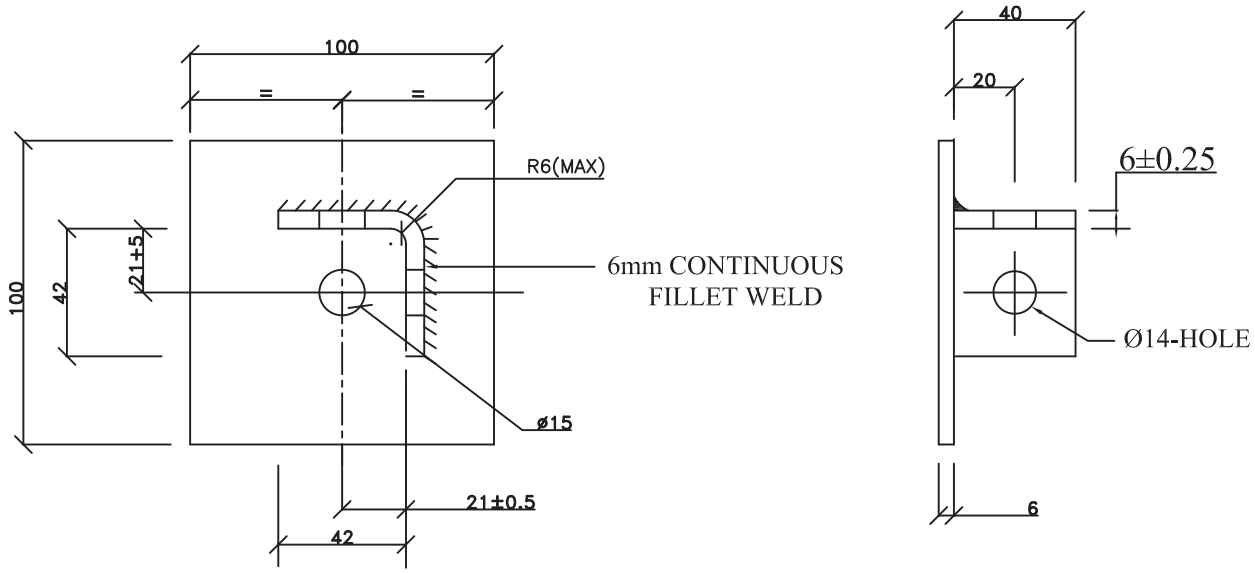
1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES ±1.0 mm
MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629 R1
5. TOLERANCE ON THICKNESS AS PER IS:1852

ANCHOR FASTENER–2NOs.
SPRING NUT & WASHER–1NO.

TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM





BASE PLATE FOR SINGLE CHANNEL BP1

NOTE

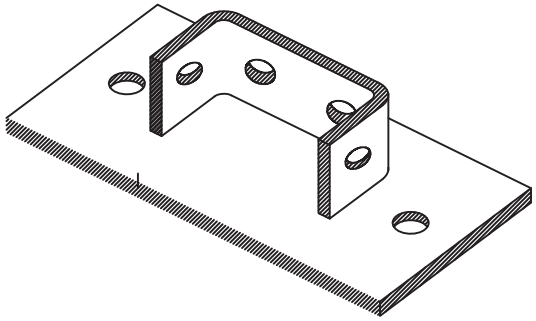
1. ALL DIMENSIONS ARE IN MM.
2. ALL FABRICATION TOLERANCES ±1.0mm.
3. MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS AS PER IS:1852

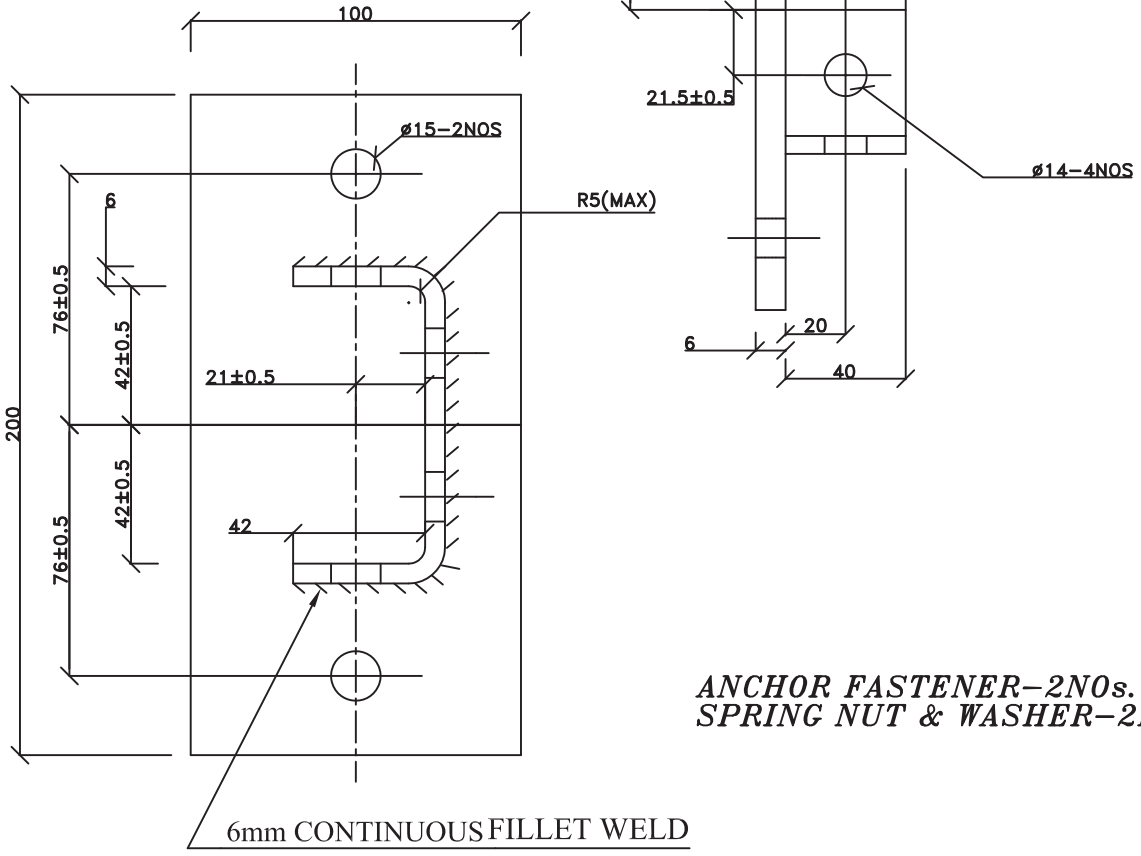
R1

ANCHOR FASTENER–1NO.
SPRING NUT & WASHER–1NO.

TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM





ANCHOR FASTENER–2NOs.
SPRING NUT & WASHER–2NOs.

BASE PLATE FOR DOUBLE CHANNEL BP2

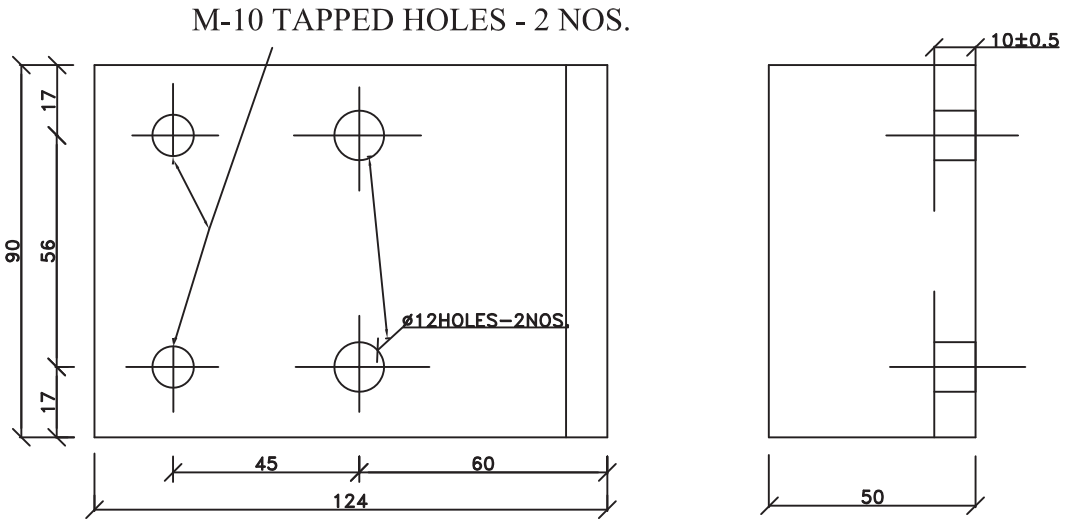
NOTES

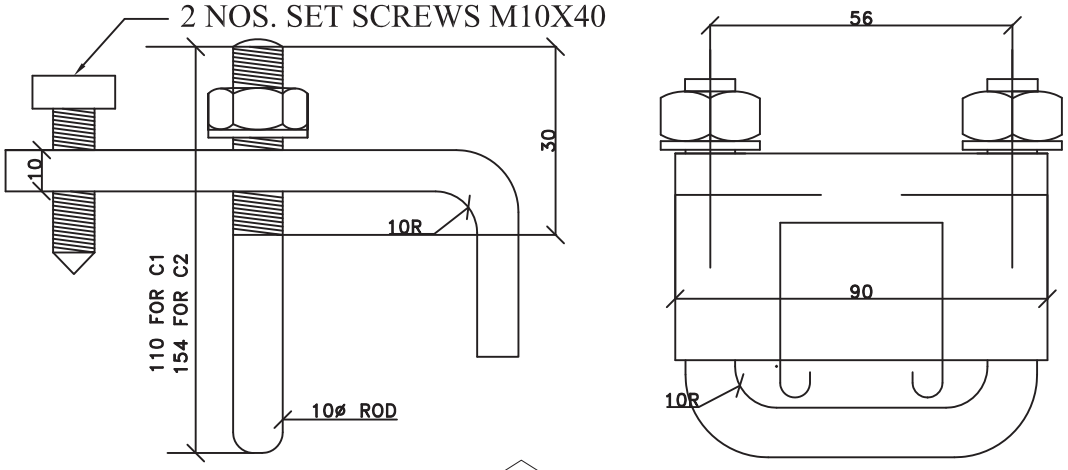
1. ALL DIMENSIONS ARE IN MM
2. ALL FABRICATION TOLERANCES ±1.0mm
MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629 R1
5. TOLERANCE ON THICKNESS AS PER IS:1852

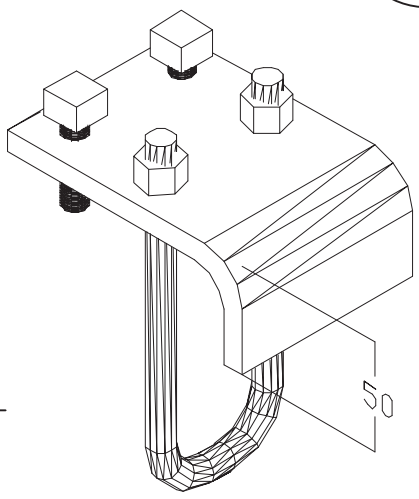
भेल BHEL

TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM







BEAM CLAMP - BC1

M–10 U–BOLT WITH
2Nos PLAIN WASHERS & NUTS
110 mm FOR SC 1
154 mm FOR DC1
2 NOs. SET SCREWS M10X40

NOTES

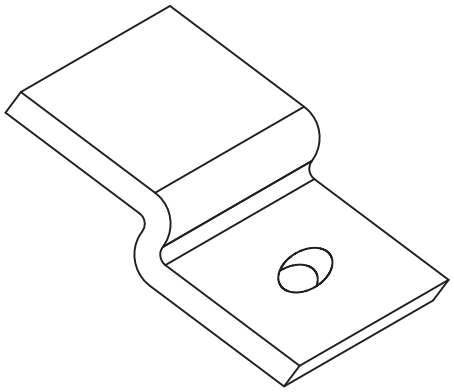
1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES ±1.0mm
MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS AS PER IS:1852

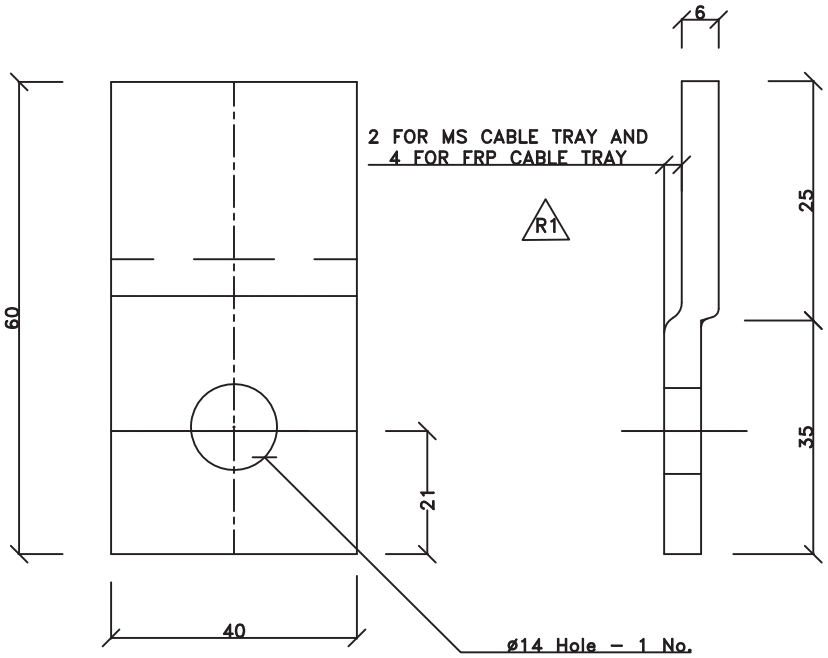
R1

BHEL

TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM





TRAY FIXING CLAMP - TC1

SPRING NUT & WASHER–1NO.

NOTES

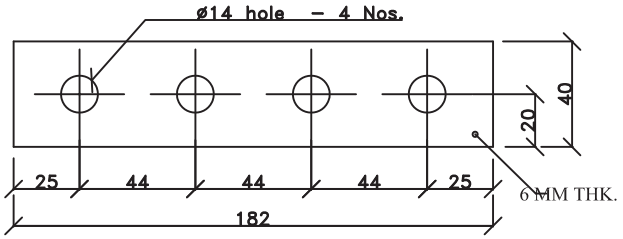
1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES : ±1.0mm

MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062

4. FINISH : HOT DIP GALVANISED AS PER IS:2629 R1
5. TOLERANCE ON THICKNESS AS PER IS:1852

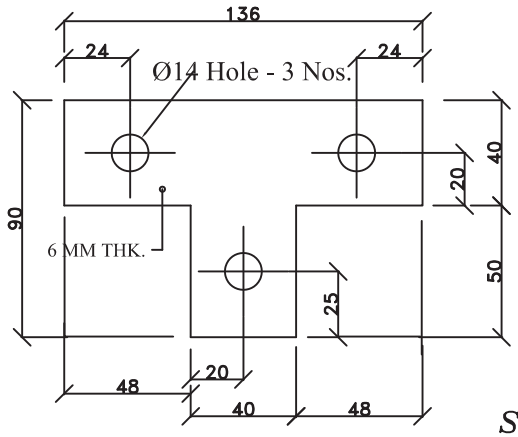
TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM



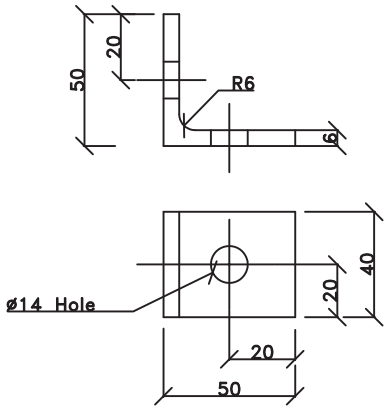
SPRING NUT & WASHER–4NOs.

FLAT PLATE STRAIGHT FITTING PF2



SPRING NUT & WASHER–3NOs.

FLAT PLATE TEE FITTING PF1



SPRING NUT & WASHER–2NOs.

90^0 ANGLE FITTING LA1

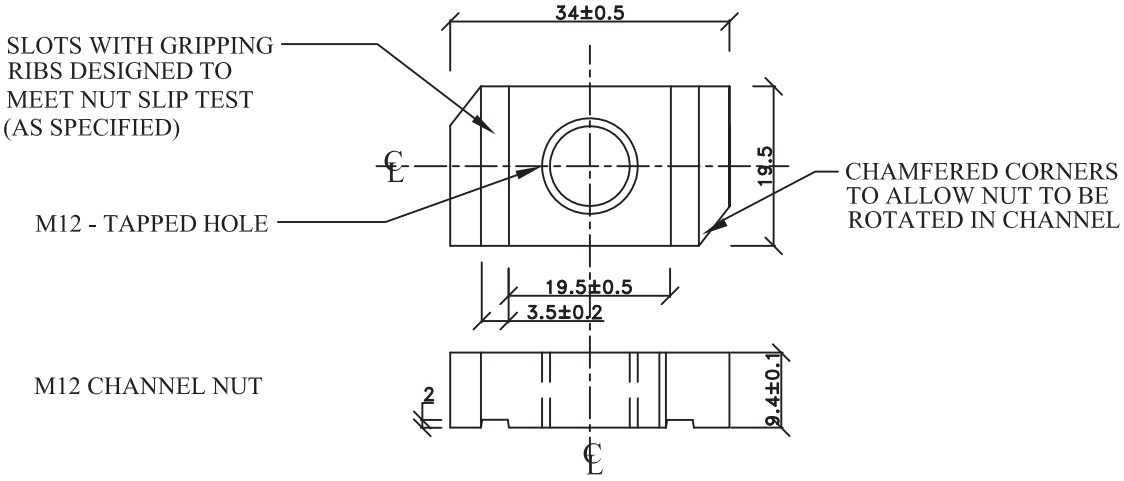
NOTES

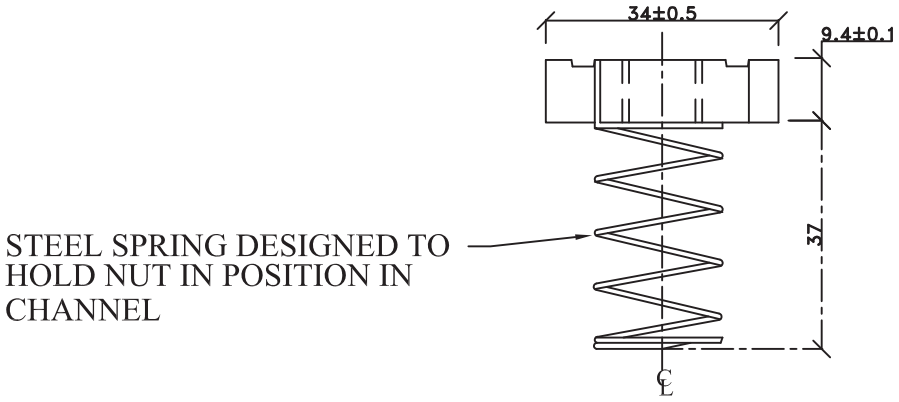
1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES ±1.0 mm
3. MATERIAL : HOT/ COLD ROLLED M.S. AS PER IS-2062 R1
4. FINISH : HOT DIP GALVANISED AS PER IS:2629

BHEL

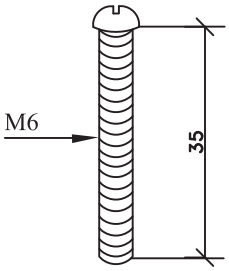
TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM

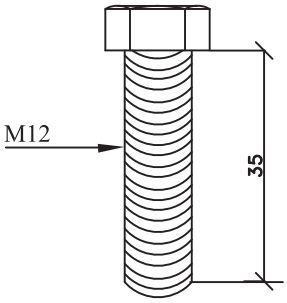




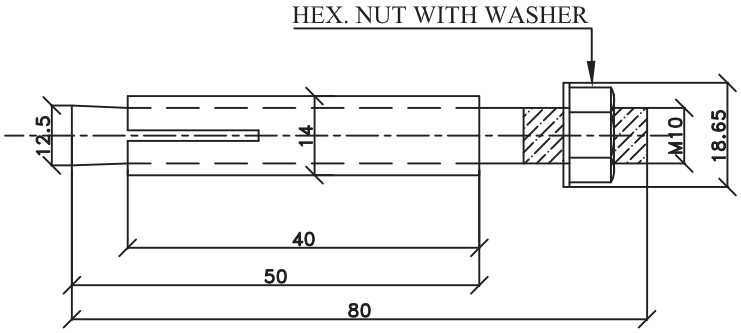
SPRING NUT ASSEMBLY



PAN HEAD SCREW



HEX BOLT



ANCHOR BOLT M10

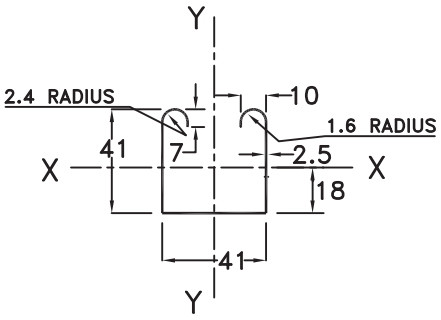
NOTES:

1. MATERIAL - MS AS PER IS - 2062. R1
2. M6 CHANNEL NUT DIMENSIONAL SIMILAR TO M12.
   EXCEPT HOLE DRILLED AND TAPPED TO M6 PAN HEAD SCREWS.
3. TAPPED HOLE THREADING TO MATCH WITH THREADING OF BOLTS.
4. SURFACE PROTECTION ELECTROGALVANISED / CADMIUM PLATED.
5. ALL DIMENSIONS ARE IN MM.

