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VOLUME III-F TECHNICAL SPECIFICATIONS FOR PIPING, SPECIALTIES & THERMAL INSULATION		

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VOLUME III-F SECTION-2 LOW PRESSURE PIPING, VALVES AND SPECIALITIES		

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1.0 <u>GENERAL INFORMATION</u> This section covers all the low-pressure piping up to 400 NB size, associated valves and specialties that include as a minimum: 1.1 The Raw Water Piping supplying raw water to raw water reservoir (from proposed raw water gravity line from Ozerkheda reservoir to existing 2 x 500 MW units.) 1.2 Raw water piping from discharge of raw water pumps up to Cascade Aerator in Pre treatment plant. 1.3 Service Air System 1.4 Instrument Air System 1.5 Demineralised Water Supply system 1.6 Plant Potable Water System - (filtered & Ozonised water) 1.7 Service Water System 1.8 Air heater washing system 1.9 Clear water supply line for Coal handling plant dust suppression/dust extraction from discharge of CHP DS/DE supply pumps located at Clear water pump house in ETP area. 1.10 Fuel oil system piping supply and Fuel Oil return from boiler and Steam tracing to HFO tank. 1.11 Any other low pressure piping as found necessary during detail engineering shall also be included. 2.0 <u>CODES AND STANDARDS</u> 2.1 In addition to the requirements spelt out in Volume II, the design, manufacture, inspection and testing of the piping, fittings, valves and		

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specialties covered under this specification shall conform, in general, to the standards and codes mentioned below:			
2.1.1	IS-1239 [Part-I & II]	:	Mild steel tubes, tubular and other wrought steel fittings.
2.1.2	IS-3589	:	Electrically welded steel pipes for water, gas and sewage (200 to 2000 NB)
2.1.3	IS-554	:	Dimensions for pipe threads where pressure tight joints are required on the threads.
2.1.4	IS-1363 [Part-I & II]	:	Hexagonal head bolts, screws and nuts (size range M5 to M36)
2.1.5	IS-1364	:	Precision and Semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm)
2.1.6	IS-3138	:	Hexagon bolts & nuts (M42 to M150)
2.1.7	IS-4736	:	Hot dip zinc coating on mild steel tubes.
2.1.8	IS 14846	:	Sluice Valves for water works purposes.
2.1.9	IS-2685	:	Code of practice for selection, installation and maintenance of sluice valve.
2.1.10	IS-5312	:	Swing check type reflux (non-return) valves.
2.1.11	IS-2379	:	Colour code for the identification of pipelines.
2.1.12	IS-2016	:	Plain washers
2.1.13	IS-2712	:	Compressed asbestos fibre jointing
2.1.14	ANSI B-16.5	:	Steel pipe flanges and flanged fittings
2.1.15	ANSI B-16.9	:	Wrought steel Butt welding flanged
2.1.16	ANSI B-16.11	:	Forged steel fittings, Socket-welding and Threaded.

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2.1.17 ANSI B-36.10 : Steel pipes thickness 2.1.18 API-600 : Steel gate valves 2.1.19 BS-2633 : Class I Arc welding of ferrite steel pipe work for carrying fluids. 2.1.20 BS-534 : Specification for steel pipes and specials for water and sewage. 2.1.21 BS-5351 : Specification for Ball valves. 2.1.22 BS EN ISO Specification for Ball valves. 17292 : 2004 : 2.1.23 AWWA-C-504 : Specification for Butterfly valves. 2.1.24 AWWA-C-208 : Dimension for fabricated steel water pipe fittings. 2.2 Other international codes and standards may also be offered by bidder. However, same may be subject to acceptance by the Owner. 3.0 <u>SCOPE OF WORK</u> 3.1 The equipment and materials to be supplied shall include as a minimum, the following : (a) Supply of all low pressure piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc as required for the piping system. (b) Matching pipes, matching pieces like reducers/expanders etc, counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc. (c) Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.		

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(d) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc complete with the counter flanges and matching connecting pieces as required for entire low pressure piping system. (e) Anchors, hangers and supports etc as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor or platform including access ladders, supporting structures etc. (f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided including pipe supports in trenches. However, trench piping shall be avoided to the extent possible. (g) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches of the Power Station. (h) Pipe rack required between WTP, Oil storage area to TG Hall and boiler area is under bidders cost of design and construction including the civil foundation for pipe rack and any other piping support foundations wherever required. (i) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc as required for interconnecting piping, valves & fittings. (j) Cleaning and Painting of all piping, valves & specialties at manufacturer's shop. 3.2 Following general requirements shall however be provided (a) Instrument connections including instruments, root valves, sensing lines etc. (b) Pipe stubs and blanking plates etc required for chemical cleaning and hydro testing.		

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For conducting acceptance test, the required pressure, temperature, flow measurement points shall be provided.