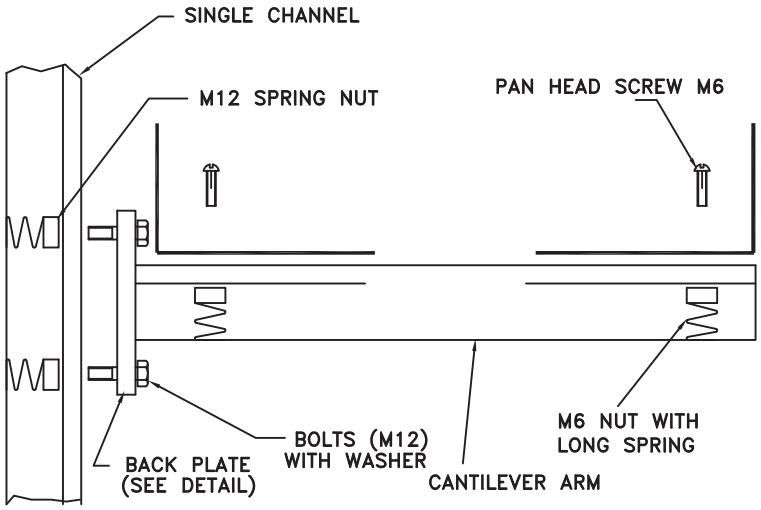
भेल BHEL

TITLE:

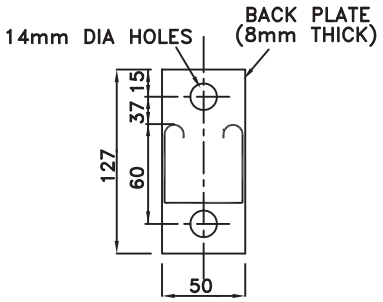
INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM



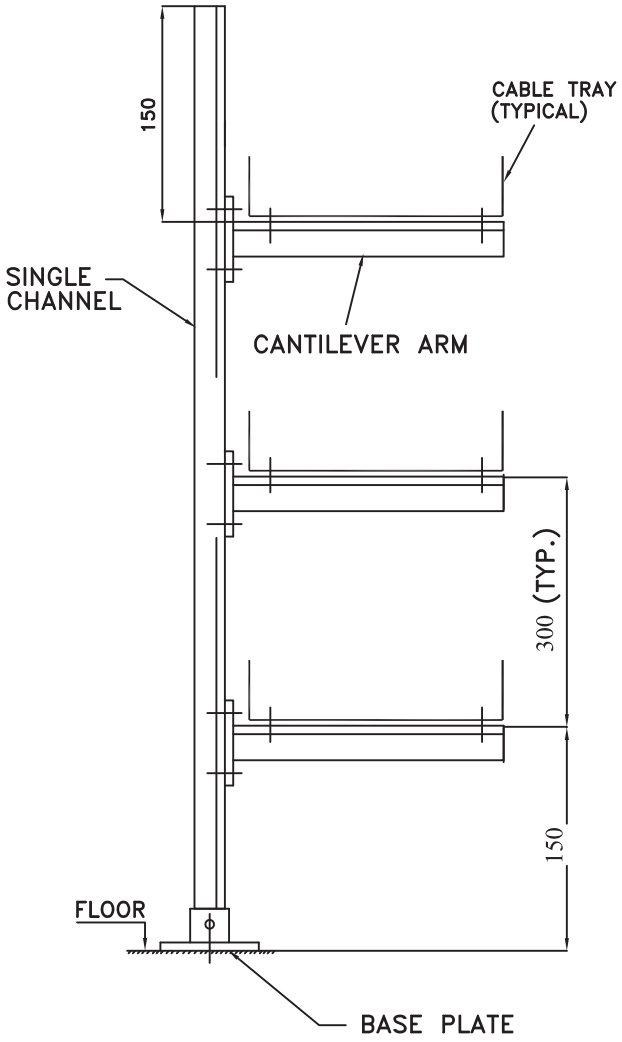
DETAIL OF ITEM–1
(SINGLE CHANNEL)

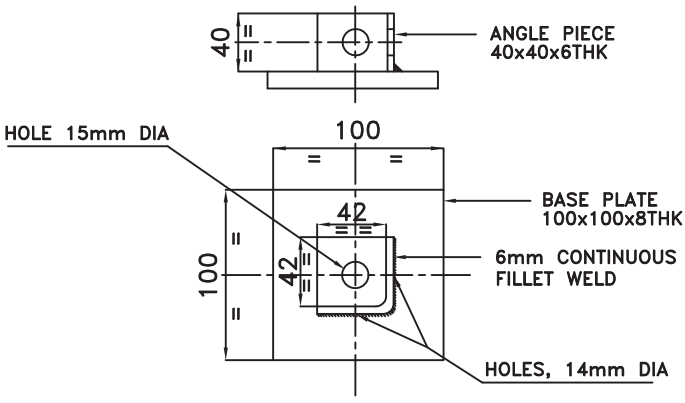


TYPICAL ASSEMBLY OF CHANNEL
SUPPORTS AND CABLE TRAY



END VIEW OF
(CANTILEVER ARM)





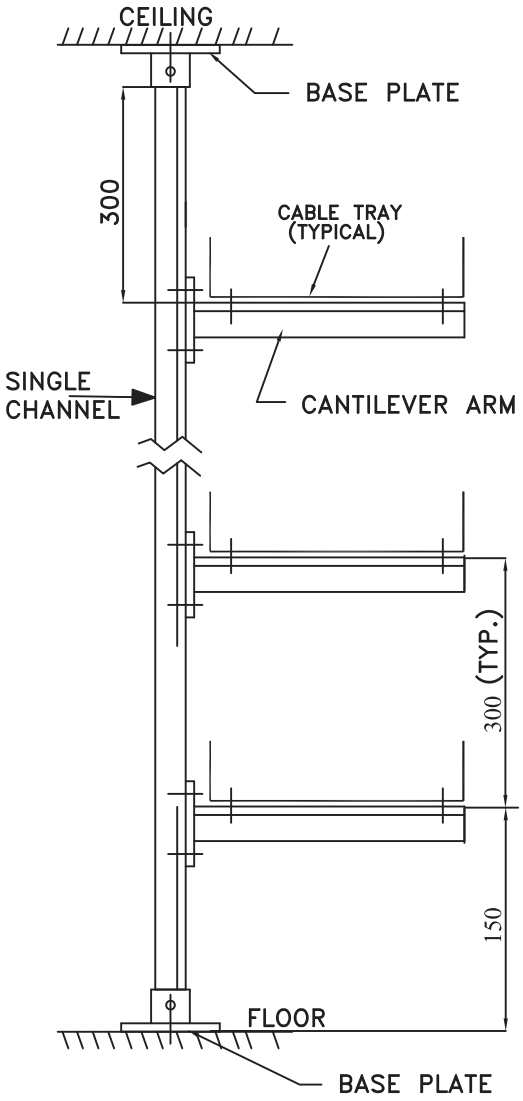
DETAILS OF BASE PLATE
FOR SINGLE CHANNEL

FLOOR SUPPORTED (SINGLE SIDE TYPE)

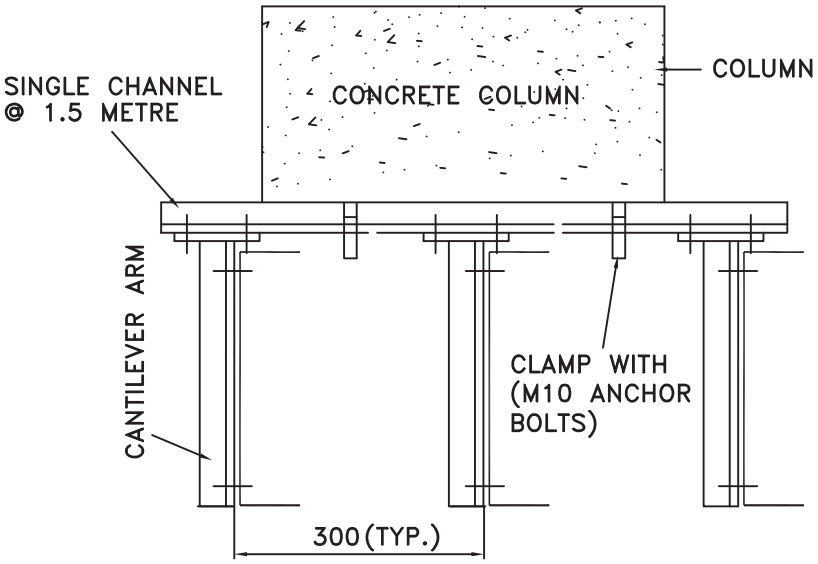
SEE GENERAL NOTES IN SHEET 15.

TITLE:

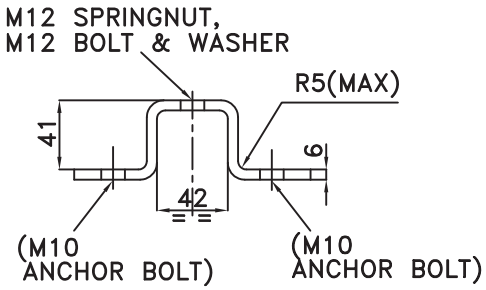
INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM



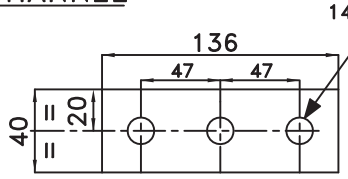
SUPPORTING ARRANGEMENT BETWEEN FLOOR AND CEILING (SINGLE SIDE TYPE)

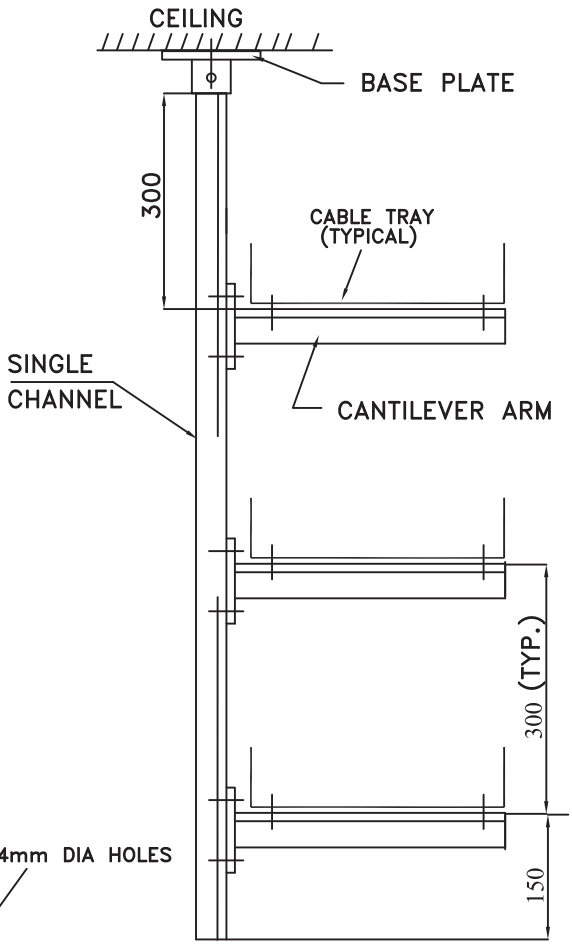


SUPPORT ARRANGEMENT FROM BUILDING COLUMN



CLAMP FOR SINGLE CHANNEL



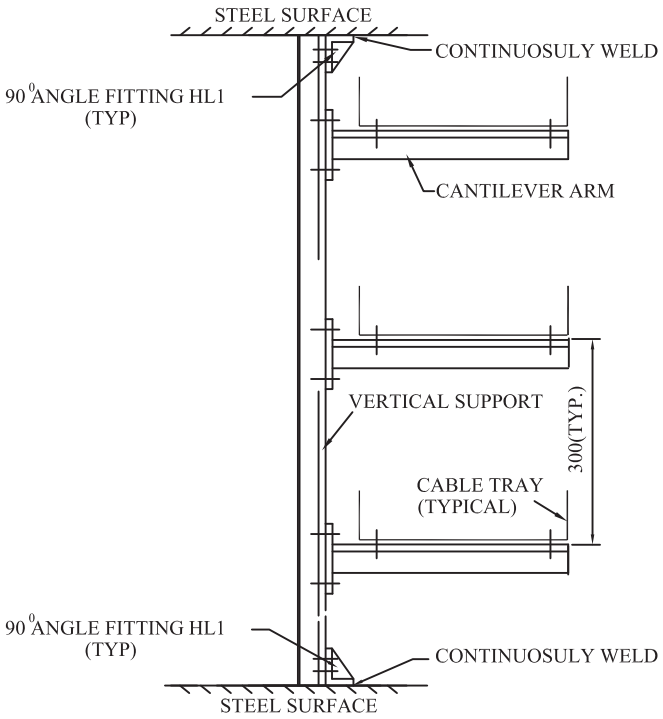


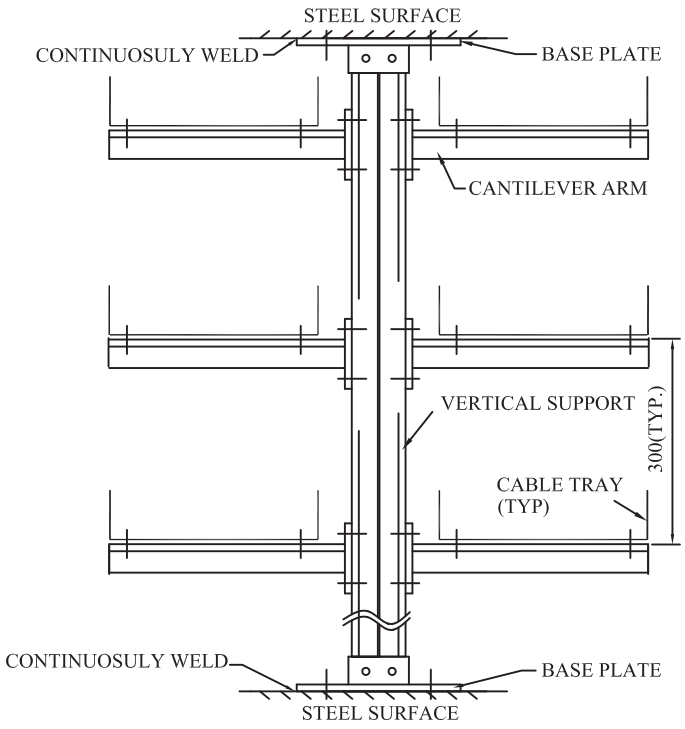
CEILING SUPPORTED (SINGLE SIDE TYPE)

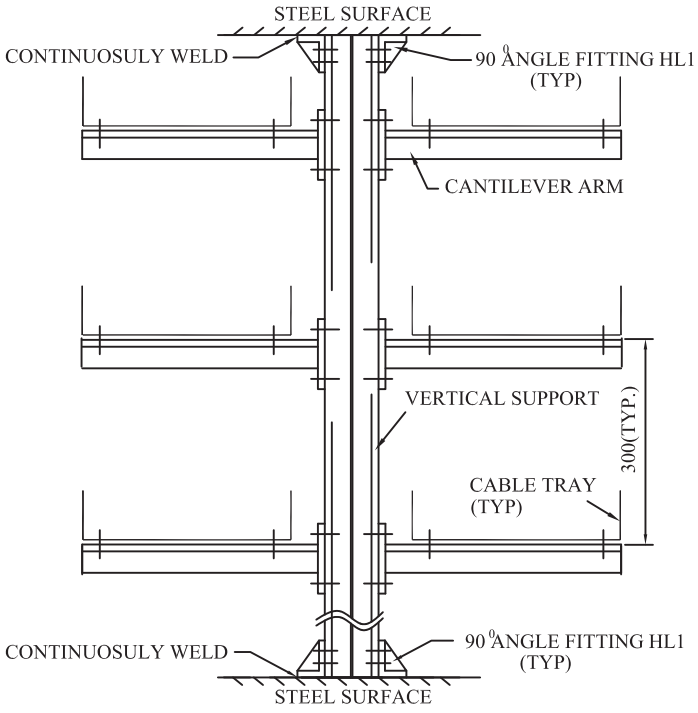
SEE GENERAL NOTES IN SHEET 15.

TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM



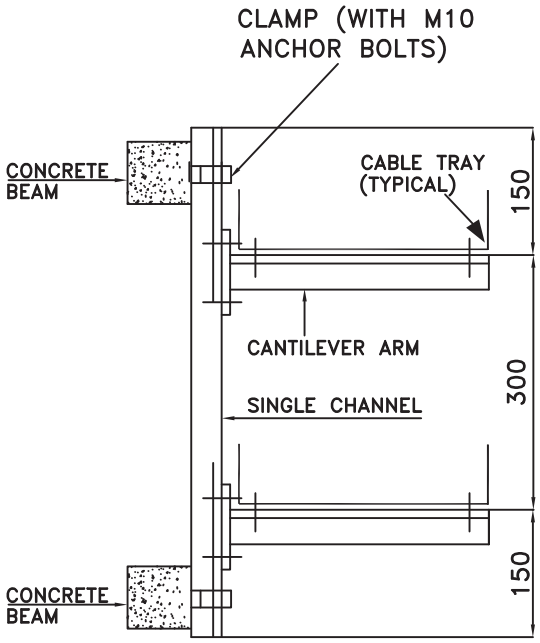




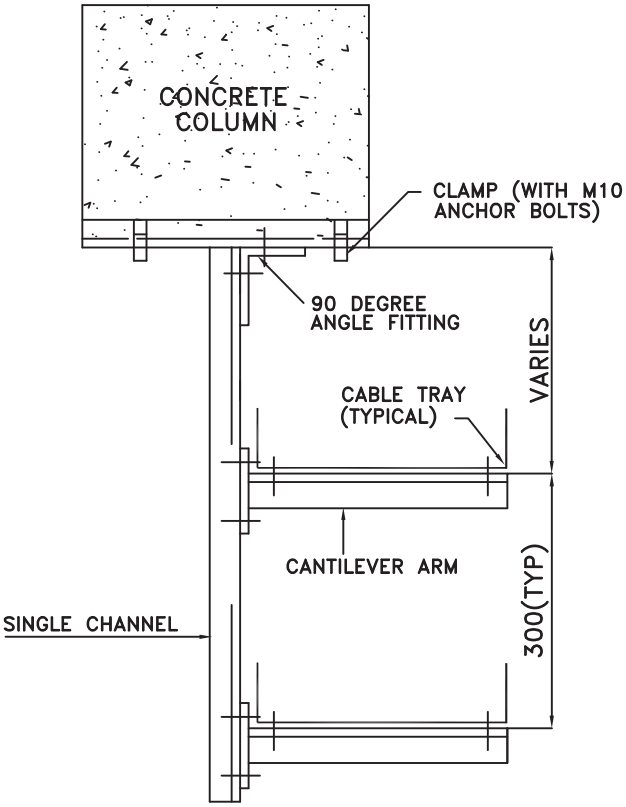
SUPPORTING ARRANGEMENT OF (SINGLE SIDE/DOUBLE SIDE) BETWEEN TWO STEEL SURFACE

SEE GENERAL NOTES IN SHEET 15.

TITLE: INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM



SUPPORT ARRANGEMENT
FROM CONCRETE BEAMS



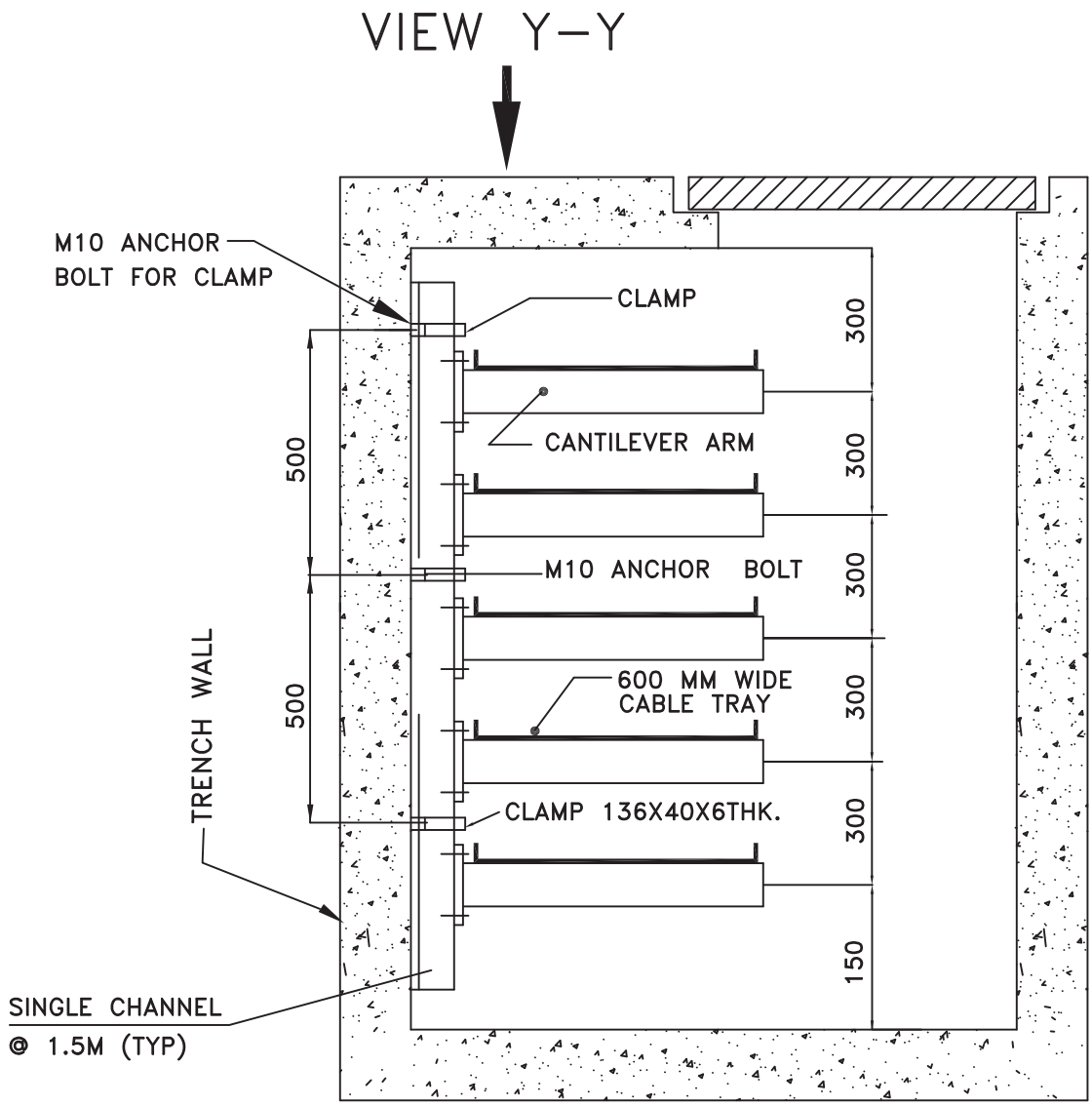
SUPPORT ARRANGEMENT
FROM CONCRETE COLUMNS
WITH ANGLE FITTING

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS INDICATED OTHERWISE.
2. ALL SUPPORTS ARE OF 2.5 MM THICK MS CHANNEL SECTIONS AND GALVANISED.
3. ALL FASTENERS SHALL BE ZINC PASSIVATED/ CADMIUM PLATED.
4. ALL SUPPORT SHALL BE FIXED ON WALL / COLUMN / TRENCH BY MEANS OF 136 X 40 X 6 MM THICK CLAMP.
5. ARRANGEMENT SHOWN ARE TYPICAL ONLY.
6. ALL WELDS FOR CABLE TRAY SUPPORTS SHALL HAVE A MINIMUM THROAT THICKNESS OF 6 MM.

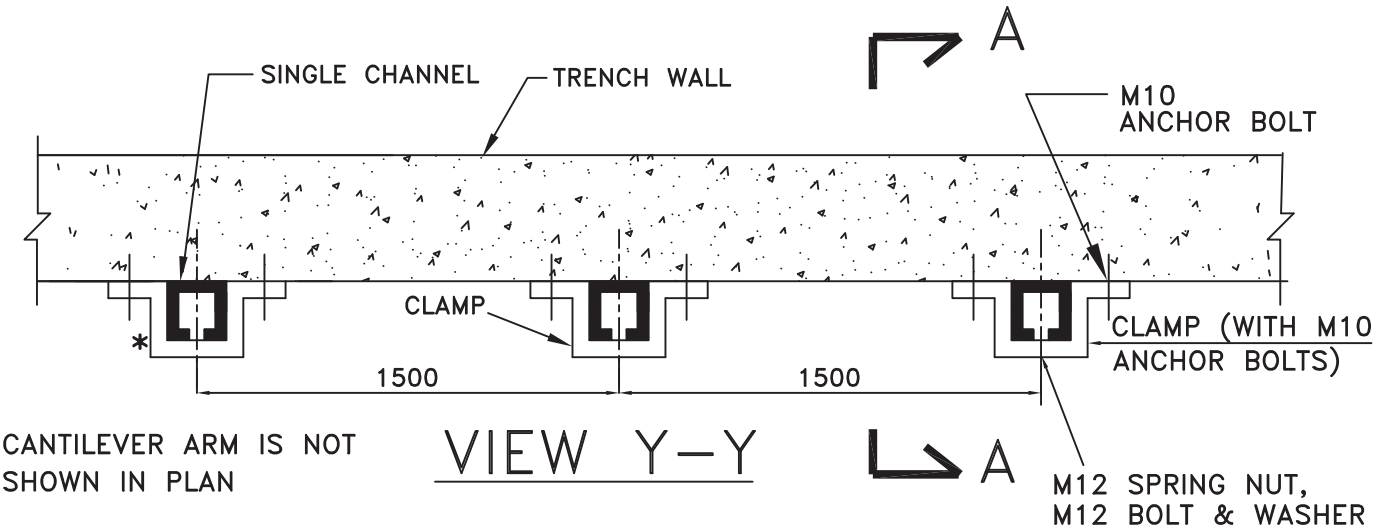
TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM



SECTION–AA

TYP. CABLE TRAYS FIXING ARRANGEMENT IN TRENCH



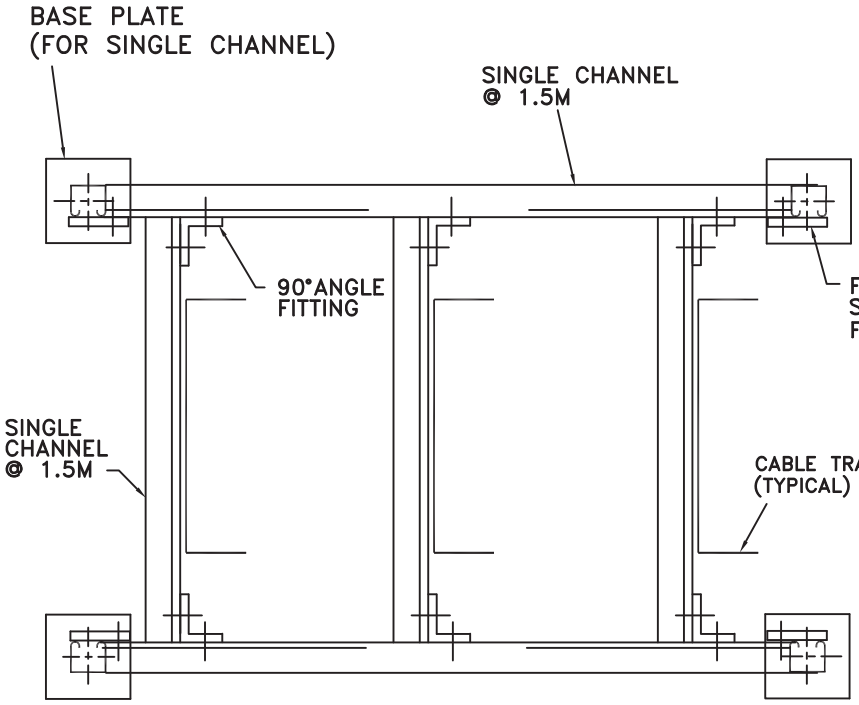
*CANTILEVER ARM IS NOT SHOWN IN PLAN

VIEW Y–Y

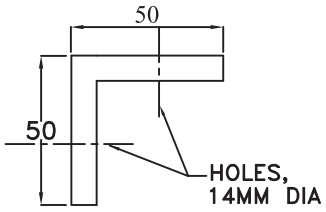
SEE GENERAL NOTES IN SHEET 15.

TITLE:

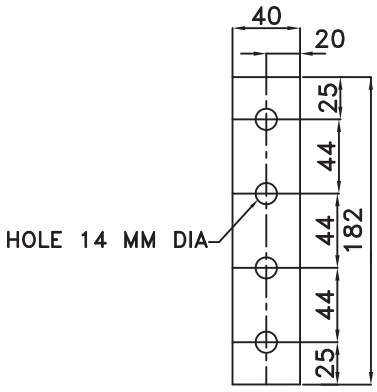
INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM



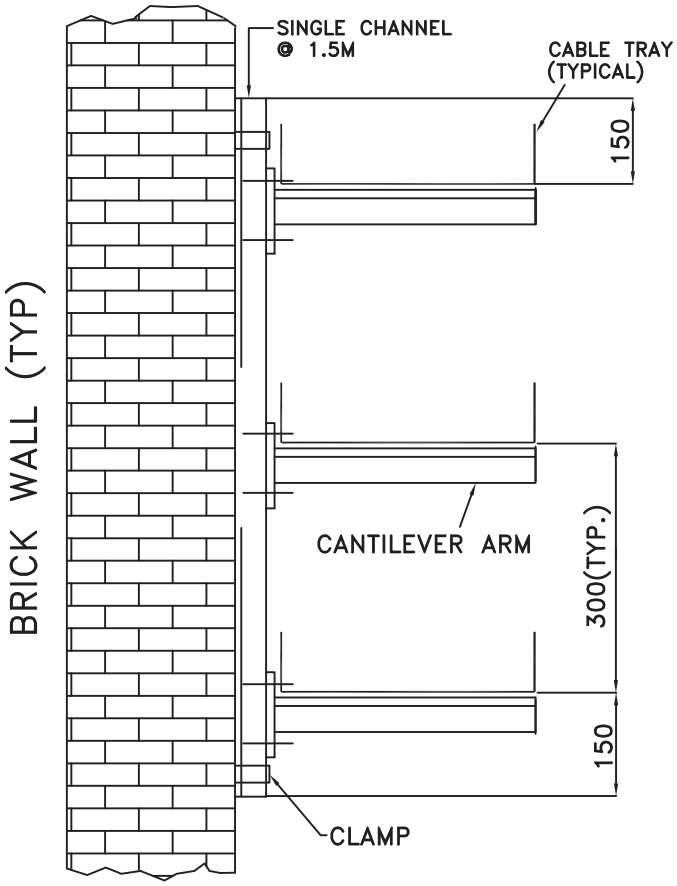
TYPICAL FLOOR SUPPORTED CHANNEL FRAME WORK (FOR BOLTABLE TYPE CABLE TRAY RISER)



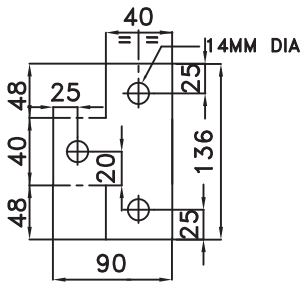
90 DEG. ANGLE FITTING
(6 MM THICK, 40 MM WIDE)



FLAT PLATE
STRAIGHT FITTING
(6 MM THICK)



TYPICAL CHANNEL SUPPORT
(ON WALL)

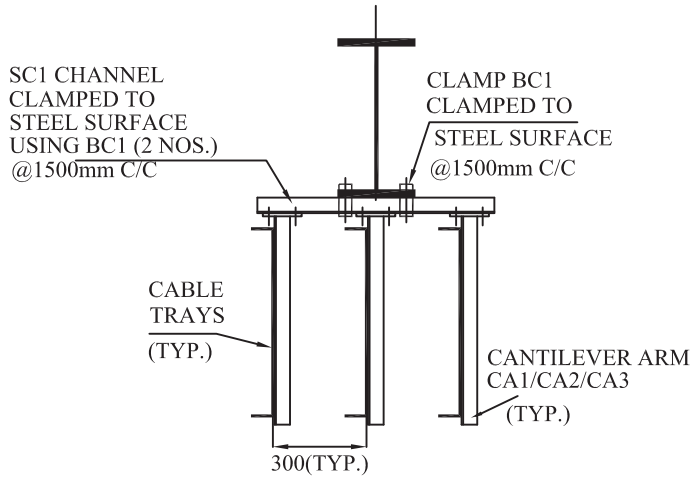


FLAT PLATE TEE FITTING
(6 MM THICK)

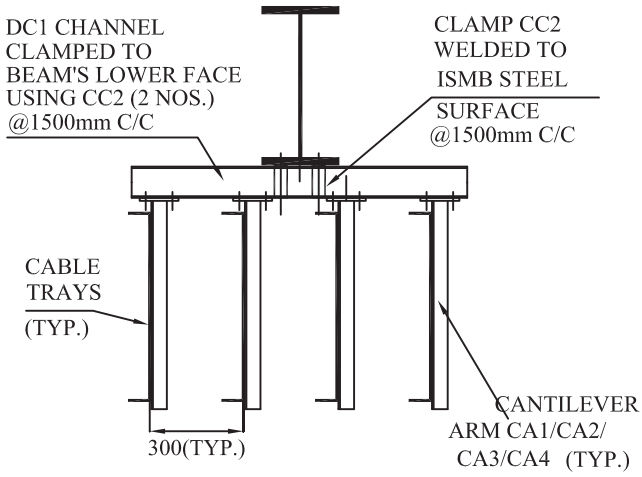
SEE GENERAL NOTES IN SHEET 15.

TITLE:

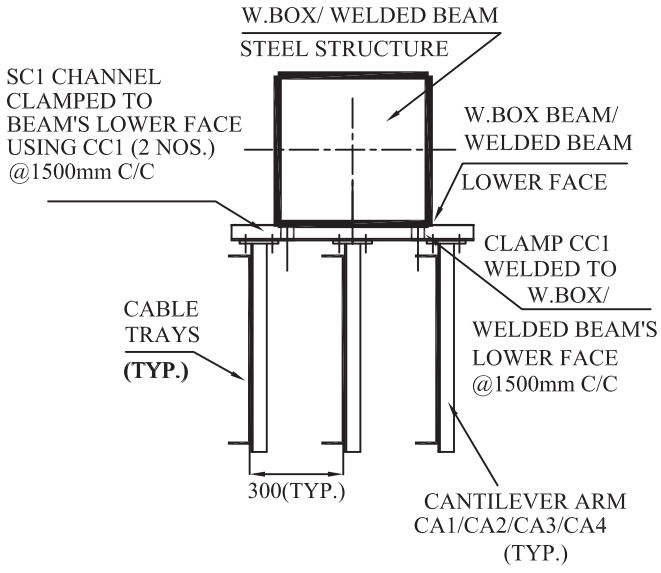
INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM



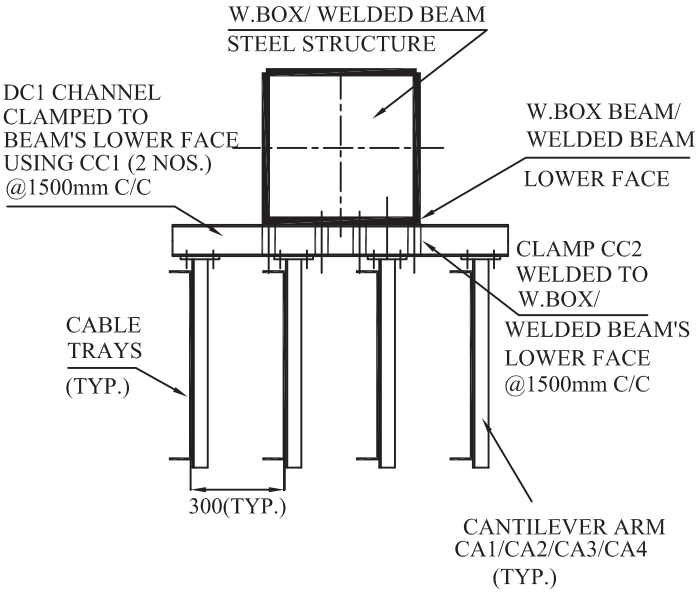
INSTALLATION DETAIL TYPE BB1:
(A)-CABLE TRAYS BELOW I-BEAMS
(UPTO & INCLUDING THREE TRAYS)



INSTALLATION DETAIL TYPE BB2:
(B)-CABLE TRAYS BELOW I-BEAMS
(MORE THAN THREE TRAYS)



INSTALLATION DETAIL TYPE BB3:
(C)-CABLE TRAYS BELOW W. BOX/
WELDED BEAM'S (APPLICABLE FOR
UPTO & INCLUDING THREE TRAYS)



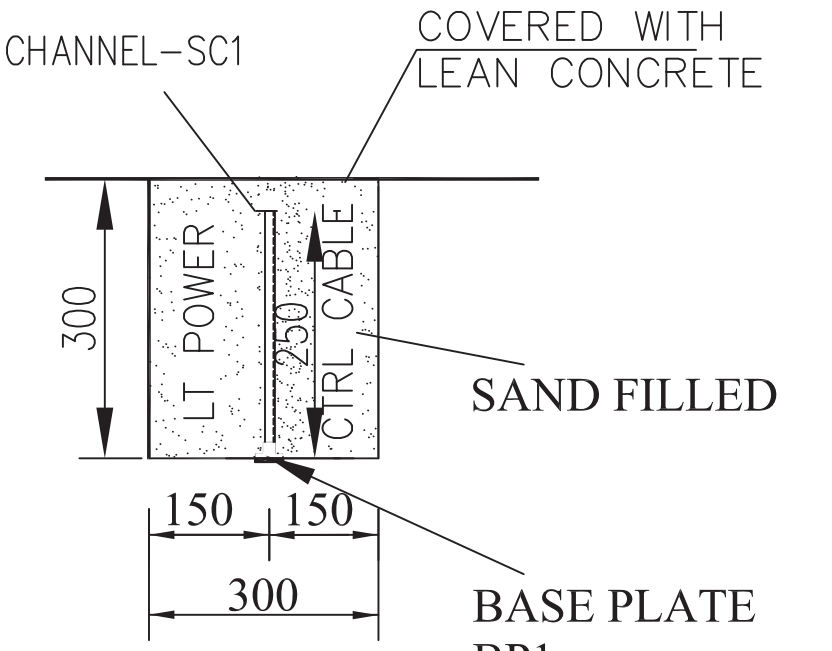
INSTALLATION DETAIL TYPE BB4:
(D)-CABLE TRAYS BELOW W. BOX/
WELDED BEAM'S (APPLICABLE FOR
MORE THAN THREE TRAYS)

CABLE TRAYS SUPPORTING ARRANGEMENT AROUND BOILER PLATFORMS

BHEL

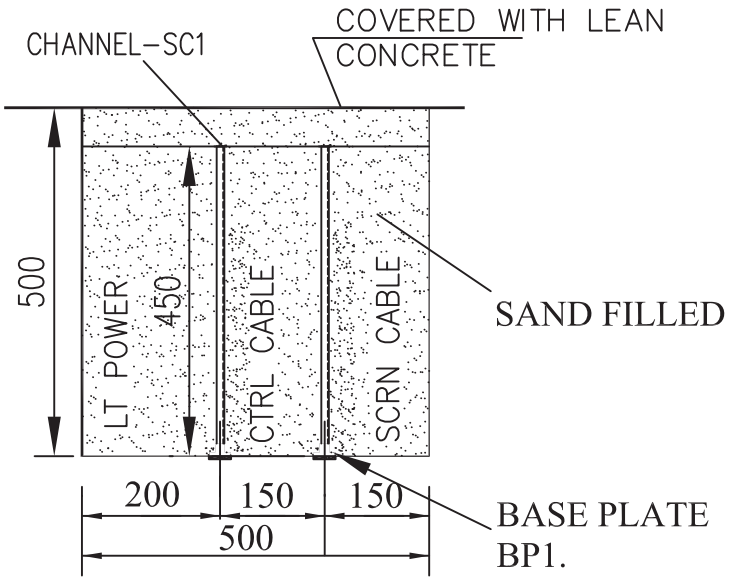
TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM



CABLE SLIT
300W x 300D

R1



R1

CABLE SLIT
500W x 500D

TITLE:

INSTALLATION DETAILS FOR CABLE TRAYS SUPPORT SYSTEM

SUB SECTION IIC

GENERAL TECHNICAL REQUIREMENTS – CONTROL & INSTRUMENTATION

	Technical specification for **2X660 MW MAITREE STPP, BANGLADESH**	REV. NO. 00 | DATE : 08.09.2017

INSTRUMENTS, JB & VALVES SPECIFICATIONS

For the following instruments please refer specified clause no. in the specification under **Section-IA**- customer's General Technical Specification – B0:

Transmitters	-	B0.6.19.8
Temperature measurement	-	B0.6.19.9
Pressure measurement	-	B0.6.19.10
Flow measurement	-	B0.6.19.11
Level measurement	-	B0.6.19.12
Solenoid Valves	-	B0.6.19.17
Analysers and monitoring systems	-	B0.6.19.13.2
Control Valves	-	B0.6.19.15
Actuators	-	B0.6.19.16
JB	-	B0.6.19.5

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

1.0 Measuring instruments / equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment. The instrumentation vendor shall be subject to BHEL's / customer's approval. Further, all instruments shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes / numbers as approved by BHEL / customer during detailed engineering.

1.1 Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

1.2 All local gauges as well as transmitters, sensors and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance under the scope of specification shall be provided. The necessary root valves, impulse piping, drain cock, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting / erection of these local instruments shall be furnished even if not specifically asked for. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm^2.

1.3 Instruments envisaged for sea water application shall be provided with wetted parts made of Monel / Hastelloy C.

1.4 All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

Technical specification
for
2X660 MW MAITREE STPP, BANGLADESH

1.5 Specification for Pr. Gauge, D.P. Gauge, Temp. Gauge and Level Gauge

Sl. No.	Features	Essential / Minimum Requirements		
		Pr. Gauge / D.P. Gauge	**Temp. Gauge**	**Level Gauge**
1	Sensing Element and Material	Bourdon for high pressure, Diaphragm / Bellow for low pr. of 316 SS	Mercury in steel below 450 Deg.C and inert gas actuated for above 450 Deg.C of SS bulb and capillary	Tempered toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel / 304 SS
3	Dial size	150 mm	150 mm	Tubular covering entire range.
4	End connection	½ inch NPT (M)	¾ inch NPT (M)	Process connection as per ASME PTC and drain / vent 15 NB.
5	Accuracy	±1% of span	±1% of span	±2%
6	Scale	Linear, 270 Deg. Arc graduated in metric units.	Linear, 270 Deg. Arc graduated in Deg. C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Test pr. For the assembly shall be 1.5 to the max. design pr. at 38 Deg. C.		
9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
10	Zero / Span adjustment	Provided	Provided	--
11	Identification	Engraved with service legend or engraved phenolic laminated tag plate	Engraved with service legend or laminated phenolic name plate	Engraved with service legend or laminated phenolic name plate
12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel / SS as per CS / Alloy process requirement.
13	Material of Bourdon movement	316 SS / 304 SS	316 SS / 304 SS	

1.6 Process Actuated Switches

Sl. No.	Features	Essential / Minimum Requirements Switches devices (Pr., Temp., Flow, Level Switches)			
		Pr. Switch / D.P.	**1 TEMP. SWITCH**	**2 LEVEL SWITCH**	**3 LIMIT SWITCH**
1	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr. / vacuum	Vapour pressure sensing, liquid filled bellow type with bulb and capillary (10 m minimum)	1.Capacitance types for oil and dirty medium, water, condensate application. Capacitance / conductivity / ultrasonic type for acid / alkali application Radio-frequency / ultrasonic type for ash hopper, ash slurry application Float type for application decided during detailed eng.	Micro switch
2	Material	316 SS	Bulb: 316 SS Capillary: 304 SS	316 SS	Silver plated high conductivity non-corrosive
3	Repeatability	±0.5% for full range	±0.5% for full	±0.5% for full range	±0.5%
4	End connection	½ Inch NPT (F)	½ Inch NPT (F)	1" NB Socket Weld	
5	Over range proof pressure	150% of max. design press.	---	150% of max. design press.	---
6	No. of contacts	2 NO + 2 NC, SPDT snap action dry contact			
7	Rating of contacts	60V DC, 6VA (or more if required by DCS).			
8	Enclosure	Weather and dust proof as per IP-55			
9	Set point / dead	Provided over full range			
10	Accessories	Syphon, snubber, chemical seal, pulsation dampener as required by process	Thermowell of 316 SS and packing glands	All mounting accessories	

11	Mounting	Suitable for enclosure / rack mounting or direct mounting	Direct factory mounting on valves, equipment with provision for adjusting at site.
12	Elect. Connection	Plug in socket	
13	General	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seal shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.	

1.7 Thermocouple

Sr. No.	Features	Essential/Minimum Requirements
1	Type of Thermocouple. :	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium-PT (Type R) depending on operating temperature Range (ungrounded type).
2	No. of element :	Duplex
3	Housing/ Head :	IP-55/ Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.
4	Sheathing of Thermocouple:	Swaged type magnesium oxide insulation.
5	Calibration and accuracy :	As per IEC-751/ANSI-C-96.1(special class) for T/C.
6	Characteristic :	Linear with respect to temp, within ±1/2 percent of top range value.
7	Accessories :	Thermowell (as specified in sl. no.1.9) and shall be spring loaded for positive contacts with the well.
8	Standard :	ANSI C 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well.

1.8 Resistance Temperature Detector (RTD)

Sr. No.	Features	Essential/Minimum Requirements
1	Type of RTD. :	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2	No. of element:	Duplex
3	Housing/Head:	IP-55/Die cast Aluminium. Plug in connectors are to be provided for external signal cable connection.
4	Sheathing of RTD:	Metal sheathed, ceramic packed
5	Calibration and accuracy:	As per DIN-43760 Class-A for RTD
6	Characteristic:	Linear with respect to temp, within ±1/2 percent of top range value.
7	Accessories:	Thermo well (as specified in sl. no.1.9) and shall be spring loaded for positive contacts With the well.
8	Standard:	DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

1.9 Thermo well

Thermo well (for all process temp. elements) shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3 1974).

1.10 Temperature Transmitter

Following types of 2-wire temperature transmitter (directly powered from 4-20 mA input cards of DDCMIS) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

(a) Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP 65.

(b) Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JBs. The specifications of the JBs shall be as specified elsewhere in the spec. CABLE with additional DIN-rails and IP 65 Protection Class. This temperature transmitter shall be the ones, which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

(c) Dual-input Temperature Transmitter with Indicator

These shall be suitable for mounting on pipes/support. These shall be provided for temperature measurement which are used for tripping/protection of auxiliaries e.g. for bearing temperature on which trip is envisaged. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change over is to be alarmed. Protection class shall be IP 65 minimum.

Common requirements for each of the above type of temperature transmitters:

(i) Output : 2-wire (power supply from input card of Control System) with 4-20 mA output with Superimposed HART protocol signal.
(ii) Input : Same transmitter shall be capable to handle Pt- 100 RTD, Thermocouples-K&R types (input type to be selectable at site through HART terminal).
(iii) Isolation : min. 500 V AC
(iv) EMC : as per EN 61326 compatibility
(v) Operating ambient : 0 to 85 deg C (without indicator) temperature 0 to 70 deg. C (with indicator)
(vi) Power supply : Compatible with input module of Control System
(vii) Accessories : Mounting arrangements including clamps etc.
(viii) Composite Accuracy:

(a) For head mounted and DIN-rail mounted

Accuracy (Refer types note 2)

RTD =<0.4% of 0-250 deg C. span

T/C-K type =<0.4% of 0-600 deg C. span

T/C-R type =<0.4% of 0-1000 deg C. Span

CJC accuracy (for thermocouples) shall be =<1 deg.

(b) For dual input type:

RTD =<0.25% of 0-250 deg C. Span

T/C-K type =<0.2% of 0-600 deg.C span

CJC accuracy (for thermocouples) shall be =< 1 deg. C.

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. transmitter shall provide low temperature output.

2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp. transmitter, for converting sensor input to output in 4-20 mA (e.g. basic accuracy, digital accuracy, D/A accuracy. etc.) and temperature effect on these accuracies at ambient temperature of 50 deg. C. based on the figure / formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/temperature effect figures in catalogue shall be first converted to deg. C, and then percentage of these converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

1.11 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, D.P., FLOW AND LEVEL ELECTRONIC TRANSMITTERS:

Sr. No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.
2.	Accuracy	± 0.1% of calibrated span (minimum)
3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal based on HART protocol
4.	Turn down ratio	10:1 for vacuum/very low pressure applications. 30:1 for other applications.

5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm².
		± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² (g).
6.	Zero and span drift	+/- 0.015% per deg.C at max span. +/-0.11% per deg.C at min. span.
7.	Load impedance	500 ohm (min.)
8.	Housing	Weather proof as per IP-55 with durable corrosion resistant Coating.
9.	Over Pressure	150% of max. Operating pressure
10.	Connection (Electrical)	Plug and socket type
11.	Process connection	1/2 inch NPT (F)
12.	Span and Zero	Continuous, tamper proof, Remote as well as adjustability Manual from instrument with zero suppression and elevation facility.
13.	Accessories	-Diaphragm seal, pulsation dampeners, siphon etc. as required by service and operating condition.
		-2 valve manifold for absolute pressure transmitters (3-valve manifold for gauge/ vacuum pressure transmitters) and 5 valve manifold for DP/level/flow transmitters.
		-For hazardous area, explosions proof enclosure as described in NEC article 500.
14.	Diagnostics	Self Indicating feature
15.	Power supply	24V DC ± 10%.
16.	Adjustment/calibration/	Centralized PC based system.