3.3 The Flow Diagrams forming a part of the specification are mainly intended to give general guidelines to the Bidder regarding extent of piping, valves, and specialties to be supplied under this section.

4.0 GENERAL DESIGN AND CONSTRUCTION

4.1 GENERAL CONSIDERATIONS

4.1.1 Line Sizing

Sizes of piping shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow.

(a)	Water				
	(i)	Condenser CW	Below 1000 NB	1000-2000 NB	Above 2000 NB
		a. Pump suction	1.0	1.3	1.5
		b. Pump discharge / distribution	2.4	2.8	3.0
	(ii)	Water- General	Below 200 NB	200-400 NB	400-700 NB
		a. Pump suction	1.0		
		b. Pump discharge / distribution	1.8	2.2	2.5
(b)	Fuel oil				
		Heavy oil (Heated)			
		a. Pump suction	1.0		

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		b. Pump discharge / distribution	1.5-2.0
(c)	Gases		
		a. Compressed air	15-25

4.1.2 The piping systems included in this section shall be designed to operate continuously without replacement during the plant service life of 30 years.

4.1.3 The piping system shall be complete in every detail and in accordance with the highest standard of workmanship. Against any doubt, Owner shall be referred for clarification.

4.1.4 All design and fabrication shall be in accordance with codes/standards specified.

4.1.5 No pipe work shall run in trenches carrying electrical cables.

4.1.6 Pipe size above 50 NB shall be shop fabricated and of size 50 NB and below shall be field run.

4.1.7 All piping shall be identified by means of colour strips, by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.

4.1.8 Air release and drain branches shall be provided, wherever necessary, depending upon the layout and arrangement so that the drains and air release valves are located for easy operation.

4.1.9 Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/cm² (g) at 80°C or as required by the design of the different piping system, if higher.

4.1.10 Drain Pipe work

(a) Low pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained, or as near as possible for conventional operation.

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(b) Unless otherwise stated, all drain piping shall be of 25 NB minimum and all vent piping shall be of 15 NB minimum. For pipes up to 40 NB, pipe wall thickness shall be as per schedule 80 of ANSI B36.10.

(c) Unless otherwise stated, wherever a main or branch of any pipeline is terminated with a valve, such terminal valve shall be provided with a blank flange/blanking cap at the free end.

4.1.11 Specification of pipes used in different services included in the L.P. piping section has been detailed in Annexure-I.

4.1.12 Following types of valves shall be used for the system/ service marked as y

	Types of Valves				
	Butterfly	Gate	Globe	Check	Ball
(a) Water	y	y	y	y	y
(b) Drains & Vent		y	y	y	
(c) Fuel oil		y	y	y	y
(d) Air		y	y	y	y

4.1.13 HFO oil line shall be traced by steam tracers.

4.2 MATERIAL SPECIFICATION

4.2.1 Materials for pipes and fittings shall be as stipulated in Annexure-I. In case bidder wants to offer alternative piping material, same may be accepted by the Owner depending on the merits of alternative material.

4.2.2 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes, shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.

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4.3 <u>FABRICATION</u> For Detailed Fabrication requirement of LP piping, Refer clause no- 6.5 of Section –I of this specification. 4.4 <u>HANGERS, SUPPORTS, ANCHORS</u> Normally pipe supports and anchors shall be selected at those points in the buildings where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item, shall be supported in such a way that the plant item does not take the weight of the piping. 4.4.1 Support spacing shall be as per good engineering practice. However, in no case it shall be less than support spacing stipulated in ANSI B31.1. 4.4.2 Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. 4.4.3 All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required. 4.4.4 Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Boltholes shall be drilled, not burned. Support components may be bolted to concrete using approved concrete anchors. 4.5 <u>VALVES AND ACCESSORIES</u> 4.5.1 Valves (a) All valves shall be of approved make and type and shall have cast/forged bodies with covers and glands of approved construction and materials as specified in Annexure-II & III.		

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(b) Valves and specialties to be supplied under this specification will be used for various air and water services and will be located indoor/ outdoor and on horizontal/vertical runs of the pipelines. However, mounting of valves in vertical pipe runs shall be avoided as far as possible. (c) All valves shall, unless otherwise stated, have the internal diameter same as the internal diameter of the pipes to be joined. (d) All valves shall receive tests at manufacturer's or contractor's works in accordance with the specific requirements of the approved Codes of Practice. Valves shall be rising stem or otherwise as approved by the Owner. (e) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing and shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate. (f) Where valves are of similar size and type they shall be interchangeable with one another. Valves shall have welded or flanged connections subject to the Owner's approval. (g) Gate, Globe and Ball valves shall be provided with the following accessories in addition to other standard items: (i) Hand wheel with embossed open and shut directions. (ii) Local position indicator. (iii) Motorised operation as specified by Engineer. (h) Gate valves, in addition shall be provided with following extra features (i) Bypass valve for larger valves (ii) Draining arrangement		