Notes :

In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold.

LVDT type is not acceptable.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

1.12 Ultrasonic Type Level Transmitter

Sl. No Features	Essential/Minimum requirements
1. Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter.
2. Output signal	Galvanically isolated 4-20mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3. Sensor Accuracy	+/- 0.5% of calibrated span.
4. Sensor Repeatability	3 mm or better.
5. Power supply	24 V DC +/- 10%
6. Temperature compensation	To be provided within transducer.
7. Configuration	Sensor unit and Electronic units are to be separate. It shall be possible to mount the Electronic unit at a remote accessible location from the transducer. All cables and weather proof fittings to interconnect transducer to electronic unit shall be provided.
8. Housing	Weather proof as per IP-55 with durable corrosion resistant epoxy coating.
9. Calibration	Through HART Communicator.
10. Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It shall be possible to calibrate the instrument without any level in the tank/sump etc
11. Sensor Material	Corrosion resistant material to suit individual application requirement.
12. False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry
13. Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc
14. Display	Minimum 4 character display with integral keypad, access protected by user code.
15. Diagnostics	Loss of echo alarm etc
16. Load Impedance	500 ohms minimum
17. Electrical Connection	Plug and socket
18. Accessories	• All weather canopy for protection from direct sunlight and direct rain. • All mounting hardware and accessories required for erection and commissioning mounting fittings material shall be SS 316. • For hazardous areas, explosion proof enclosure as described in NEC article 500.

1.13 Guided Wave Radar Type Level Transmitter

Type	Guided wave Radar
Principle	TDR (Time domain reflectometry)
Probe Type & Material	Coaxial, SS316/316L. If required probe shall be suitable for overfill Prevention.
Signal o/p	4-20mA with HART signal suitable for overfill prevention.
Display	Integral
Power supply	24 VDC
Accuracy	5mm
Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and Amdt A1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2
Mounting	External cage mounting

The transmitters shall be provided with IP-55 protection class with durable corrosion resistant coating.

The transmitters shall be able to provide digital signals super imposed on 4-20 mA signal as per HART protocol.

1.14 DEW POINT METER

Sensor

Type :	Capacitance type with change in output proportional to moisture present.
Service :	Dry Air
Range :	-50 to 0 Degree Centigrade Dew-Point
Sensor Accuracy :	Better than +/-0.5^
Operating Temperature:	0 to 50 degree C.
Operating Pressure :	0-10 Kg./Cm2, suitable for process application.

Analyser

Input :	Change in capacitance from dew point sensor.
Display :	Combined enclosure with two three-digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of atleast 10 meters.
Range :	-50 to 0 Degree Centigrade Dew-Point
Display Accuracy :	Better than =/-2 Degree C.
Mounting :	Table top/Flush mounting, to be finalised during detailed engineering.
Power supply :	240V AC, 50 Hz to be arranged by the supplier.
Output :	4-20 mA DC capable of driving a load impedance of 500 ohms min.

1.15 IMPACT HEAD TYPE FLOW ELEMENT

The impact head type element shall be tubular insert type with four impact ports facing upstream direction, located precisely for determination of average flow velocity and shall be of SS 316 L.
Accuracy shall be 1.0% of actual value or better.Repeatability shall be + 0.1% of actual value or better.
The elements shall be supplied complete with mounting hardware; end support plugs and CS valve manifold (1/2" NPT connection) for instrument connections. All pertinent data including Employer's instrument tag no. for the flow element shall be punched on a stainless steel plate and affixed to the element.
Flushing arrangement shall be provided.

1.16 FLOW ELEMENTS

ORIFICE PALTE

Features	Essential/Minimum Requirements
Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167
Material	316 SS
Thickness	3 mm for main pipe diameter up to 300 mm and6 mm for main pipe dia above300 mm.
Material of branch pipe	Same as main pipe
Root valve type	Globe
Root valve material	316 SS
Root valve size	1 / 2 inch or 1 inch (as applicable)
Impulse pipe of same material up to root valve	Required
Tappings	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings.
Beta Ratio	0.34 to 0.7
Beta Ratio calculation to be submitted	Yes
Assembly drg. and flow Vs DP Curves	Yes
Accessories	Root valves, flanges, Vent/drain hole(As required)

Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations.

1.17 ROTAMETERS

Sr. No.	Features	Essential / minimum requirements
1.	Type	Variable Area Metal Tube
2.	Fluid media	Water/oil
3.	Tube body	SS316
4.	Material of float	316 SS
5.	Indicator	Linear scale
6.	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 100 mm)
7.	Housing protection class	IP-55
8.	Accuracy	± 2% of measured value.

1.18 SOLENOID VALVES

1.	Type	Single/Double coil type, corrosion resistant type
2.	Body	SS316
3.	Internals	SS316
4.	Spring	SS316
5.	Size	½inch
6.	Class of insulation	H
7.	Electrical connection	24 V DC from BOP-DCS
8.	Connectivity	Connectivity with BOP-DCS required for operation
9.	Protection Class	IP-65

1.19 ELECTRONIC FLOW METER

The electronic flow meter shall include flow sensor and flow indicator cum integrator / totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore ultrasonic / electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner. The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feedback on satisfactory performance of the instruments. The flow meter shall meet or exceed the following requirement:

(a)	Output	:	4-20 mA DC Isolated output
(b)	Accuracy	:	± 0.5% of calibrated span or better *
(c)	Repeatability	:	± 0.2% of calibrated span or better
(d)	Ambient Temp. &	:	4 deg.C to 55 deg.C.
	Humidity		5% to 100% RH
(e)	Power Supply	:	240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arrangec by the contractor.
(f)	Protection class	:	IP-55
(g)	Flow tube		SS304
(h)	liner		Hard Rubber

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser / integrator to get the daily and monthly discharge as stated above.

1.20 LIMIT SWITCH

For offsite plant application, Limit switches shall be gold plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.

MASS FLOW METER

Sensor

01.	Measuring Principle	:	Coriolis Mass flow.
02.	Primary Element	:	Flow Tube of 316SS or better
03.	Heating Arrangement	:	Integral with Flow Element.
04.	Temperature Control For Heating	:	To be provided for heavy fuel oil application.
05.	Process Connection	:	Flanged and rating as per process requirement.
06.	Drain	:	Self-draining facility
07.	Enclosure	:	Stainless steel
08.	Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets, prefab cable etc.

Transmitter

01.	Measured quantities	:	Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
02.	Input Signal Processing	:	Digital Processing.
03.	Display	:	Digital Display (LCD).
04.	Output	:	2 Nos. isolated output of 4-20mA DC & HART selectable from four measured quantities.
05.	Load	:	< 750 ohms.
06.	Power supply	:	240V AC ±10%, 50 Hz.
07.	Turn Down	:	100:1
08.	Accuracy	:	± 0.2% of measured value
09.	Housing	:	Epoxy coated Die cast aluminium. IP-65 (Explosion proof for NEC Class-1, DIVISION-1 area) with ½" NPT (F) cable entry.
10.	Hazardous duty Version	:	FM Standards.

13.0 DENSITY HYDROMETER

Hydrometer should be made of glass graduated in units of Density Conforming to ASTM-Specification E-100 and calibrated at 15°C. Suitable for determination of density of hydrocarbons:-

Sl. No.	Range	Subdivisions	Quantity
1.	0.60 to 1.00	0.001	2 Nos.
2.	1.00 to 1.10	0.001	2 Nos.
3.	1.10 to 1.20	0.001	2 Nos.
4.	1.40 to 1.50	0.001	2 Nos.

14.0 DEPOSITION & CORROSION METER

Deposition & Corrosion Meter is meant for monitoring bio fouling, scaling and corrosion of cooling water systems. The test material should be SS 304, Cupronickle 90:10, Cupronickle 95:05 and brass.

14.1 Bio fouling monitor

1. Sample tube material – as mentioned above.
2. Water flow indicator – Rotameter
3. Flow control valve – manual / automatic control
4. Differential pressure guage – Diaphragm dial type range 0-250 mm W.C
5. Inlet and outlet water pressure tapping.
6. By pass line of SS / copper tube for differential pressure gauges.
7. Mounted on panel

14.2 Scaling Monitor

1. Sample tubes (3 no. each) – material as mentioned above

2. Outside jacket tube – Acrylic

3. Metal temperature sensor – 20-100°C; accuracy 1°C

4. Inlet and outlet water temperature sensor and digital indicator – 10-70°C; accuracy – 1°C

5. Water flow sensor digital indicator – 200 to 1000 litres accuracy 5%

6. Water flow indicator – Rotameter or digital indicator

7. Heater – 1000 to 1500 watts 220 ±10 V AC

8. Heat input controller – Selector switch.

9. Power input – 220±10 V AC

10. Heater protection relay – 50 to 100°C operating valve

11. Heater and water flow relay – Automatic on/off switch for heater with water flow stopper.

12. Display – Digital.

13. Water flow regulator – valve.

14. Complete with all fittings and fixtures for attachment of equipment.

14.3 Corrosion Test Racks

1. Corrosion test rack equipment – 12 no.

2. Corrosion test coupons size 13 mm×76 mm×1.6 mm as per ASTM-D-2688-92 – Mild steel, SS 304, Cupronickle 90:10, Cupronickle 95:05, Brass – 100 no. each

3. Complete with all fittings and fixtures for attachment of equipment

15.0 DEW POINT APPARATUS

This is for measuring the dew point of hydrogen gas in the generator casing. The instrument should be intrinsically safe from hazardous areas and should be able to measure dew point in the range of +20°C to –60°C. It should have auto calibration /

calibration check facility and should comply with ASTM D 2029. The working principle should be either (a) Automatic Chilled mirror (Peltier cooling) principle or (b) Capacitance method.

a) Automatic Chilled Mirror

Consisting of internal cooling, temperature sensing, photo-source and photo-detector systems for the determination of dew point by measuring the moisture on the mirror. It should be complete with necessary electronics to give digital display of the dew point temperature and ambient temperature in deg. C and moisture in % and ppm. It should avoid elaborate piping within the instrument so that the time taken for attaining equilibrium is minimized. Complete with necessary connections, valves and tubing, operation and maintenance manual. Should operate at 230 V, 50 Hz single phase AC supply.

b) **Capacitance method**

Capable of measuring various levels of moisture content in test gases using aluminium oxide or silicon oxide sensor - which change capacitance in proportion to the amount of moisture absorbed. Isolation package housing the sensor should allow for the introduction of the test gases maintaining the test gas integrity. Should have the necessary microprocessor capable of computation and digital display of the dew point and ambient temperature in deg. C and moisture in ppm and percentage. Battery operated, complete with necessary connections and tubing accompanied by operation and service manual.

16.0 ELECTRONIC ANALYTICAL BALANCE

This should be a top loading electronic analytical balance having auto calibration facility with built in weights. It should have tare facility and automatic draught shield. Stabilisation time should not be more than 15 seconds and pan size should not be less than 80mm.

			I	II
i)	Range/capacity	:	220 gm	220 gm
ii)	Readability	:	0.1 mg	0.01 mg

Complete with all accessories and O&M Manual, it should be suitable for use at 220 V, 50 Hz single phase AC supply.

6.01.00 **CONDUCTIVITY ANALYZER**

A. Sensor

1.	Type of Cell	:	Flow thru'
2.	Conductivity Range	:	As per process
3.	Cell Constant	:	0.01 / 0.1 / 1.0 depeding upon range
4.	Temp. Compensation	:	Manual and Automatic (Integral) 0-100°C
5.	Process Connection	:	Screwed
6.	Wetted Parts	:	Electrodes-SS 316L/ Insulators KYNAR/ Viton
7.	Pressure Rating	:	10 kg/cm^2
8.	Accessories	:	Vessel (SS 316) with ½" NPT connection
9.	Cable	:	Upto transmitter in flexible conduct

B. Transmitter

1.	Type	:	Microprocessor based, Single stream
2.	Mounting	:	2" pipe
3.	Protection Class	:	IP-65 or better
4.	Output	:	4-20 mA DC (isolated)
5.	Display	:	Digital Display in Engineering Unit, Alarm Status.
6.	Zero/Span Adjustment	:	Front Panel Membrane type Keyboard

7.	Temp. Compensation	:	Automatic
8.	Diagnostic	:	Self diagnostic for electronics, electrode etc
9.	Alarm	:	Dual set point, hysterisis and time delay adjustable
10.	Enclosure	:	Die cast aluminum, epoxy coated
11.	Cable Termination	:	Internal (cable entry through conduit)
12.	Accuracy	:	± 1.0 % of measured range
13.	Response time	:	Less than 5 sec
14.	Stability	:	± 1.0 % of output range / month non-cumulative
15.	Accessories	:	a.2" pipe mounting bracket, Sensor cable with flexible conduit (as required), ½" NPT Cable Gland, SS Tag plate, For cation conductivity- Dual Ion-Exchange column, resin, etc. (minimum 12 months' requirements). b.Retractable type conductivity sensor along with flow chamber and other accessories shall be provided for vacuum application. Transmitter (local) along with 4-20 Ma output to SWAS room & DDCMIS shall also be provided.

6.02.00 **pH ANANYER**

A. Sensor

1.	Type of Cell	:	Flow thru'
2.	Range	:	0-14 pH
3.	Type of measurement	:	Combination electrode
4.	Temp. Compensation	:	Manual and Automatic (Integral) 0-100°C
5.	Process Connection	:	Screwed

6.	Measuring Electrode	:	Glass, high independence, thin electrode in one housing
7.	Pressure Rating	:	10 kg/cm^2
8.	Accessories	:	Vessel (SS 316) with ½" NPT connection
9.	Cable	:	Upto transmitter in flexible conduct
10.	Preamplifier	:	Integral or separate
11.	Liquid Junction	:	Ceramic / Kyner or equivalent
B.	**Transmitter**		
1.	Type	:	Microprocessor based, Single stream
2.	Mounting	:	2" pipe
3.	Protection Class	:	IP-65 or better
4.	Output	:	4-20 mA DC (isolated)
5.	Display	:	Digital Display in Engineering Unit, Alarm Status.
6.	Accuracy	:	± 0.2% of FSD or better
7.	Response time	:	Less than 5 sec
8.	Stability	:	± 0.001 pH /week
9.	Repeatability	:	± 1% or better
10.	Temp. Compensation	:	Automatic (Pt-100 sensor)
11.	Diagnostic	:	Self diagnostic for **"**Calibration requried**"/ "**Calibration O.K.**"**, electrode checking etc.
12.	Alarm	:	Dual set point, hysterisis and time delay adjustable
13.	Enclosure	:	Die cast aluminum, epoxy coated
14.	Cable Termination	:	Internal (cable entry through conduit)
15.	Accessories	:	2" pipe mounting bracket, Sensor cable

				with flexible conduit (as required), ½" NPT Cable Gland, SS Tag plate, , Ultrasonic Electrode Cleaner, Buffer solution tablets

6.03.00 **SILICA ANALYZER**

1.	Type	:	Colorimetric monitor, gravity / pumped feed Microprocessor based
2.	No. of Streams	:	Multi-stream with atleast one stream as spare
3.	Output	:	4-20 mA DC (isolated) into 600 ohms
4.	Readout	:	Digital Indicating meter for direct readout
5.	Accuracy	:	± 1% of F.S.D or better
6.	Reproducibility	:	± 2% of F.S.D. or better
7.	Calibration	:	Manual & automatic
8.	Cycle time	:	Less than 10 min or better
9.	Operating temperature	:	0-50 ^{O} C
10.	Temperature Compensation	:	(Pt-100 Sensor)
11.	Mounting	:	2" pipe
12.	Life of light source	:	10,000 hours (approx.)
13.	Alarm Facility	:	2 HI & 2 LO independently adj. over span.
14.	Enclosure Protection	:	IP-65
15.	Accessories	:	Reagent cabinet , Sample strainer, Reagent Reservoir etc., Phenolic name plate, Reagents & consumables, Special cables.

6.04.00 **SODIUM ANALYZER ASSEMBLY**

1.	Type of Cell	:	Flow Through ion-selection electrode
2.	Flow Chamber	:	Plexi Glass Body or equivalent

	3.	Measuring Electrode	:	Sodium Selective Glass Electrode
	4.	Output	:	4-20 mA DC (isolated) into 600 ohms
	5.	Temp. Compensation	:	Automatic upto 45 deg.C
	6.	Read Out	:	Digital Indicating meter
	7.	Accuracy	:	< 5% of reading
	8.	Response Time	:	2 minutes or better
	9.	Mounting	:	Flush Panel
	10.	Calibration	:	Automatic
	11.	Alarm Facility	:	2 HI and 2 LO independently adj. over span.
	12.	Enclosure Protection	:	IP-65 or better
	13.	Accessories	:	Phenolic tag plate, Sample filter, Pressure regulator & flow meter, Automatic calibration kit, Reagents and consumables, Special cables, ½" NPT cable gland.

6.05.00 **HYDRAZINE ANALYZER**

	1.	Type	:	Electrochemical
	2.	Output	:	4-20 mA DC linear
	3.	Readout	:	Digital Indicating Meter, linear read-out
	4.	Accuracy	:	± 2% of FSD or better
	5.	Reproducibility	:	2% of FSD or better
	6.	Drift	:	2 ppb/month or better
	7.	Temp. Compensation	:	Automatic up to 45 ^{O} C
	8.	Response Time	:	1 minutes or better
	9.	Mounting	:	Flush Panel
	10.	Alarm Facility	:	2 HI and 2 LO independently adj. over span

	11.	Preferred Feature	:	2 Hi and LO alarm LED visible from front , Power supply on/failure LED
	12.	Enclosure Protection	:	IP-65/ NEMA 4 or better
	13.	Accessories	:	Sample Conditioning kit, Phenolic nameplate, Special cable upto transmitter with flexible conduit Chemical reagents for 12 months, . ½" NPT Cable Glands

6.06.00 **DISSOLVED OXYGEN ANALYZER**

	1.	T y p e	:	Electro-chemical, Microprocessor based.
	2.	Range	:	As per process.
	3.	Type of Cell	:	Flow through sampling type (continuous)
	4.	Enclosure	:	IP-65 or better
	5.	Output	:	4-20 mA DC isolated to a load of 600 Ohms (minimum)
	6.	Temp.Compensation	:	Automatic up to 45^{o}C
	7.	Readout	:	Digital Indicating meter
	8.	Accuracy	:	Better than ± 2% of full scale for Transmitter
	9.	Sensor Response Time	:	90% in 30 seconds or better
	10.	Mounting	:	Flush panel
	11.	Alarm Facility	:	2 HI & 2 LO independently adj. over span.
	12.	Preferred Feature	:	HI & LO Alarm LED visible from front, Power supply on/failure LED, In-built calibration facility.
	13.	Accessories	:	Phenolic nameplate, Special cable upto transmitter with flexible conduit, ½" NPT Cable Glands

6.07.00 **CHLORIDE ANALYZER**

	1.	T y p e	:	Electro-chemical, Microprocessor based.

2.	Type of cell	:	Chloride ion selective electrode
3.	Enclosure	:	IP-65 or better
4.	Output	:	4-20 mA DC isolated to a load of 600 Ohms (minimum)
5.	Temp.Compensation	:	Automatic with Pt 100
6.	Ambient temperature	:	45ºC
7.	Readout	:	Digital Indicating meter
8.	Accuracy	:	Better than ± 2%
9.	Reproducibility	:	<3%
10.	Detection limit	:	0.5 mg/ L or better
11.	Analysis time	:	5 minutes (max).
12.	Cycle time	:	Adjustable
13.	Calibration	:	Manual or automatic
14.	Mounting	:	Flush panel
15.	Alarm	:	1 HI, 1 LO & 1 system alarm
16.	Control accessories	:	Sample level detector, Reagent level detector, Calibration solution level detector, Automatic sample, rinse and drain valve, Pump for calibration solution, Pump for reagent solution.
17.	Accessories	:	Reagent solution tank, Calibration solution tank

6.08.00 **TURBIDITY ANALYZER**

1.	T y p e	:	Nephelometric (Light reflection principle)
2.	Range	:	0.001-100 NTU
3.	Body	:	Corrosion resistant polystyrene
4.	Enclosure	:	IP-65 or better

5.	Output	:	4-20 mA DC isolated to a load of 600 Ohms (minimum)
6.	Readout	:	LCD Display
7.	Accuracy	:	Better than ± 2% of full scale
8.	Repeatability	:	± 1% of reading or ±0.002 NTU (which ever is greater)
9.	Accessories	:	Phenolic nameplate, Special cable upto transmitter with flexible conduit, ½" NPT Cable Glands, 2" pipe mounting bracket, Calibration kit & standard solution etc.

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-421-145-I007 VOLUME II B SECTION D REV. NO. 00 DATE: 06.10.16 SHEET 1 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL*	* PROJECT	2X660MA BIFPCL, MAITREE BANGLADESH		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	☐ ON / OFF ☐ INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY		
	* OPENING / CLOSING TIME	☐		
	* WORKING PRESSURE	☐		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, DUST TIGHT, WEATHER PROOF, SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, IP:65		
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.**		
HANDWHEEL	* REQUIRED	■ YES ☐ NO		
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED		
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SEVEN TIMES THE RATED CURRENT as per IEC-60034-30		
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ■ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	■ BLUE (RAL 9003) ☐		
	PAINT TYPE **(## Refer Notes)**	☐ ENAMEL ■ EPOXY ☐		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		Starting current shall not exceed 7 times rated current as per IEC 60034 for IE-3 motors.
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-421-145-I007 VOLUME II B SECTION D REV. NO. 00 DATE: 06.10.16 SHEET 2 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ☐ FLAME PROOF
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ ----------
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED
INTEGRAL STARTER	INTEGRAL STARTER	■ REQUIRED ☐ NOT REQUIRED
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ☐ THYRISTORS
	TYPE	■ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)
	IF SMART	
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED
	OPEN / CLOSE PB	■ REQUIRED ☐ NOT REQUIRED
	STOP PB	■ REQUIRED ☐ NOT REQUIRED
	INDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED
	LOCAL REMOTE S/S	■REQUIRED ☐ NOT REQUIRED
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ NOT REQUIRED
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	■ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER
	QUANTITY	■ 2 NOs. ☐ 3 NOs.
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos
	CONTACT TYPE	2 NO + 2 NC
	RATING	5A 240V AC AND 0.5A 220V DC
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE
	ACCURACY	+3% OF SET VALUE
LIMIT SWITCH (Not Applicable	MFR & MODEL NO.	BIDDER TO SPECIFY
	OPEN : INT : CLOSE	■1 No ☐2 Nos. : 2 Nos. (ADJ.) : ■1 No. ☐2Nos.

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-421-145-I007 VOLUME II B SECTION D REV. NO. 00 DATE: 06.10.16 SHEET 3 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
for Smart Actuator) **($$ Refer Notes)**	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐ ……	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@☐ IP 68 @☐……	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	■ REQUIRED ☐ NOT REQUIRED☐ ■ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:----------	
	@ SPACE HEATER CABLE GLAND	SIZE:----------	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :----------	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST INTERNATIONAL STANDARD (INDIAN CODES ARE NOT ACCEPTABLE).
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -6% TO +4% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

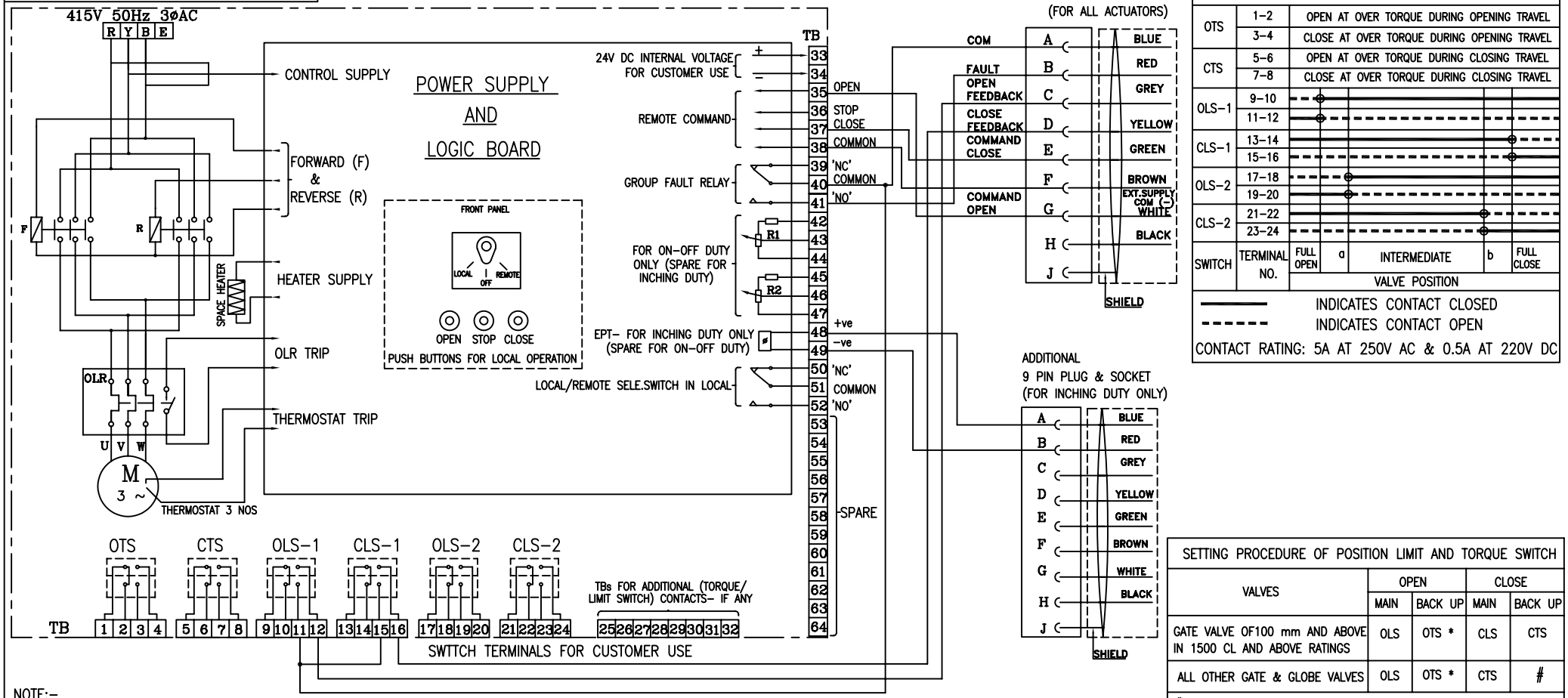
EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

.

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

DRAWING NO. 3-V-MISC-24283



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	

SWITCH TERMINAL NO. — FULL OPEN | a | INTERMEDIATE | b | FULL CLOSE — VALVE POSITION

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

– CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* – BYPASS OTS FOR INITIAL 5% OF TRAVEL(FOR GATE VALVES ONLY)

NOTE:–

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1–24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25–32
2. CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS–1, OLS–2 – LIMITSWITCHES FOR POSITION OPEN
5. CLS–1, CLS–2 – LIMITSWITCHES FOR POSITION CLOSE
6. EPT – ELECTRONIC POSITION TRAMSMITTER (CONTACTLESS TYPE, FOR INCHING DUTY)
7. R1–R2–POTENTIOMETER 2 x 100 OHMS (FOR ON–OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M – MOTOR 3ø 415V 50 Hz AC SUPPLY
10. TORQUE SWITCH BYPASS WITH LIMITSWITCH BOTH ON OPEN & CLOSE DIRECTION TO BE DONE INTERNALLY.

REV	DATE	ALTERED
		CHD & APPD

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS FOR NTPC PROJECTS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI–620014.
365–121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	17.03.05	–
CHD	D.DINAKARAN	D.D	17.03.05	
APPD	K.ARUNACHALAM	K.A	17.03.05	

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL	NTS	–		–
CODE	–			

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET FOR NTPC PROJECTS

CARD CODE: U 01

DRAWING NO.: 3–V–MISC–24283

REV: 0

Size A3

INSTRUMENTS CHECK LIST

Important notes for Quality assurance and checks shall be as follows:

1) The requirement indicated in the check list is minimal. Vendor has to submit Quality Plans/ Checklists for addressing the minimal requirement indicated in the check list and also those indicated under **clause B0.7** in the specification under **Section-IA**- customer's General Technical Specification – B0, as relevant to instruments. Vendor submitted quality plans shall be subject to customer approval during detail engineering without any commercial and time implication. For instruments for which checklist is not attached, vendor's Quality Plan for such items will also be subject to customer approval during detail engineering without any commercial and delivery implication.

2) The inspection agencies indicated in the Checklists in specification may be ignored. These will be aligned in line with approved Inspection categorisation plan during detail engineering without any commercial and delivery implication.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR FLOW SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	100%	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	RANGE						
	MODEL / TAG No.						
	END CONNECTION						
	DIMENSIONS						
	SIZE						
2	ACCURACY & REPEATABILITY (WET CALIBRATION)	100%		P	W	V	
3	HV / IR	100%		P	W	V	
4	CONTACT RATING / No. OF CONTACTS	RANDOM		P	W	V	
5	MATERIAL TC FOR BODY, WET PARTS, SENSING ELEMENT	ONE / LOT		P	W	V	
6	ACCESSORIES AS APPLICABLE	100%		P	W	V	
7	DEGREE OF PROTECTION	ONE / LOT		P	W	V	
8	OVER PRESSURE TEST	100%		P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out routine test for 100%
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR TEMPERATURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	100%	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL/TAG NO.						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS CHECK	100%		P	W	V	
3	ACCURACY	100%		P	W	V	
4	SWITCHING DIFFERENTIAL	100%		P	W	V	
5	CONTACT RATING / No. OF CONTACTS	RANDOM		P	W	V	
6	MATERIAL TC FOR BULB, CAPILLARY, ARMOUR	ONE / LOT		P	V	V	
7	HV / IR	RANDOM		P	W	V	
8	DEGREE OF PROTECTION	TYPE TEST		P	V	V	
9	THERMOWELLS						
	DIMENSIONS,PROCESS CONN	100%		P	W	V	
	MATERIAL TC	ONE / LOT		P	V	V	
	HYD TEST	100%		P	W	V	
	IBR CERTIFICATE, IF APPLICABLE			P	V	V	
10	REPEATABILITY	100%		P	V	V	
11	HYSTERISIS	100%		P	V	V	
12	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.
4. Manufacturer to carry out routine test for 100%

STANDARD CHECK LIST FOR C&I INSTRUMENTS (

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR FLOAT OPERATED LEVEL SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	MODEL NO/TAG NO						
	TYPE						
	END CONNECTION						
2	ON/OFF DIFFL			P	W	V	
3	REPEATABILITY			P	W	V	
4	IR TEST			P	W	V	
5	HV TEST			P	V	V	
6	PR. TEST ON CHAMBER	SEE NOTE-5		P	V	V	
7	MATL. TC FOR CHAMBER & FLOAT	FOR LOT	---	V	V	V	
8	CONTACT CONFIG. & RATING FOR MICROSWITCH	FOR LOT	---	V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST	---	V	V	V	
10	MANUFACTURER TO ENSURE WELDING PROCEDURE,WELDERS & NDT AS PER ASME FOR PR >40 KG/CM2		---	P	V	V	
11	CHECK FOR TEMP. SUITABILITY FOR MICROSWITCH AND LEAD WIRE	SEE NOTE-1 BELOW	---	V	V	V	
12	ACCESSORIES AS APPLICABLE		APPROVED SPEC./ DATA SHEETS	V	V	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. IBR certificates shall be provided wherever required.
6. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR ANALYTICAL INSTRUMENTS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	VISUAL						
	MAKE, MODEL No.						
	POWER SUPPLY						
	TYPE						
2	DIMENSIONS CHECK			P	V	V	
3	FUNCTIONAL CHECK			P	V	V	
4	LEAKAGE TEST			P	V	V	
5	HV / IR TEST			P	V	V	
6	LINEARITY			P	V	V	
7	RESPONSE TIME			P	V	V	
8	ENCLOSURE CLASS			P	V	V	
9	ACCESSORIES, AS APPLICABLE			P	V	V	
10	ACCURACY / CALIBRATION			P	V	V	
11	ALARM CONTACT TEST			P	V	V	
12	ANALOG OUTPUT CHECK			P	V	V	
13	BURN-IN TEST OF ELECTRONIC PARTS	1/LOT		P	V	V	
14	IN-BUILT INDICATOR, ZERO, SPAN, RANGE SCALE SELECTION ETC	SEE NOTE-1 BELOW		P	V	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR TEMPERATURE ELEMENT

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUTY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.
4. IBR certificate to be provided, if applicable

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR MAGNETIC TYPE FLOW METER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	MODEL						
	TAG No						
	VISUAL						
2	DIMENSIONS,			P	W	V	
3	PROCESS CONNECTION			P	W	V	
4	RANGE / SCALE			P	W	V	
5	ACCURACY			P	W	V	
6	MATERIAL TC FOR METERING TUBE, ORIFICE PLATE, FLANGES AND FASTNER			P	V	V	
7	CALIBRATION REPORT	ONE / SIZE		P	V	V	
8	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR SOLENOID VALVES

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUCTIONAL TEST			P	W	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR TEMPERATURE GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST			P	W	V	
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. IBR certificate to be provided if called for in specn.
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR SIGHT FLOW INDICATOR

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	MODEL						
	TAG No.						
	VISUAL						
2	DIMENSIONS,			P	W	V	
3	PROCESS CONNECTION			P	W	V	
4	RANGE / SCALE			P	W	V	
5	ACCURACY			P	W	V	
6	MATERIAL TC FOR METERING TUBE, ORIFICE PLATE, FLANGES AND FASTNER			P	V	V	
7	CALIBRATION REPORT	ONE / SIZE		P	V	V	
8	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

Microprocessor System Configuration & UPS Single line diagram

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR µP SYSTEM**	SPECIFICATION NO.:
		VOLUME II B
		SECTION D
		REV. NO. 02 / DATE: 19.07.2008
		SHEET 1 OF 1

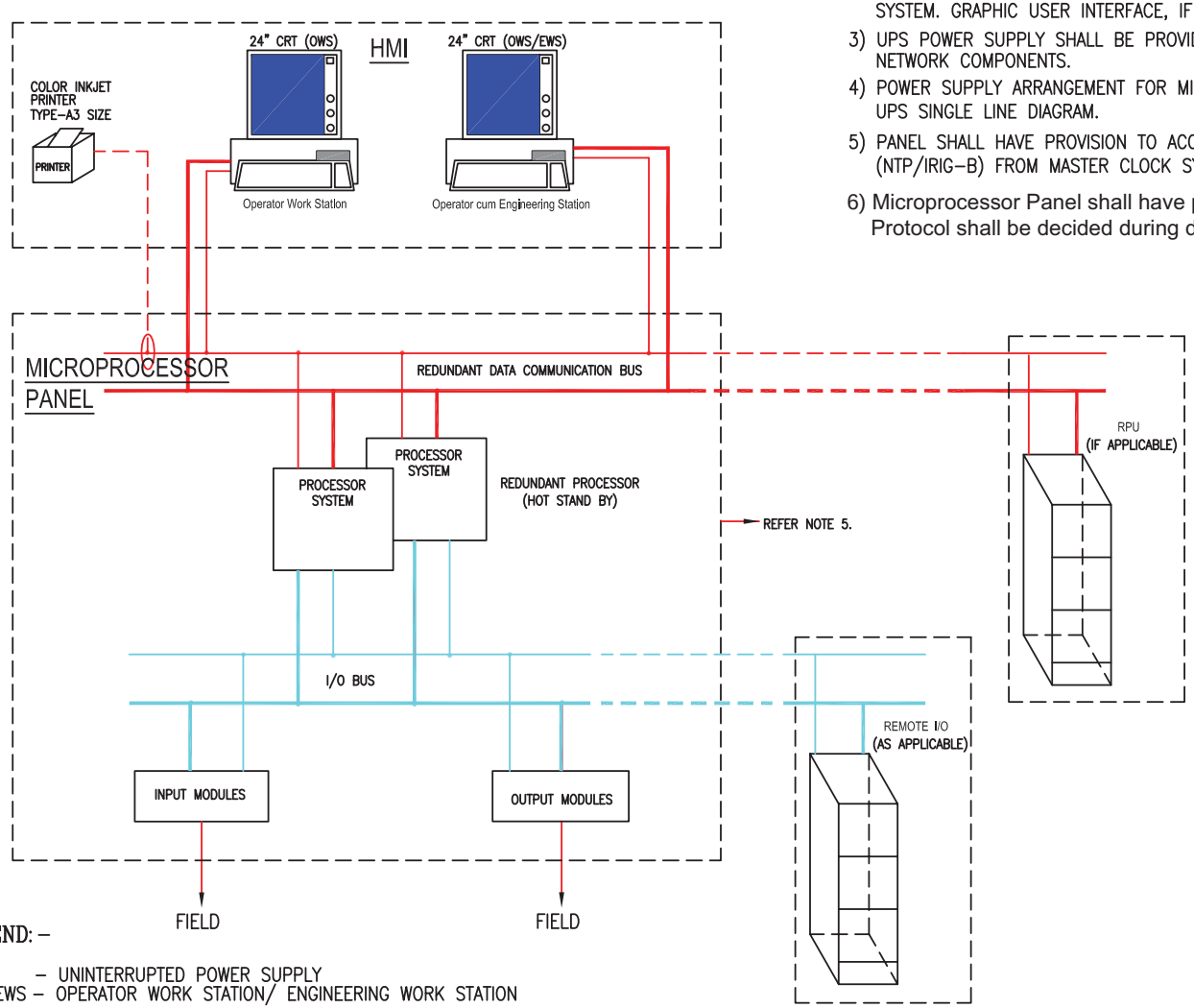
Data Sheet No.: **PES-145-36-DS1-0**

Data Sheet A & B

		DATA SHEET-A FOR µP SYSTEM (TO BE FILLED BY PURCHASER)	DATA SHEET – B (TO BE FILLED BY BIDDER)
GENERAL	PROJECT	2 X 660 MW MAITREE	
	SERVICE		
	QUANTITY	☐ UNITISED ■ COMMON	
	LOCATION	■ INDOOR ☐ OUTDOOR	
µP EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE	
	PROCESSOR	REDUNDANT WITH HOT STANDBY	
	DATA BUS (HMI)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (REMOTE I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	FIELD CONTACTS INTERROGATION VOLTAGE	■ 24 V ☐ 48 V	
	LOCATION OF COUPLING RELAYS	■ MCC ☐ PLC PANEL	
	GUI QUANTITY	☐ ONE ■ TWO ☐ _____	GUI , Alternatively called as OWS.
	GUI TYPE	☐ 19" ■ 24" TFT/CRT MONITOR	
	PRINTER (A4) - QUANTITY	INKJET _____ LASER B/W _____ COLOR INKJET _____ COLOR LASER _____	
	PRINTER (A4) - MODEL	■ DOT MATRIX (1 No.) _____ LASER B/W _____ ■ COLOR INKJET (1 No.) _____ COLOR LASER _____	
	PROGRAMMING / CONFIGURATION FACILITY	A) ☐ HAND HELD B) ENGINEERING SOFTWARE ■ ONE OWS ☐ ALL OWS ☐ _____	
	SAFETY STANDARD	_____	
	COMPUTER FURNITURE	■ YES ☐ NO	
PANEL	QUANTITY	BIDDER TO INDICATE	
	CLASS OF PROTECTION	☐ _____	
	REMOTE I/O PANEL	☐ YES ■ NO	
	COLOUR	AS PER IS-5 SHADE _____	
	BACK-UP DESK	☐ YES ☐ NO	
	MIMIC	■ YES ☐ NO	
	CONTROL HARDWARE	☐ PB ☐ INDICATORS ☐ FACIAS _____ Nos. ☐ OTHERS	
COMMUNICATION TO OTHER SYSTEM	HARDWIRED	☐ YES ☐ NO	
	PURPOSE	☐ CONTROL ■ MONITORING	
	MEDIUM	☐ UTP ■ FIBRE OPTIC ☐ OTHERS	
	TIME SYNCRONIZATION SIGNAL FORMAT	☐ PULSE ☐ RS-485 ■ IRIG-B	
	SOFTLINK	■ MODBUS ■ OPC	
	SERIAL LINK	COMMUNICATION PORT TYPE _____	
POWER SUPPLY INPUT FEEDER	µP PANEL	**a.** 24V DC **Charger** for electronics b. 240V AC **UPS** for HMI/PRINTERS	
	REMOTE I/O PANEL		

NOTES:

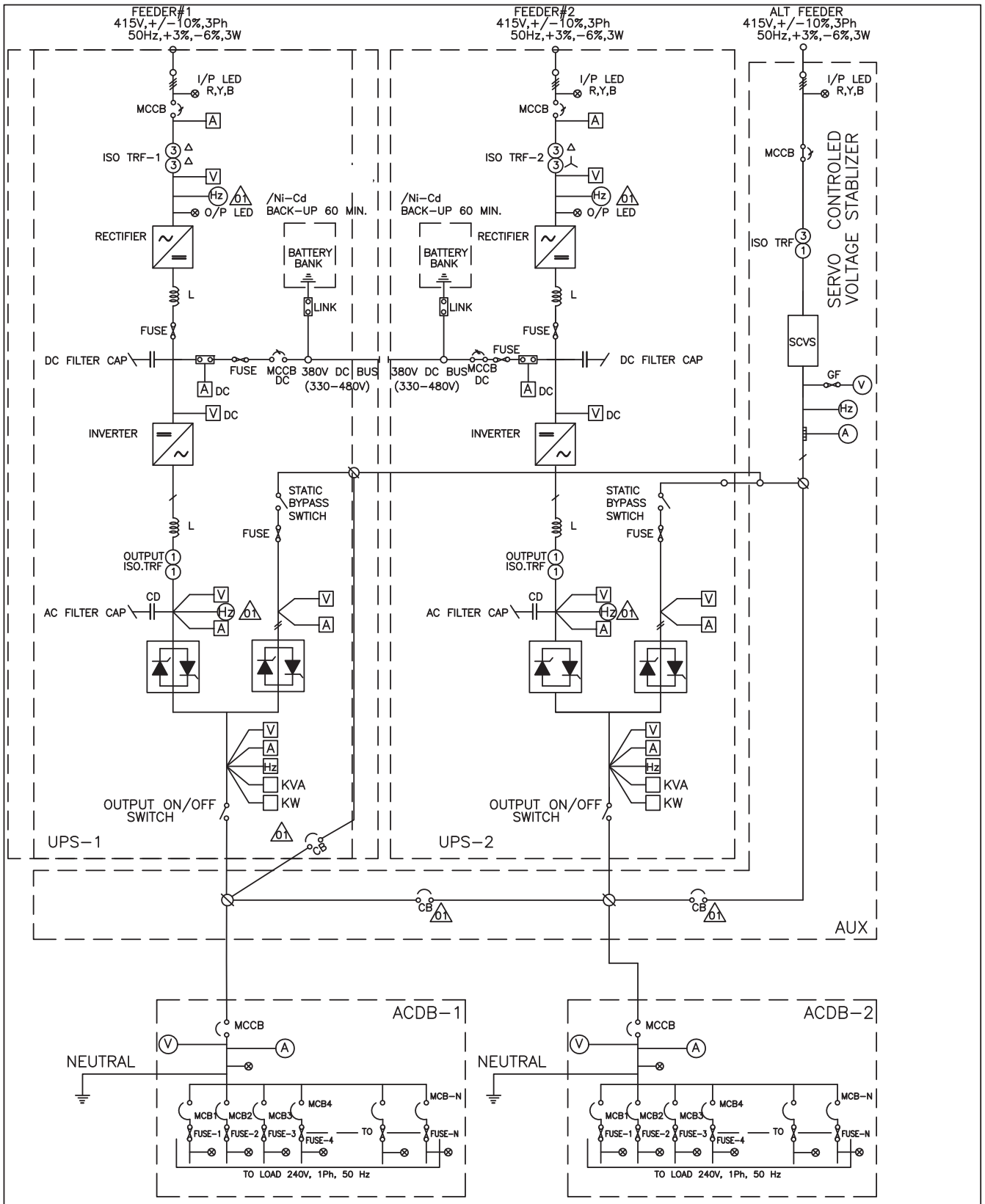
1) TABLE TOP OWS/EWS SHALL BE 24" OR AVAILABLE INDUSTRY STANDARD.
2) MICROPROCESSOR SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR AND COMMUNICATION SYSTEM. GRAPHIC USER INTERFACE, IF APPLICABLE, SHALL BE PANEL MOUNTED.
3) UPS POWER SUPPLY SHALL BE PROVIDED FOR MICROPROCESSOR PANEL(S), OWS/EWS AND NETWORK COMPONENTS.
4) POWER SUPPLY ARRANGEMENT FOR MICROPROCESSOR SYSTEM SHALL BE AS SHOWN ON UPS SINGLE LINE DIAGRAM.
5) PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (NTP/IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
6) Microprocessor Panel shall have provision for data exchange with Plant DCS. Protocol shall be decided during detail engineering.