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(iii) Enclosed Gear operators for valves 300 NB and above for ease in operation. (iv) Motorised operation as specified by Engineer. (i) All gate and globe valves shall be rising stem type. (j) All valves shall be provided with hand-wheels, chain, operator, extended spindle and floor stand wherever required so that they can be operated manually by a single operator from the nearest operating floor either at a lower or higher elevation as the case may be. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also. (k) All valves and specialties shall be provided with brass Tag Discs indicating Tag numbers and nomenclature of the valve including duty or service intended and the function of the valves specialties. (l) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position. (m) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Bidder shall supply the first fill of oil or grease for these parts. The Bidder shall supply a suitable manually operated grease gun for the standard type of nipple provided. (n) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction. (o) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.		

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(p) Plastic or bakelite valve hand wheels will not be accepted. (q) All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers. (r) Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500kg shall be provided with suitable lugs to permit direct suspension by hanger rod or direct resting on bottom support, as applicable. (s) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum. (t) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves. (u) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve construction. (v) All sampling and root valves shall be of integral body bonnet type. (w) Gate and globe valves used for fuel oil system shall be of such design as to permit re-packing while in service. For Design Requirements for different valves, refer Annexure-II & III. 4.5.2 Strainer for fuel oil system (a) There shall be Duplex strainers on the Fuel Oil Line.		

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	(b) The strainer shall have basket type straining elements permitting easy removal and replacement. (c) The open area ratio (i.e. straining area to the inlet area ratio) shall be at least 6:1. (d) The strainer shall have screen of stainless steel (AISI-316) construction with wire diameter of about 0.01 inch and open area of about 50%. (e) Strainer body shall be made of Mild steel. No Cast Iron component shall be used in F.O. system. (f) All strainers shall also be provided with oil drip plates beneath them for collection of oil. (g) Bolts and nuts shall be as per IS-1363. Gaskets shall be minimum 3 mm thick and made of compressed asbestos fibre as per IS-2712.	
4.5.3	Steam Traps (a) The steam traps shall be inverted bucket or thermodynamic type complete with integral or separate strainers. (b) Traps shall have carbon steel body with stainless steel internals to AISI 316. (c) Y-type strainers whether integral with steam traps or otherwise shall have body of Cast Steel Class 150 material and perforated metal screen of type AISI-316 stainless steel with about 0.8 mm perforation. The strainer shall have screwed blow off connections fitted with removable plug. The free hole area shall be at least three (3) times the internal pipe area. (d) Numbers and location of steam traps shall be selected by the Bidder.	
4.6	<u>SAFETY/RELIEF VALVES</u>	
4.6.1	Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.	

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4.6.2 All safety valves shall be provided with manual lifting lever. 4.6.3 Valves used for air and any other compressive fluid shall be of pop type. 4.6.4 Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure. 4.6.5 Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Engineer. 4.6.6 The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting. 4.7 <u>HOSE PIPE AND ACCESSORIES</u> 4.7.1 Hose valves for service water system shall be Gate valves and service air system shall be Globe valves. 4.7.2 Hose pipes with fittings for Service Water System: (a) The water hose shall be as per IS-444 (Type-3). (b) Length of each hose shall be 15 metres. (c) For each hose, one end shall be fitted with M.S. female coupling with swivelling nuts and soft seating ring suitable for connection to male end of hose valve and other end shall be made threaded for joining with the swivelling nut of a second hose whereby two hose lengths may be joined. 4.7.3 Hose pipes with fittings for Compressed air System (a) The compressed air hose shall be as per IS-911 (Type 2). (b) The length and type of each end shall be similar to as specified in above clause no. 4.7.2 (b) (c) above.		

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5.0	<u>BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING</u>	
5.1	All fittings like "T" pieces, flanges, reducers etc shall be suitably matched with pipes for welding. The valves shall be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.	
5.2	Adjustments like removal of oval ties in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered part of work and such work shall be carried out as per instructions, which shall include specified heat-treatment procedures etc also, wherever required.	
5.3	Certain adjustments in length may be necessary while erecting low pressure pipelines and the extra lengths shall be removed to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.	
5.4	Suspension for piping, pressure parts etc shall be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.	
5.5	All the valves, lifting equipments, actuators, power cylinders etc shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and during pre-commissioning. Even after commissioning, the equipments, if there are problems in the operation, shall be attended to by the Bidder during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work.	
5.6	All tubes and pipes shall be cleaned and blown with compressed air and shown to the engineer before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over, the end caps shall be put back in tube openings till such time they are welded to other tubes.	
5.7	Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small-bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even	