LEGEND: –

UPS – UNINTERRUPTED POWER SUPPLY
OWS/EWS – OPERATOR WORK STATION/ ENGINEERING WORK STATION
HMI – HUMAN MACHINE INTERFACE
NTP – NETWORK TIME PROTOCOL
OPC – OLE PROCESS CONTROL
MCCB – MOULDED CASE CIRCUIT BREAKER
MCB – MINIATURE CIRCUIT BREAKER
RPU – REMOTE PROCESSING UNIT

MICROPROCESSOR SYSTEM CONFIGURATION



BHEL	2X660MW BIFPCL MAITREE KHULNA STPP	DRG. No.	MAITREE-01-CW-FS-123004-PEM-2	
	TITLE:− UPS SINGLE LINE DIAGRAM	REV. No.	2	DATE 06.09.2017
		SHEET	2 OF 3	

L1

	Technical specification for **2X660 MW MAITREE STPP, BANGLADESH**	REV. NO. 00 | DATE : 08.09.2017

APPLICABLE CABLE TYPES

Cable Sizes for 2X660MW STPP, BIFCL Maitree Project	
Sl no.	Cable Type
G-TYPE	
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
F-TYPE	
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
CONTROL CABLE	
1	3C X 2.5 sqmm

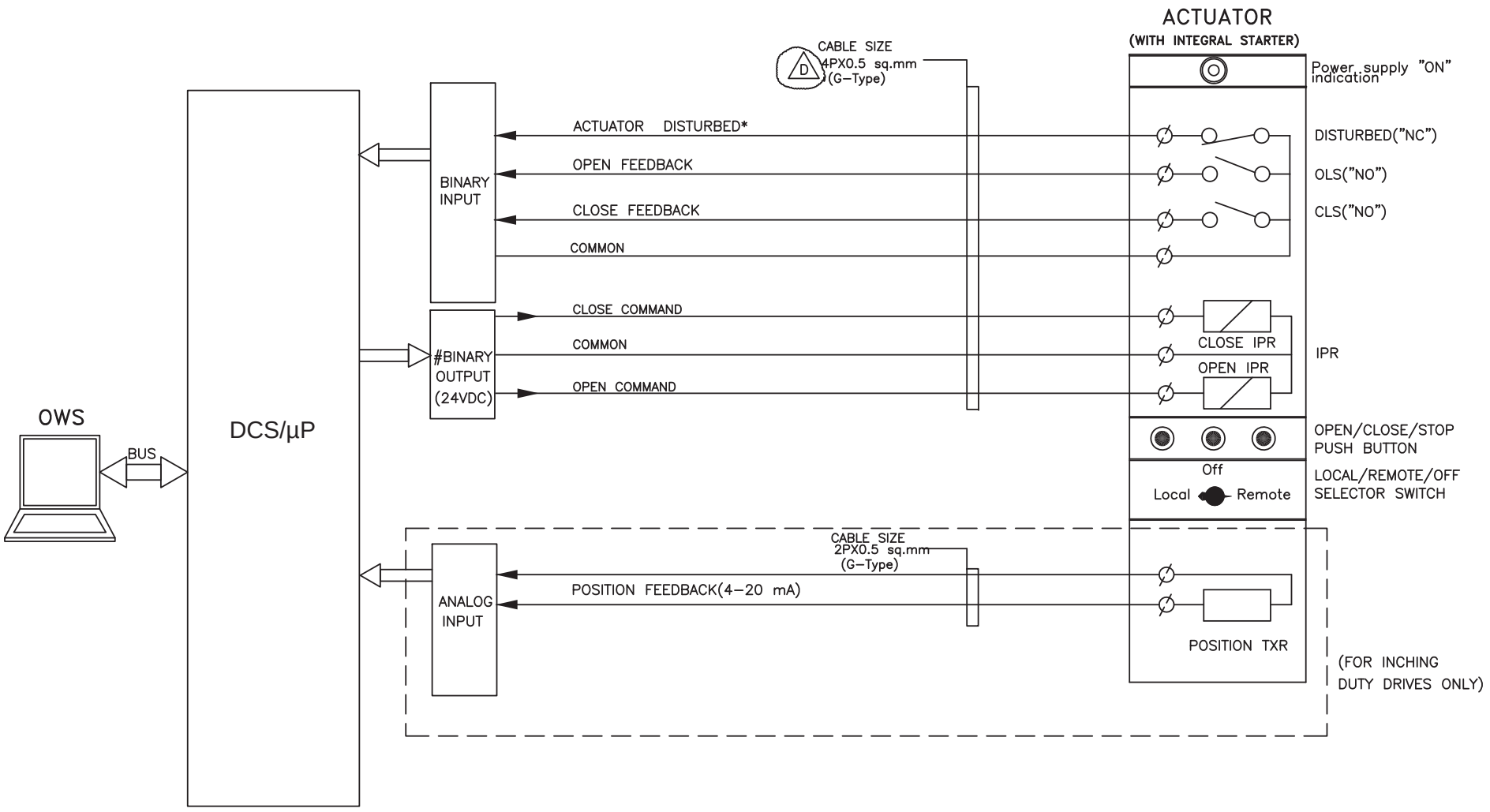
APPLICABLE CODES & STANDARDS
(Refer B0.6.2)

Please refer **clause no. B0.6.2** in the specification under **Section-IA**- customer's General Technical Specification – B0 for applicable codes and standard.

	Technical specification for **2X660 MW MAITREE STPP, BANGLADESH**	REV. NO. 00 | DATE : 08.09.2017

DRIVE CONTROL PHILOSOPHY

DCS/µP INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



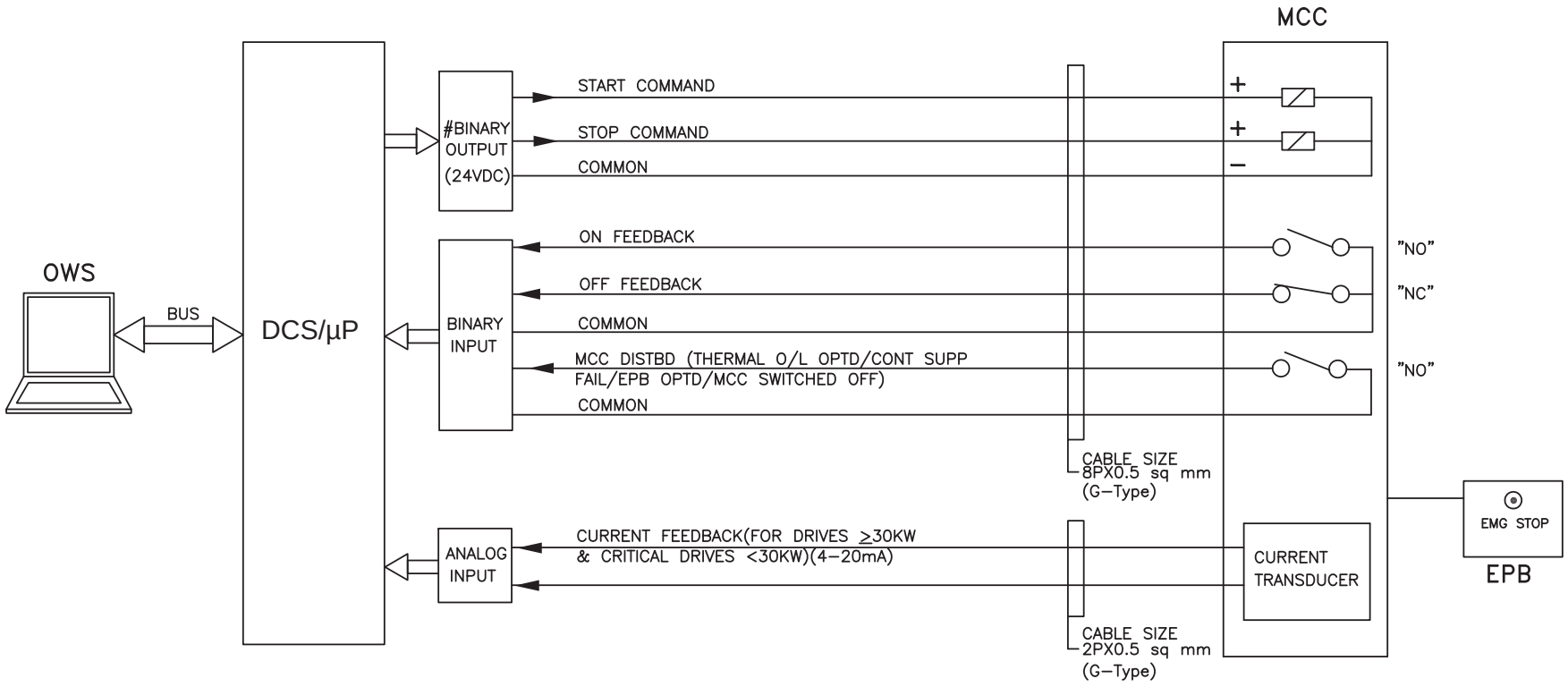
NOTE:

* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/ Loss of control supply/ Motor thermostat trip/ Thermal over load/ Local/Off/Remote Sel. switch in local or off mode/ Stop PB optd.

#BINARY= OUTPUT # Redundant output shall be provided C

BHEL	PROJECT: 2X660MW BIFPCL MAITREE	DRG.NO. Maitree–01–CD–FF–123002–PEM–D
	TITLE DCS/µP INTERFACE FOR BIDIRECTIONAL DRIVE	DATE 10.08.2017
		SHT 7 OF 11

DCS/µP INTERFACE FOR UNIDIRECTIONAL LT DRIVE

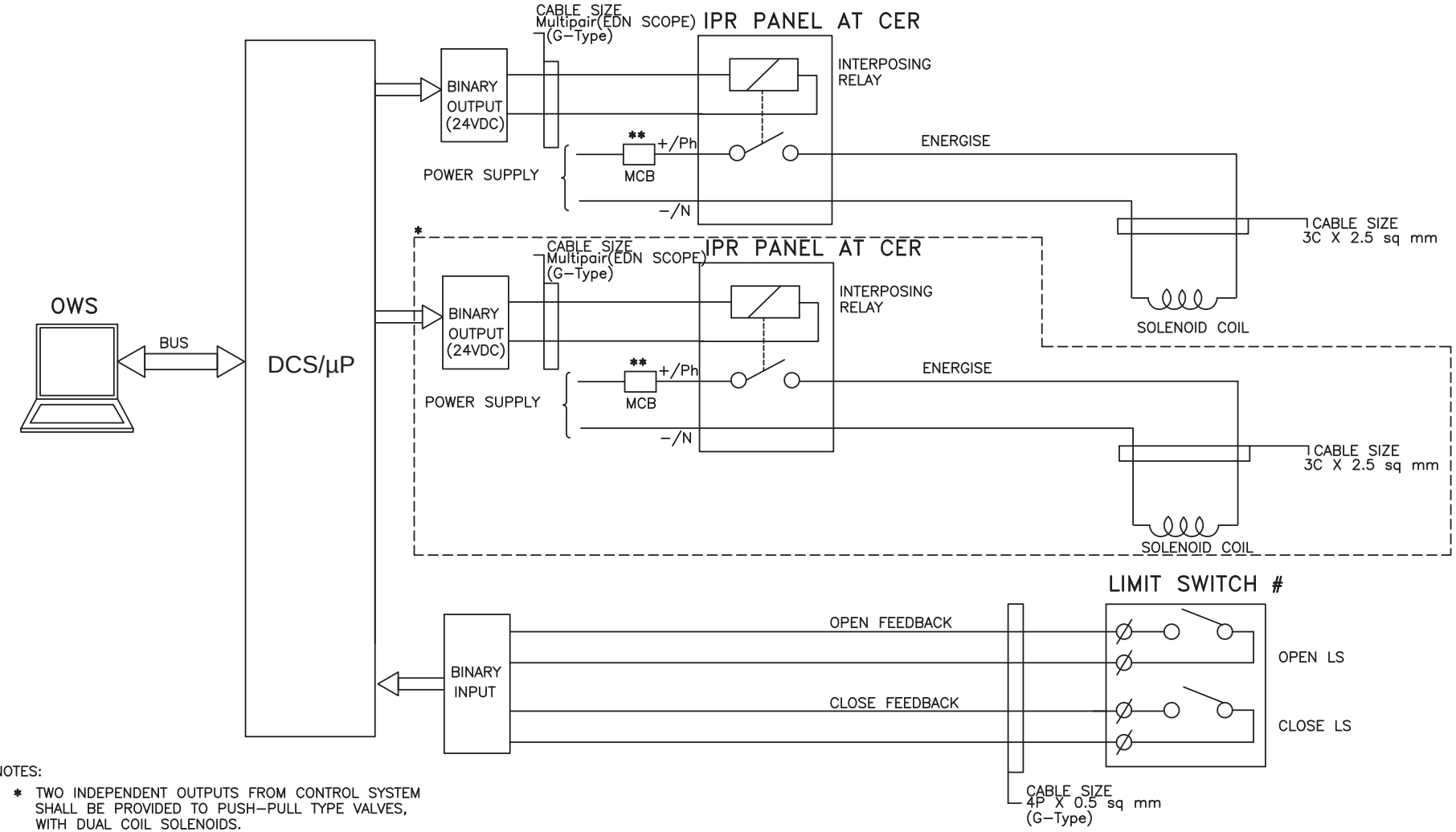


NOTE:

#BINARY= OUTPUT # Redundant output shall be provided (C)

BHEL	PROJECT: 2X660MW BIFPCL MAITREE	DRG.NO. Maitree-01-CD-FF-123002-PEM-D
	TITLE DCS/µP INTERFACE FOR UNIDIRECTIONAL LT DRIVE	DATE 10.08.2017
		SHT 8 OF 11

DCS/µP INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



NOTES:

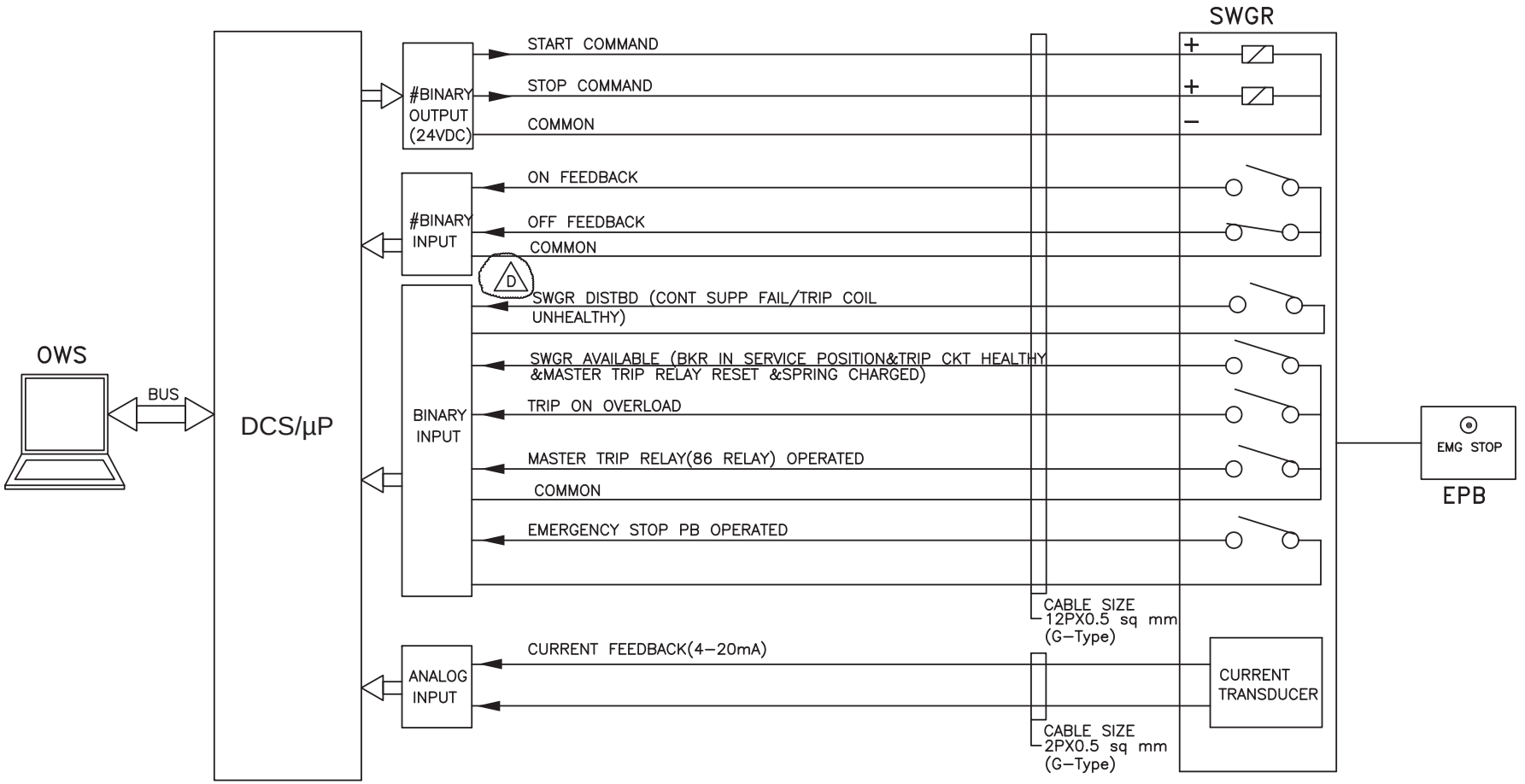
* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH–PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

\# FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

BHEL	PROJECT: 2X660MW BIFPCL MAITREE	DRG.NO. Maitree–01–CD–FF–123002–PEM–D
	TITLE: DCS/µP INTERFACE FOR SOLENOID DRIVE	DATE: 10.08.2017
		SHT 9 OF 11

DCS/µP INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)

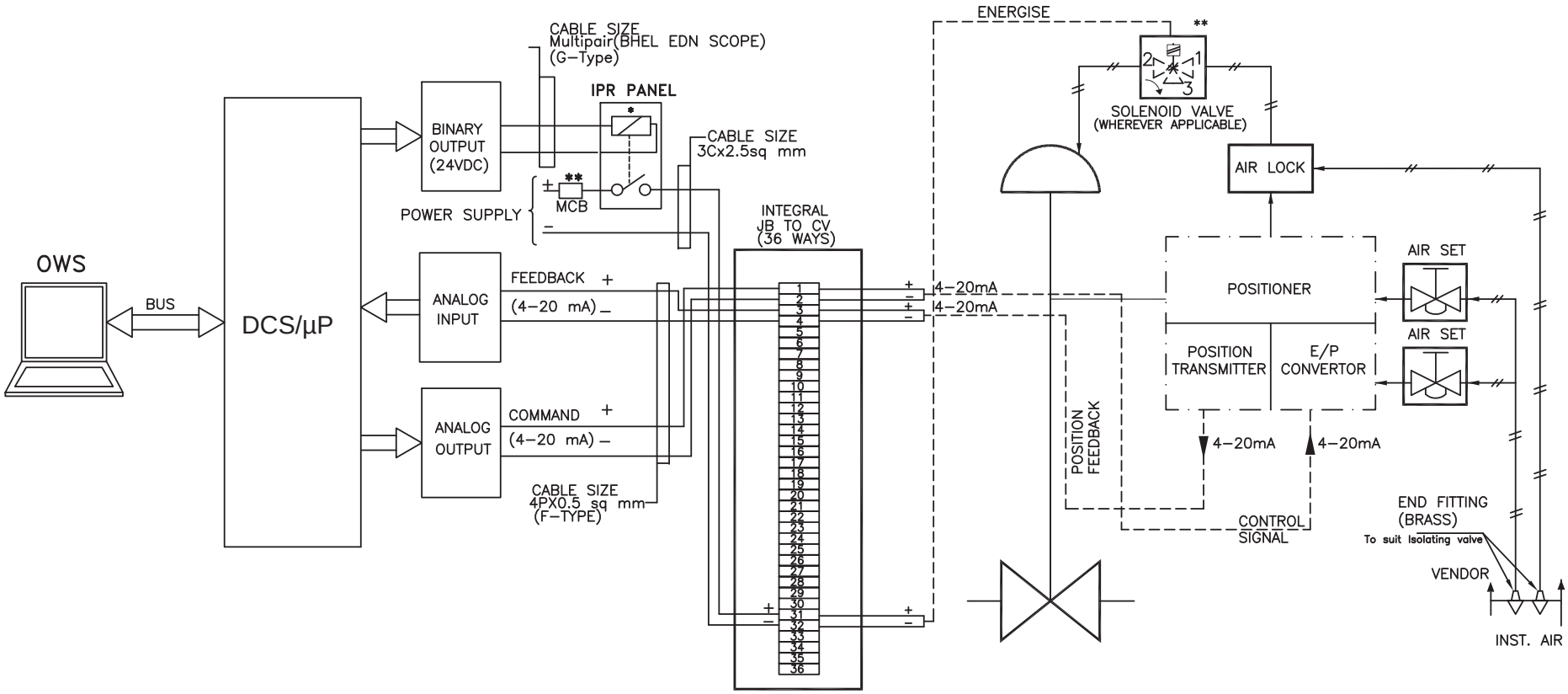


NOTE:

#BINARY= INPUT/OUTPUT (D) # Redundant input & output shall be provided

BHEL	PROJECT: 2X660MW BIFPCL MAITREE	DRG.NO. Maitree-01-CD-FF-123002-PEM-D
	TITLE DCS/µP INTERFACE FOR UNIDIRECTIONAL HT DRIVE	DATE 10.08.2017
		SHT 10 OF 11

DCS/µP INTERFACE FOR ANALOG DRIVE



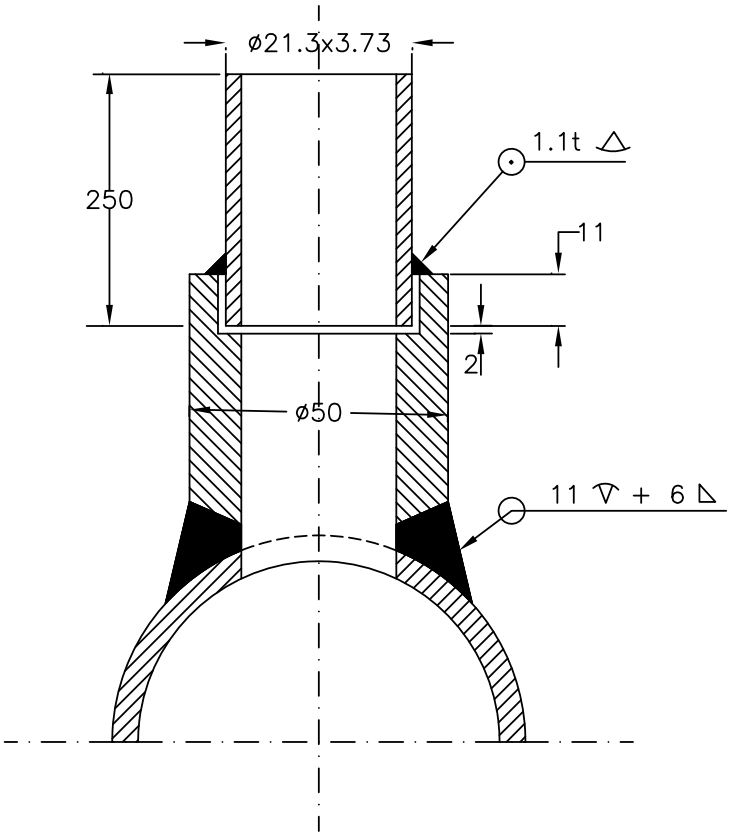
NOTES:

* APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

BHEL	PROJECT: 2X660MW BIFPCL MAITREE	DRG.NO. Maitree-01-CD-FF-123002-PEM-D
	TITLE: TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE	DATE: 10.08.2017
		SHT 11 OF 11

INSTRUMENT STUB DETAILS



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. FOR PU COATED PIPE REFER SHT NO–9.

TITLE :

INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

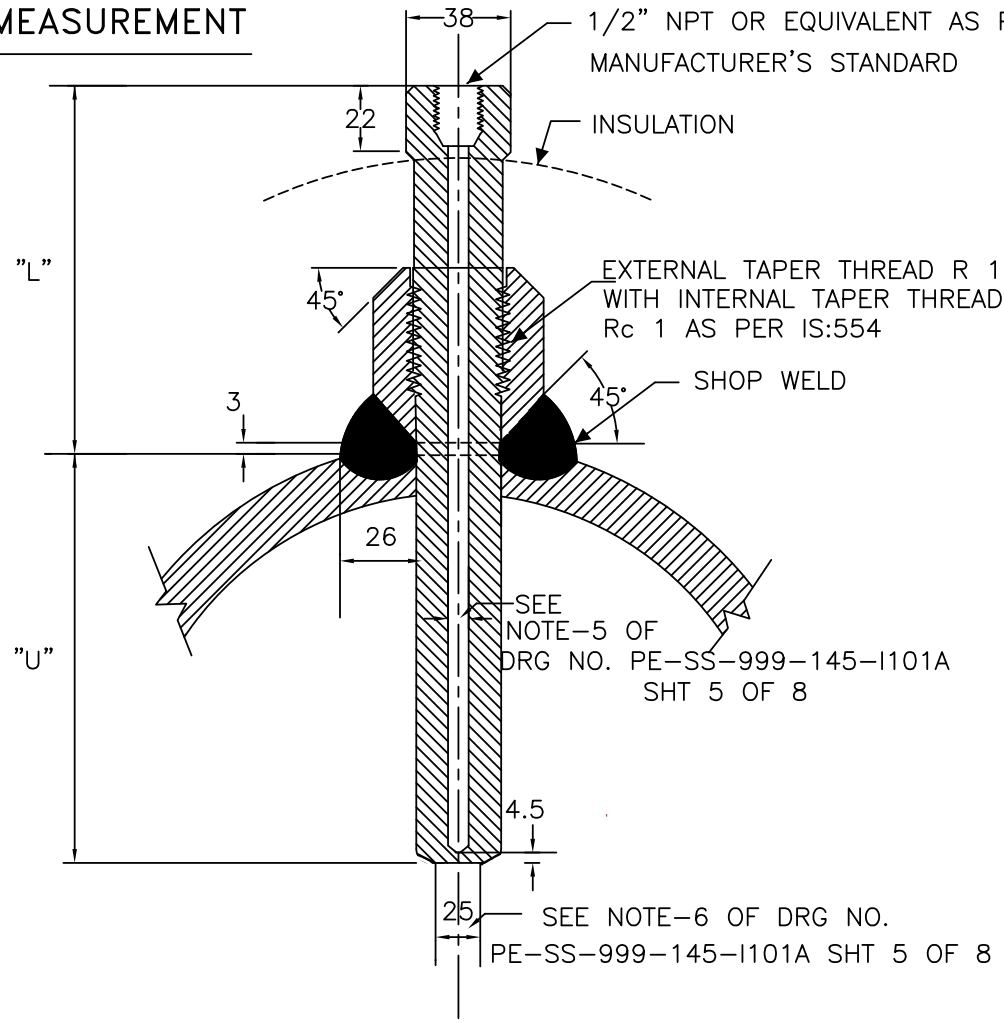
(SYSTEM PRESS UPTO 40Kg/Cm2, CLASS 3000#)

DRG. NO. PE–SS–999–145–I101A

REV. 00

SH. 04 OF 10 SHS.

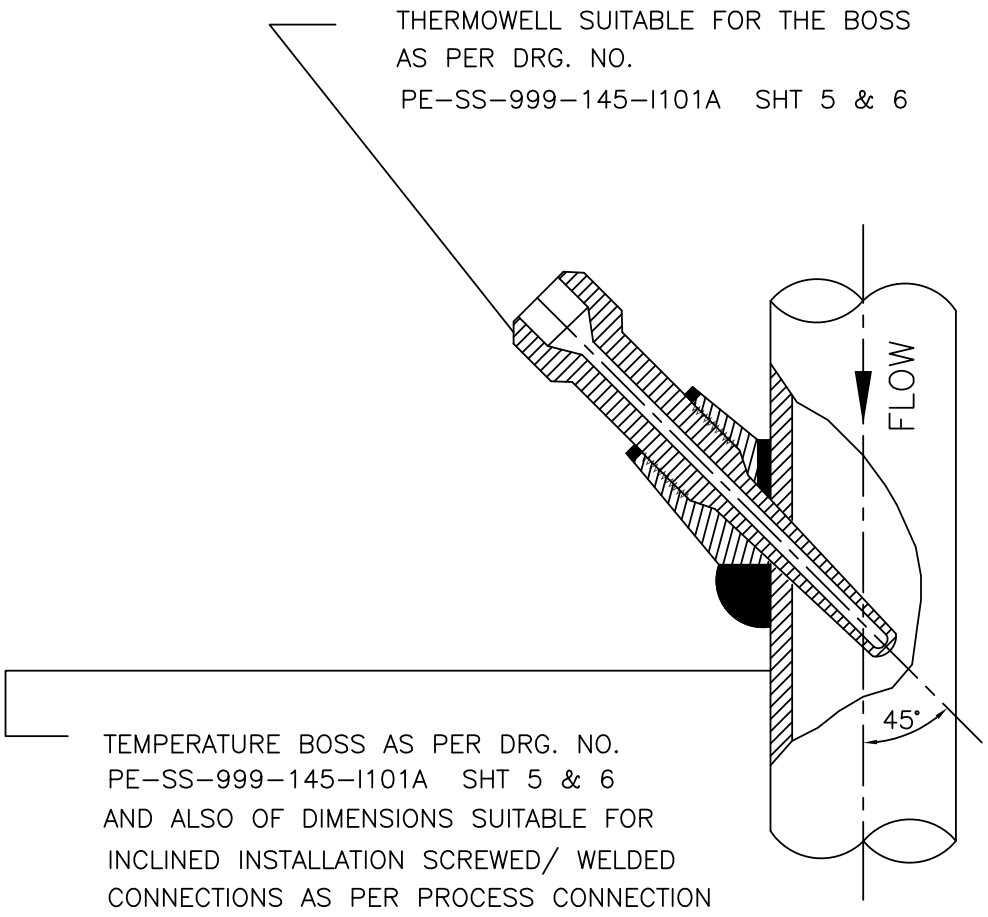
TEMP. MEASUREMENT



NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESS/ TEMP. BELOW 40 KG/CM2(g)/400°C.
2. FOR PRESS. TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. SEE NOTES-2 TO 9 IN SHT. 5 OF 8 OF THIS DRG.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. FOR PU COATED PIPING REFER SHEET NO-10 FOR TEMP STUB DETAILS.

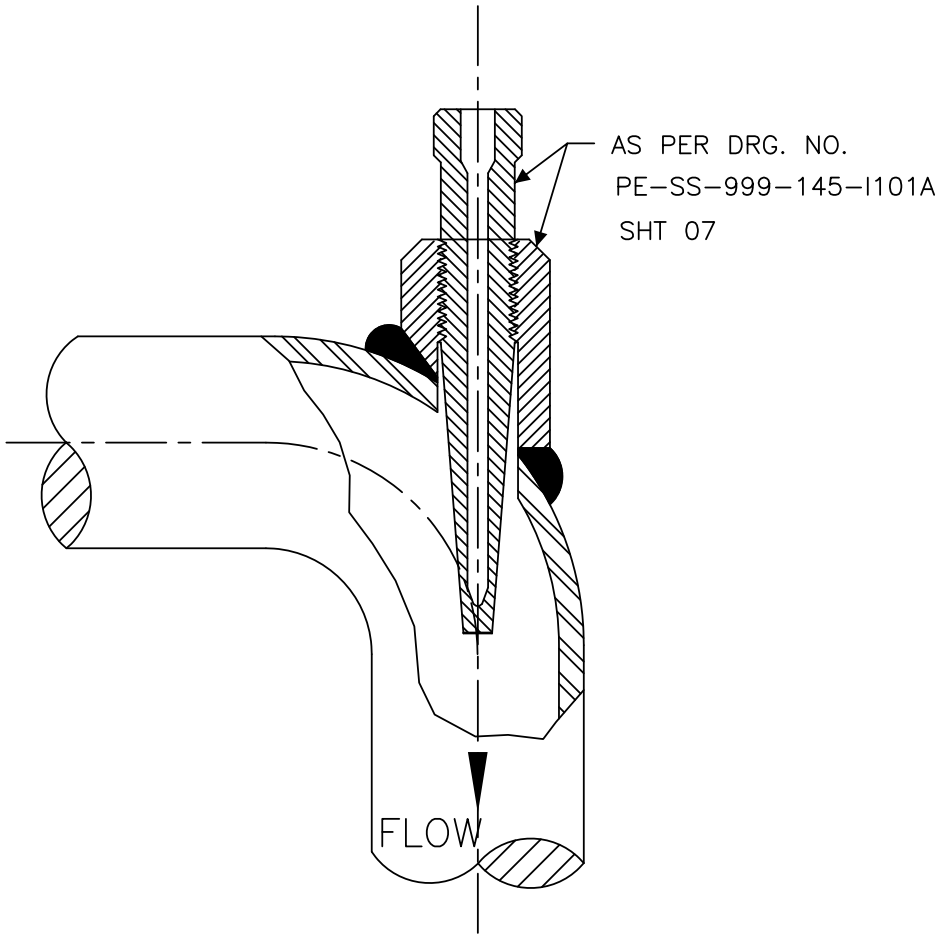
BHEL	TITLE : INST. STUB DETAILS (TEMP) (APPLICABLE FOR PIPE SIZE ABOVE 4") [PROCESS PRESS < 40 Kg/Cm2 (g),TEMP < 400 ℃] SH. 06 OF 10 SHS.	DRG. NO. PE-SS-999-145-I101A REV. 00



NOTES :–

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION TO BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (AT LEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDES OF THE INSTALLED THERMOWELL).

भेल BHEL	TITLE : THERMOWELL INSTALLATION	DRG. NO. PE–SS–999–145–I101A REV. 00 SH. 07 OF 10 SHS.



NOTES :-

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.

भेल BHEL	TITLE : THERMOWELL INSTALLATION	DRG. NO. PE-SS-999-145-I101A REV. 00 SH. 08 OF 10 SHS.

	Technical specification for **2X660 MW MAITREE STPP, BANGLADESH**	REV. NO. 00 | DATE : 08.09.2017

INSTRUMENT INSTALLATION DIAGRAM

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INSTALLATION NOTES

01. HORIZONTAL PIPE RUNS SHALL HAVE A SLOPE OF 50 MM'S IN ONE METER

02. LEGEND/ABBREVATIONS USED IN THE INSTALLATION SCHEMES.

- A/R : AS REQUIRED
- PT : PRESSURE TRANSMITTER
- DPT : DIFFERENTIAL PRESSURE TRANSMITTER (FT or LT or DPT type).
- DFDC : DOUBLE FERRULE DOUBLE COMPRESSION
- INST : INSTRUMENT

03. DRAIN PIPE INSIDE LIE / LIR SHALL BE OF A106 Gr. C– 2" NB Sch. 80 ALONGWITH WITH SUITABLE ADAPTER / ELBOW ON ONE SIDE & CAP ON OTHER SIDE.

04. DRAIN FROM LIE / LIR SHALL BE CONNECTED TO NEAREST PLANT DRAIN THROUGH OPEN FUNNEL (1/2" SIZE).

THIS IS THE PART OF TECHNICAL SPECIFICATION NO. PE-TS-421-177-A001
TENDER NO PSER:SCT:KLN-C1984:19 (TCN-05) (TECH SPEC FOR SWM- REV-01)

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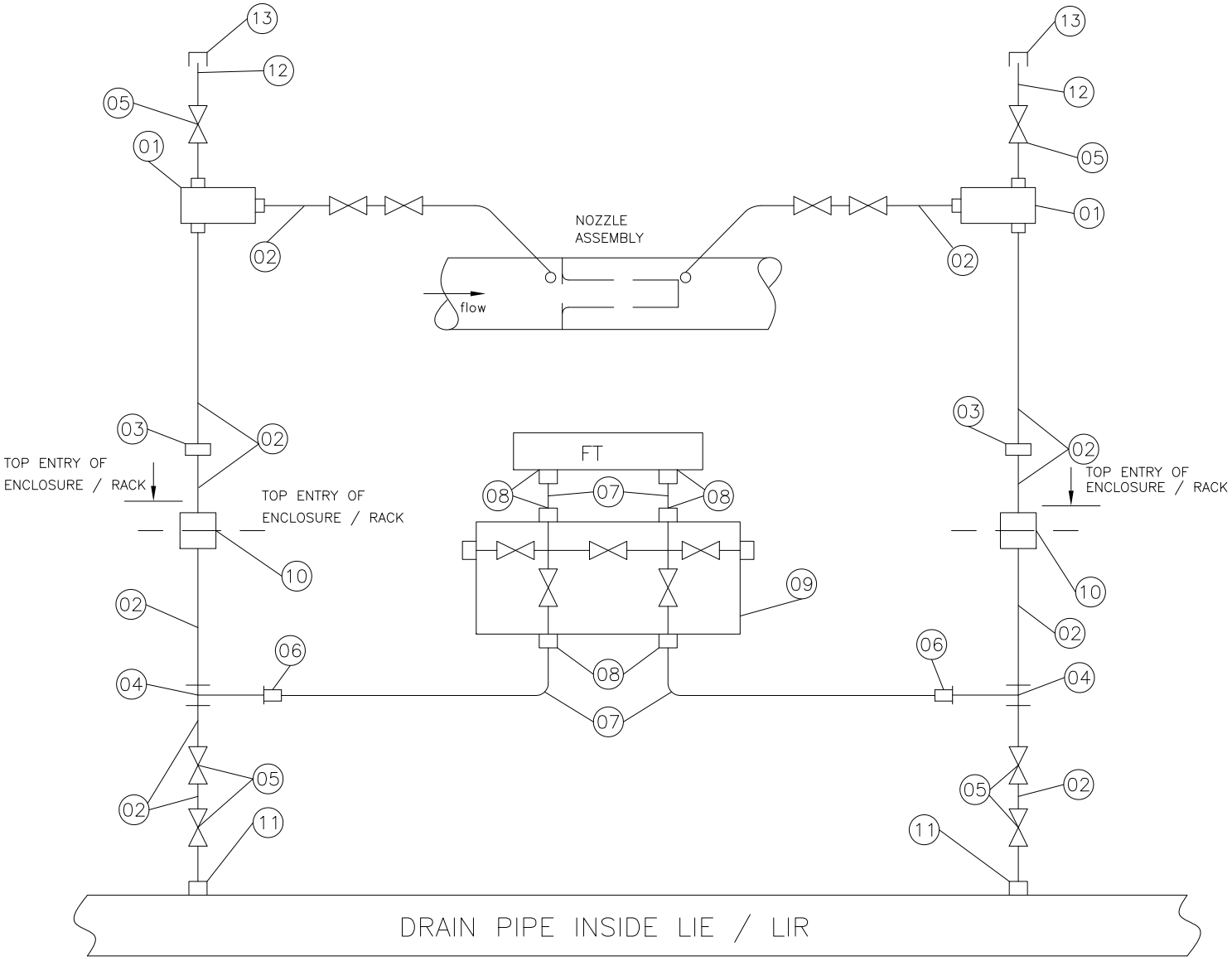

NOTE:

1. "TRANSMITTER BELOW SOURCE"
2. FOR BILL OF MATERIAL REFER PAGE 04

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PE-DG-421-145-I555

REV. NO. 00

PAGE : 03

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ITEM NO.	ITEM DESCRIPTION	QTY/INST.
13	CAP,MTL : A182 F22 , 1/2" NPTF	02
12	NIPPLE: ½" NB XXS / MATL. : A335 P22 CONN : ONE END PLAIN x OTHER END 1/2" NPTM	02
11	HALF COUPLING / ASTM 182 – F22 /AS PER ANSI B16.11 1/2" NB–SW CL 9000	02
10	BULK HEAD UNION / COUPLING MATL : ASTM A182 F22/AS PER ANSI 16.11 CL : 9000LBS / 1/2" NB–SW	02
09	FIVE VALVE MANIFOLD WITH VENT PLUG PORT SIZE : 1/2" NPTF / BODY : SS316 PR. TESTING : 9000PSI	01
08	TUBE FITTING : DFDC MATERIAL : SS316 SIZE : 1/2" NPTM x TO SUIT 1/2" OD SS TUBE	06
07	TUBE / MAT. : A 213 TP 316H SIZE : 1/2" OD x 2.1 mm THK.	A/R
06	TEE–TUBE UNION SIZE : OD OF 1/2" NB PIPE x TO SUIT TO 1/2" OD SS TUBE MATL. : SS316	02
05	FORGED GLOBE VALVE MTL. BODY : ASTM A182 F22 SIZE : 1/2" NB–SW / CL. 3000 SPL	06
04	FORGED TEE / AS PER ANSI B16.11 MATL : ASTM A182 F22 SIZE : 1/2" NB–SW / CL. 9000	02
03	FORGED COUPLING / AS PER ANSI B16.11 MATL : ASTM A182 F22 SIZE : 1/2" NB–SW / CL 9000	A/R
02	IMPULSE PIPE MATL : ASTM A335 P22 SIZE : 1/2" NB–SCH XXS	A/R
01	CONDENSATE POT/MATL : ASTM A182 F22 SIZE : ø 88.9 x 17.6 mm THK. CONNECTION : PROCESS – 15NB SW / INSTR. : 15NB–SW	02

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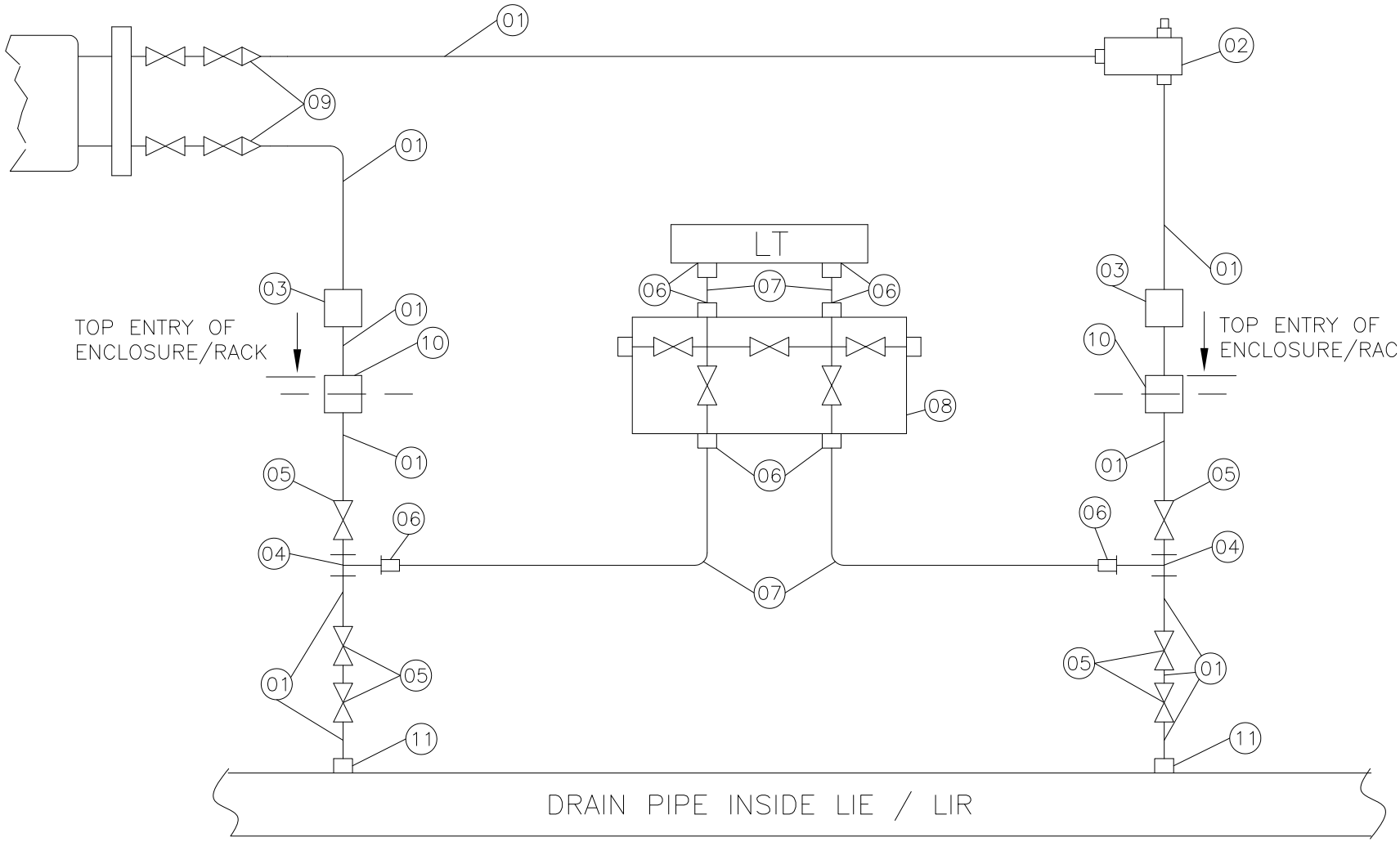

NOTE:

1. " TRANSMITTER BELOW SOURCE"
2. FOR BILL OF MATERIAL REFER PAGE 6
3. DRAIN PIPE / 2" NB SCH 80–A106 Gr. C.

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REV. NO. 00

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ITEM NO.	ITEM DESCRIPTION	QTY/INST.
01	SEAMLESS PIPE MATL. : ASTM A 106 Gr C SIZE : 1/2" NB–SCH 160	A/R
02	CONDENSATE POT MATL.: ASTM A105/ASTM A106 Gr C /SIZE: ø88.9mmx12mm THK. CONNECTION : PROCESS – 15NB SW / INSTR. : 15NB–SW	01
03	FORGED COUPLING / AS PER ANSI B16.11 MATL. : ASTM A 105 SIZE : 1/2" NB–SW / CL. 6000 LBS	A/R
04	FORGED UNEQUAL TEE / AS PER ANSI B16.11 MATL. : ASTM A 105 SIZE : 2x1/2" NB–SW x 1/2" NPTF/ CL. 6000 LBS	02
05	FORGED GLOBE VALVE BODY : ASTM A 105 SIZE : 1/2" NB–SW / CL. 2500	06
06	MALE CONNECTOR MATL. : SS316 SIZE : 1/2" NPTM x TO SUIT 1/2" OD SS TUBE	08
07	SEAMLESS TUBE MATL. : A 213 TP 316 SIZE : 1/2" OD x 2.1 mm THICK	A/R
08	FIVE VALVE MANIFOLD PORT SIZE : 1/2" NPTF / MATL. : SS316 PR. TESTING : 6000 PSI	01
09	FORGED REDUCER / AS PER ANSI B16.11 MATL. : ASTM A 105 / SIZE : OD OF 1–1/2" NB TO 1/2" NB–SW CL. 6000 LBS	02
10	BULK HEAD UNION/COUPLING / AS PER ANSI B 16.11 MATL. : ASTM A 105 / 1/2" NB–SW CL : 6000 LBS	02
11	HALF COUPLING / AS PER ANSI B16.11 MATL. : ASTM A 105 SIZE : 1/2" NB–SW / CL. 6000	02

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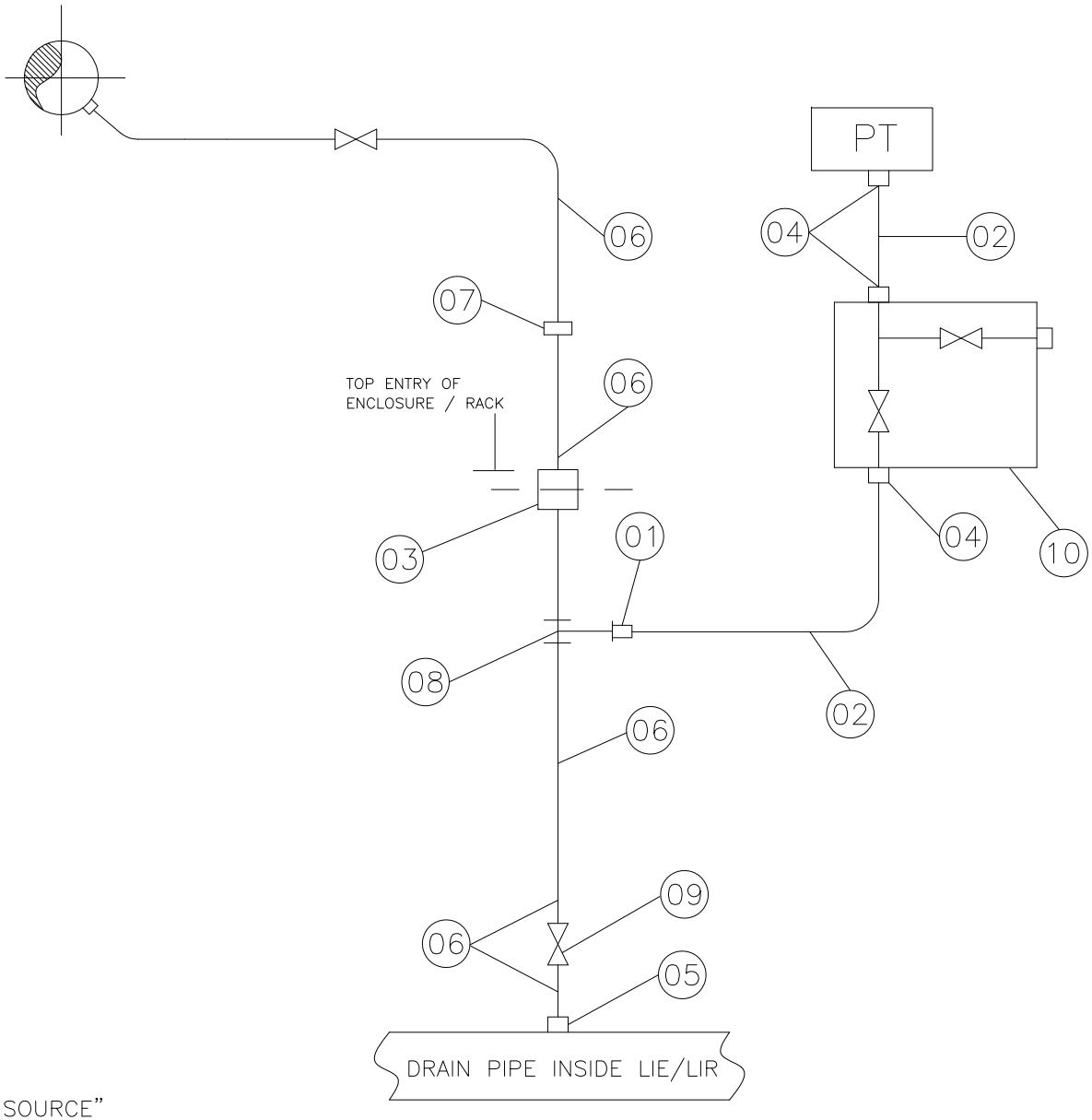

NOTE:

1. " TRANSMITTER BELOW SOURCE"
2. FOR BILL OF MATERIAL REFER PAGE 8

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PAGE : 7

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ITEM NO.	ITEM DESCRIPTION	QTY/INST.
10	TWO VALVE MANIFOLD WITH VENT PLUG PORT SIZE : 1/2" NPTF / MATL : SS316 PR. TESTING : 3000PSI	01
09	FORGED GLOBE VALVE BODY : ASTM A105 SIZE : 1/2" NB-SW / CL : 800	01
08	FORGED TEE / AS PER ANSI B16.11 MATL. : ASTM A105 SIZE : 1/2" NB-SW / CL : 3000	01
07	FORGED COUPLING / AS PER ANSI B16.11 MATL : ASTM A105 SIZE : 1/2" NB-SW / CL. 3000	A/R
06	IMPULSE PIPE MATL : ASTM A106 Gr. C SIZE : 1/2" NB-SCH 80	A/R
05	HALF COUPLING / 1/2" NB-SW /AS PER ANSI B16.11 MATL : ASTM A105 /CL. 3000	01
04	TUBE FITTING / DFDC MATL. : SS316 SIZE : 1/2" NPTM X TO SUIT 1/2" OD SS TUBE	03
03	BULK HEAD UNION / COUPLING CL : 3000 LBS / 1/2" NB-SW MATL : ASTM A105/AS PER ANSI B16.11	1No.
02	TUBE / MATL. : SS316 ASTM A 213 TP 316 H SIZE : 1/2" OD X 2.1 mm THK.	A/R
01	TEE TUBE UNION / MATL. : SS316 SIZE : OD OF 1/2" NB – PIPE X TO SUIT TO 1/2" OD SS TUBE	01

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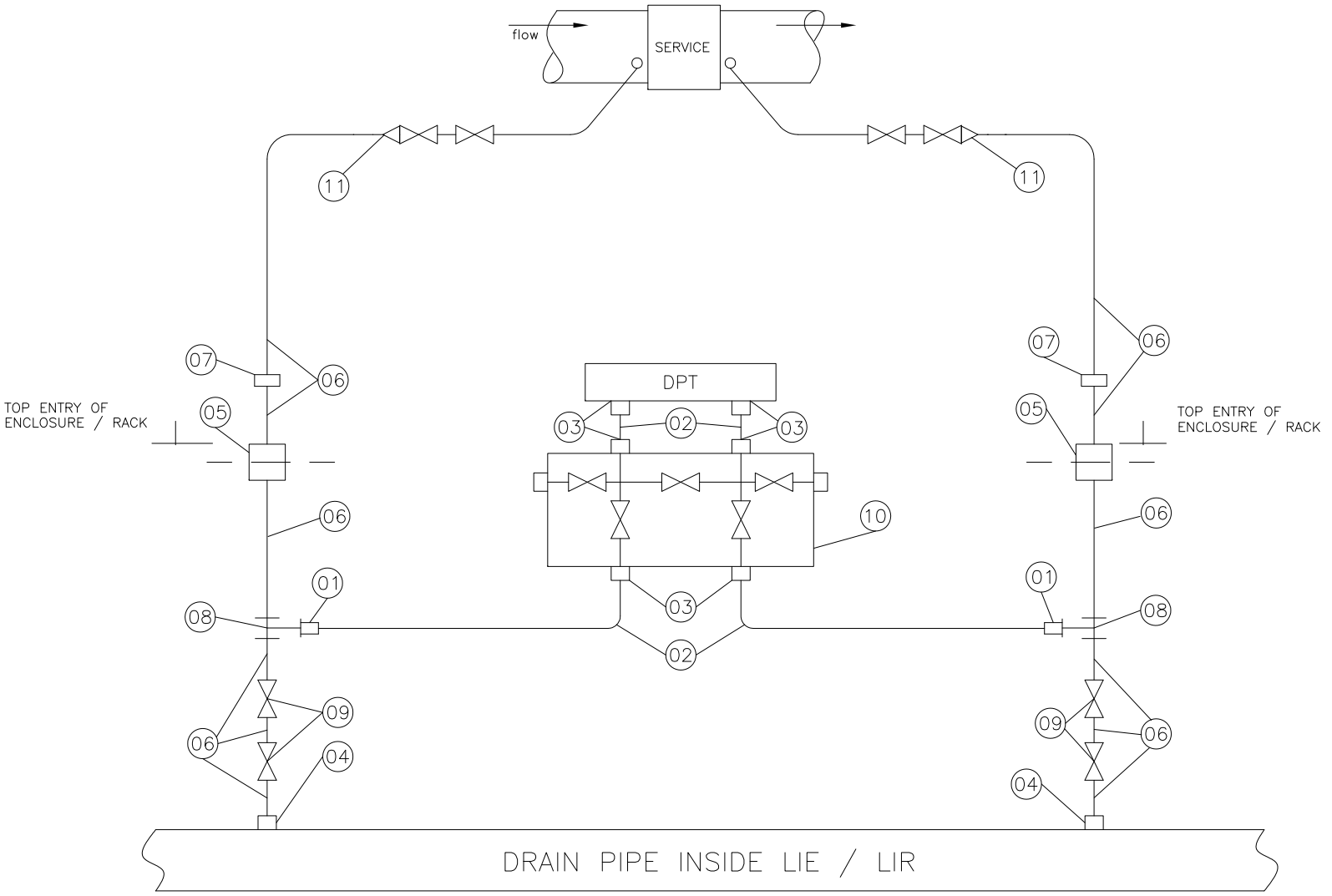

NOTE:

1. " TRANSMITTER BELOW SOURCE"
2. FOR BILL OF MATERIAL REFER PAGE 10

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ITEM NO.	ITEM DESCRIPTION	QTY/INST.
11	FORGED REDUCER / AS PER ANSI B16.11 MATL.: ASTM A105 SIZE: OD OF 1" NB TO 1/2" NB – SW CL 6000	02
10	FIVE VALVE MANIFOLD WITH VENT PLUG PORT SIZE : 1/2" NPTF / MATL. : SS316 PR. TESTING : 6000PSI	01
09	FORGED GLOBE VALVE BODY MATL : ASTM A105 SIZE : 1/2" NB–SW / CL. 2500	04
08	FORGED TEE / AS PER ANSI B16.11 MATL. ASTM A105 SIZE : 1/2" NB–SW /CL : 6000	02
07	FORGED COUPLING / AS PER ANSI B16.11 MATL. : ASTM A105 SIZE : 1/2" NB–SW / CL. 6000	A/R
06	IMPULSE PIPE MATL. ASTM A106 Gr.C SIZE : 1/2" NB–SCH 160	A/R
05	BULK HEAD UNION COUPLING / AS PER ANSI B16.11 MATL. : ASTM A105/ 1/2" NB–SW CL : 6000	02
04	HALF COUPLING / AS PER ANSI B16.11 MATL. : ASTM A105 / 1/2" NB–SW /CL.6000	02
03	TUBE FITTING / DFDC MATL. : SS316 SIZE : 1/2" NPTM X TO SUIT 1/2" OD SS TUBE	06
02	TUBE / MATL. : ASTM A 213 TP 316 H SIZE : 1/2" OD X 2.1 THK.	A/R
01	TEE– TUBE UNION MATL. : SS316 / SIZE : OD OF 1/2" NB X TO SUIT 1/2" OD SS TUBE	02

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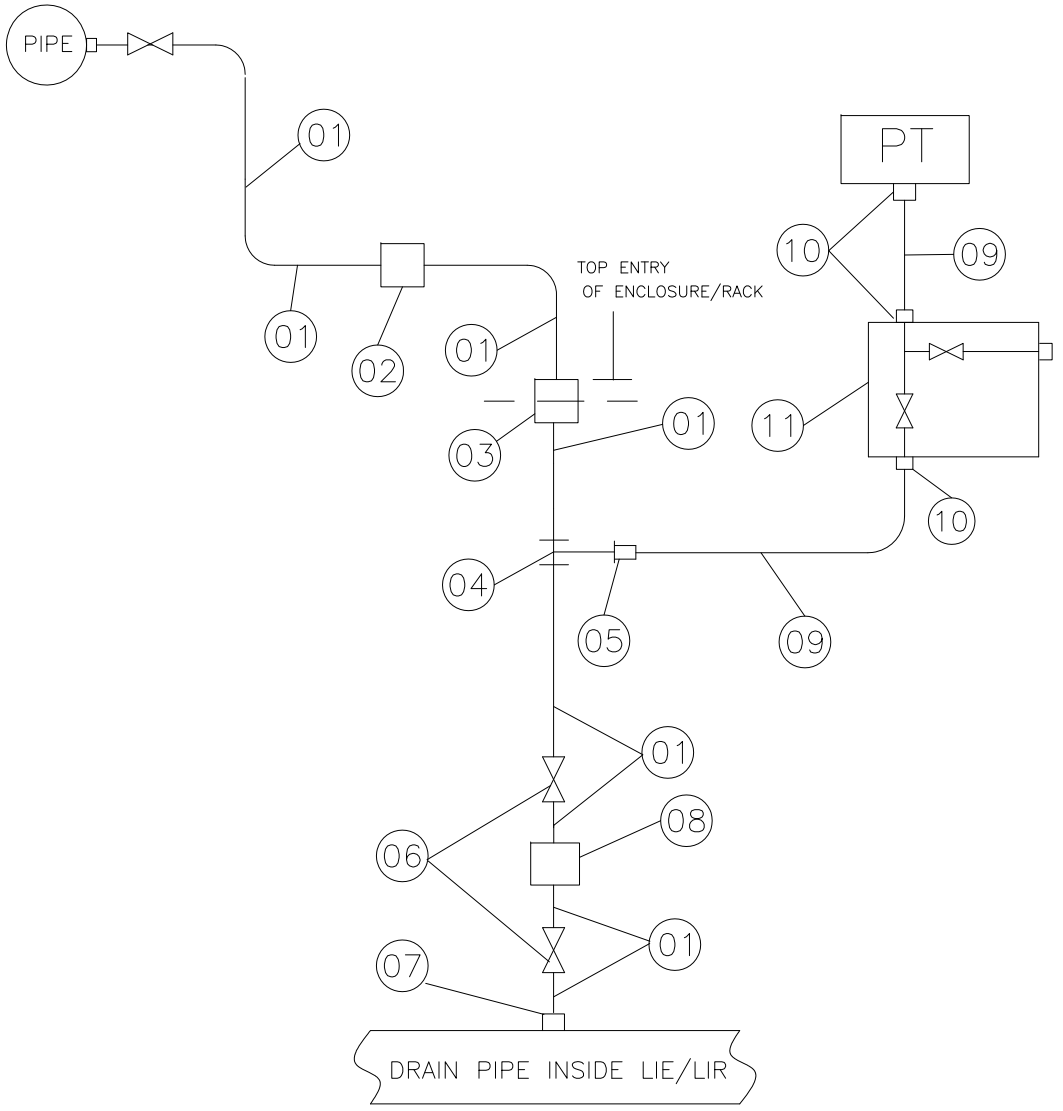

NOTE:

1. " TRANSMITTER BELOW SOURCE"
2. FOR BILL OF MATERIAL REFER PAGE 16

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ITEM NO.	ITEM DESCRIPTION	QTY/INST.
11	TWO VALVE MANIFOLD + VENT PLUG / PR.TESTING: 3000 PSI MATL. : SS316, PORT SIZE : 1/2" NPTF	01
10	TUBE FITTING/DFDC/, MATL. : SS316 SIZE : 1/2" NPTM x TO SUIT 1/2" OD SS TUBE.	03
09	TUBE MATL. : ASTM A213 TP 316 H SIZE : 1/2" OD x 1.13 mm THK.	A/R
08	DRAIN POT: 2" NB Sch 80 BODY: A106 Gr. C / CONN. 3/4" NB – SW	01
07	HALF COUPLING / 3/4" NB–SW /AS PER ANSI B16.11 MATL : ASTM A105 /CL. 3000	01
06	GLOBE VALVE / CL. 800 SIZE : 3/4" NB–SW BODY: ASTM A105	02
05	TEE TUBE UNION; MATL. : SS316 SIZE : OD OF 3/4" NB PIPE x SUIT TO 1/2" OD – TUBE RATING : 3000	01
04	FORGED EQUAL TEE/AS PER ANSI B16.11/RATING : CL 3000 SIZE : 3/4" NB–SW ; MATL. : ASTM A105	01
03	FORGED BULK HEAD UNION / AS PER ANSI B16.11 RATING : ANSI CL. 3000 SIZE : 3/4" NB – SW/MATL. : ASTM A105	01
02	FORGED COUPLING/AS PER ANSI B16.11 SIZE : 3/4" NB – SW / RATING : ANSI CL 3000 MATL. : ASTM A105	A/R
01	IMPULSE PIPE; SIZE : 3/4" NB – SCH 80 MATL. : ASTM A106 Gr. C	A/R

	TITLE : **2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT**	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: III	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION:	
		REV. No. 00	DATE : 06.02.2018

SECTION III

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: III	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION:	
		REV. No. 00	DATE : 06.02.2018

LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- Technical pre-bid clarification if any strictly in the enclosed Schedule of pre bid clarifications only with mention of specification clause for which clarification is being asked. (Stamped & Signed).
- Technical Deviation if any strictly in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed).
- Compliance cum confirmation certificate (Stamped & Signed).
- Un Price Schedule duly filled in (Stamped & Signed).
- Schedule of Declaration (Stamped & Signed).
- No deviation certificate in 'Schedule of deviation with cost of withdrawal' format stating "No Deviation" to technical specification.

NOTE: Any other documents submitted by bidder except as asked above shall not be evaluated & considered as null & void.

	TITLE : **2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT**	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: III	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION:	
		REV. No. 00	DATE : 06.02.2018

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
3. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
4. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
5. There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
6. The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
7. The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL and Customer).
8. All sub vendors shall be subject to BHEL/CUSTOMER approval.
9. Any special tools & tackles, if required, shall be in bidder's scope.
10. Performance guarantee test parameters shall stand valid till the satisfactory completion of Performance guarantee test and its acceptance by BHEL and Customer.

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: III	
	TECHNICAL SPECIFICATION SOLID WASTE MANAGEMENT	SUB-SECTION:	
		REV. No. 00	DATE : 06.02.2018

PRE BID CLARIFICATION SCHEDULE

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

THIS IS A PART OF TENDER TECHNICAL SPECIFICATION PE-TS-421-177-A001

SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL

PROJECT:- 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT

SOLID WASTE MANAGEMENT

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF withdrawal OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF withdrawal OF DEVIATION IS APPLICABLE	NATURE OF COST OF withdrawal OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given seperately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

	TITLE : 2 X 660 MW MAITREE SUPER THERMAL POWER PROJECT	SPECIFICATION NO. PE-TS-421-177-A001	
		SECTION: III	
	TECHNICAL SPECIFICATION FOR SOLID WASTE MANAGEMENT	SUB-SECTION:	
		REV. No. 00	DATE : 06.02.2018

SCHEDULE OF DECLARATION

I ……certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated …… and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name ……

Authorized Representative's Signature ……..

Name ……..

Bidder's Name ……

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated.

PACKAGE 14C: CIVIL & ARCHITECTURAL WORKS FOR CHP,AHP & MISC.WORK FOR 2X660 MW MAITREE RAMPAL PROJECT, BANGLADESH. (Tender no PSER:SCT:KLN-C1984:19.)			
ANNEXURE-A TO TCN-05			
CHANGES/ MODIFICATIONS/CLARIFICATIONS			
SL. NO.	**REFERENCE CLAUSE OF TENDER**	**EXISTING PROVISION**	**MODIFIED PROVISION**
1.0	Clause No. 2.1.1 of Tech spec for SWM-Rev-01(Refer Page no 3 of 775)	One (100) nos. of manual sweeping sticks of reputed make along with required accessories. The sweeping sticks shall be provided of suitable length so that sweeping of roads shall be done easily with these sweeping sticks.	One Hundred (100) nos. of manual sweeping sticks of reputed make along with required accessories. The sweeping sticks shall be provided of suitable length so that sweeping of roads shall be done easily with these sweeping sticks.
2.0	Clause No. 2.1.33 of Tech spec for SWM-Rev-01 (Refer Page no 5 of 775)	Bidder to consider operation and maintenance of WMC until the handover of the Solid waste management package to end customer (BIFPCL). Further after handover of SWM package to end customer (BIFPCL) additional 1-year O&M of solid waste management plant shall be in bidder's scope.	Bidder to consider operation and maintenance of Complete Solid waste management package for 18 months after successful commissioning of the Complete solid waste management package. The same shall be in considered by bidder in his scope.
3.0	Clause No. 2.1.34 of Tech spec for SWM-Rev-01 (Refer Page no 5 of 775)	Initial charge of all lubricants, grease, RO plant chemicals & fuel (diesel & petrol) etc. shall be in bidder's scope. Bidder to also consider all lubricants, grease & fuel (diesel & petrol) in their scope till handover of the SWM package to end customer (BIFPCL) and additional one-year requirement of lubricants, grease, RO plant chemicals & fuel (diesel & petrol) etc. For solid waste management plant.	Initial charge of all lubricants, grease, RO plant chemicals & fuel (diesel & petrol) etc. shall be in bidder's scope. Further bidder to also consider all lubricants, grease & fuel (diesel & petrol) in their scope for 18 months after successful commissioning of the Complete solid waste management package. The same shall be in considered by bidder in his scope.
4.0	Clause No. 3.0 (o) of Tech spec for SWM-Rev-01 (Refer Page no 9 of 775)	Operation and maintenance of solid waste management plant (WMC) until the handover of the Solid waste management package to end customer (BIFPCL). Further after handover of SWM package to end customer (BIFPCL) additional 1-year O&M of solid waste management plant shall be in bidder's scope as per guarantee /demonstration test parameters.	Operation and maintenance of complete solid waste management plant for 18 months after successful commissioning of the Complete solid waste management package. The same shall be in considered by bidder in his scope.
5.0	Clause No. B.12.2.4 Sr. no. (1) of Tech spec for SWM-Rev-01 (Refer Page no 500 of 775)	The Contractor is responsible to operate the entire waste management system comprising also the waste collection and transportation system, the WMC as specified above until the Hand-Over of the Maitree-STPP to the Owner.	The bidder is responsible to operate the entire waste management system comprising also the waste collection and transportation system, the WMC as specified above for 18 months after successful commissioning of the complete solid waste management package. The same shall be in considered by bidder in his scope.
6.0	Data Sheet-A Remarks 1 of Tech spec for SWM-Rev-01 (Refer Page no 567 of 775)	Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.	Registration, insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till 18 months after successful commissioning of the Complete solid waste management package shall be in Bidder's scope.
7.0	Data Sheet-A Remarks 1 of Tech spec for SWM-Rev-01(Refer Page no 568 of 775)	Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.	Registration, insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till 18 months after successful commissioning of the Complete solid waste management package shall be in Bidder's scope.
8.0	Data Sheet-A Remarks 2) of Tech spec for SWM-Rev-01 (Refer Page no 569 of 775)	Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.	Registration, insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till 18 months after successful commissioning of the Complete solid waste management package shall be in Bidder's scope.

PACKAGE 14C: CIVIL & ARCHITECTURAL WORKS FOR CHP,AHP & MISC.WORK FOR 2X660 MW MAITREE RAMPAL PROJECT, BANGLADESH. (Tender no PSER:SCT:KLN-C1984:19.)			
ANNEXURE-A TO TCN-05			
CHANGES/ MODIFICATIONS/CLARIFICATIONS			
SL. NO.	**REFERENCE CLAUSE OF TENDER**	**EXISTING PROVISION**	**MODIFIED PROVISION**
9.0	Data Sheet-A Remarks 1) of Tech spec for SWM-Rev-01 (Refer Page no 575 of 775)	Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.	Registration, insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till 18 months after successful commissioning of the Complete solid waste management package shall be in Bidder's scope.
10.0	Data Sheet-A Remarks 1) of Tech spec for SWM-Rev-01(Refer Page no 576 of 775)	Registration, Insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till handover of Solid waste management plant to end customer (BIFPCL) shall be in Bidder's scope.	Registration, insurance & all other applicable requirements to use the vehicle at Bangladesh site for operation till 18 months after successful commissioning of the Complete solid waste management package shall be in Bidder's scope.
11.0	GENERAL		The O&M of Solid Waste Management shall start after successful commissioning of the SWM package in bidder's scope.

ANNEXURE - 2

FORMAT FOR NO DEVIATION CERTIFICATE
(To be submitted in the bidder's letter head)

BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector - Eastern Region,
Plot no 9/1, DJ Block, Sector – II, Salt Lake City,
Kolkata – 700 091

Sub	No Deviation Certificate.	
Job	PACKAGE 14C: CIVIL & ARCHITECTURAL WORKS FOR CHP,AHP & MISC.WORK FOR 2X660 MW MAITREE RAMPAL PROJECT, BANGLADESH.	
Ref	1.0	Tender no PSER:SCT:KLN-C1984:19.
	2.0	BHEL's NIT, vide reference no PSER:SCT:KLN-C1984:7559, Date: 13-09-2019.
	3.0	BHEL's TCN-01, vide reference no PSER:SCT:KLN-C1984:TCN-01 Date: 17-09-2019.
	4.0	BHEL's TCN-02, vide reference no PSER:SCT:KLN-C1984:TCN-02 Date: 18-09-2019.
	5.0	BHEL's TCN-03, vide reference no PSER:SCT:KLN-C1984:TCN-03 Date: 19-09-2019.
	6.0	BHEL's TCN-04, vide reference no PSER:SCT:KLN-C1984:TCN-04 Date: 20-09-2019.
	7.0	BHEL's TCN-05, vide reference no PSER:SCT:KLN-C1984:TCN-05 Date: 21-09-2019.
	8.0	All other pertinent issues till date.

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed/ modified the tender documents as appeared in the website/ issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above referred NIT. We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification, integrity pact (if applicable) and acceptance to reverse auctioning process.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted/uploaded offer/documents in accordance with tender instructions with acceptance of the terms & conditions of the tender by us and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized
representative of the bidder)