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	after completion of erection, which shall be carried out by the Bidder without any extra cost to the Owner. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions. 5.8 No temporary supports shall be welded on the pressure parts. Welding of temporary supports, cleats etc on the building columns shall also be avoided. In case of absolute necessity, prior approval from Engineer shall be taken. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Engineer. 5.9 Wherever piping is connected to other piping or equipment, the joint at the connecting point shall be considered under this specification. (a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance. (b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance. (c) Piping shall be routed above ground unless otherwise specifically indicated/approved by the Engineer. In such special case, the piping may be arranged in trenches or buried and properly protected as per AWWA Standards. (d) Overhead piping shall have a minimum overhead clearance of 4 meters above walkways and working areas and 6 meters above roadways unless otherwise approved by the Engineer. Inside TG hall, headroom clearance for piping should be minimum 2 metres. (e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective drawings or not. The pipelines shall be sloped towards the drain points.	

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(f) All drips and drains for piping and equipment whether shown in the drawings or not shall terminate on the ground floor up to station drain unless otherwise specified. 5.10 Painting (a) All uninsulated piping systems, hangers and supports shall have two coats of red oxide Zinc Chromate primer (conforming to IS 2074) with minimum dry film thickness (DFT) of 25 microns per coat and two coats of finish paints using enamel paint to give a minimum total DFT of 100 microns (after two coats of primer and two coats of finish paint). Shades shall be as per IS 5 or as indicated by Owner/Engineer. Service of the pipe/line designations shall be painted on all pipes at visible locations. (b) Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot, grease, rust etc. (c) All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint. 6.0 <u>DRAWINGS, DATA, INFORMATION & MANUALS</u> 6.1 For Drawing, Data and Information required along with BID refer, Volume VIII.		

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<u>ANNEXURE – I</u> <u>(SPECIFICATION OF PIPES FOR DIFFERENT SERVICES)</u>				
	A	B	C	D
1.0 Services	(a) Raw Water Piping (b) Clarified Water piping, (c) Filtered Water to DM Plant	Drinking (Potable) Water Supply piping (filtered water, ozonised)	Demineralised Water, Service and Instrument air piping less than and equal to 40 NB	Demineralised Water, Service and Instrument air piping for sizes equal to or greater than 50 NB
2.0 Material of Pipe	Carbon Steel IS-1239 Part I Heavy Grade upto 150 NB and IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm.	Carbon Steel as per IS-1239 Part I Heavy Grade upto 150 NB and IS-3589 for sizes above 150 NB. The pipes shall be galvanized as per IS-4736.	Stainless Steel as per ASTM A-312 Gr 304. Thickness schedule 40S as per ANSI-B 36.19	Stainless steel as per ASTM A-312 Gr 304. Size up to 250 NB as per schedule 10S, ANSI B 36.19
3.0 Construction	ERW/Seamless	ERW/Seamless	Seamless	ERW/Seamless
4.0 End connections	Flange and butt weld for size 50 NB and above and Socket weld joint for size 40 NB and below.	Screwed flange for sizes 50 NB and above and screwed socket for size 40 NB and below.	Socket welded for DM water lines. Screwed end connection for airlines.	SORF and butt weld joint for DM application. Screwed end connection for air

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		A	B		C	D	
				(Part-II)		valves/equipment	
			All fittings shall be galvanized				
6.0 Flanges		150 class as per ANSI B16.5 complete with nuts, bolts and gaskets. FF flanges for CI valves.	As per ANSI B16.5 pressure class 150 - galvanized- complete with nuts, bolts and gaskets. FF flanges for CI valves.		As per ANSI B16.5 pressure class 150 complete with nuts, bolts and gaskets. Use slip on flanges here.	150 class, flat face, as per ANSI-B-16.5 complete with nuts, bolts and gaskets. Use Lap Joint flanges here.	
1.0	Services	Fuel Oil System					
2.0	Material of Pipe	API 5L Gr B or ASTM 106 Gr B					
3.0	Construction	Seamless					
4.0	End connections	≤ 40NB SW, ≥ 50NB – BW					
4.1	Fittings	ASTM A234 Gr WPB/ A 105					
5.0	Valve end	Flanged end is preferred					
6.0	connection						
NOTE:							
1. Refer Annexure –III for Valve material specification.							
2. Pipes which fall under IS: 1239 shall be hydrostatically tested according to the said code, for others refer Section-V, Volume II.							

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<u>ANNEXURE – II</u> <u>SERVICES OF VARIOUS CATEGORIES OF VALVES</u>			
SR. NO.	VALVE CLASSIFICATION	SERVICE	
1.0	Cast iron body Gate/ Globe/Check Valve	(a) Service Water (Clarified)	For sizes 50 NB and above
		(b) Filtered Water	
		(c) Drinking Water	
		(d) Inhibited Demineralised Water	
2.0	Stainless steel & Bronze body Gate / Globe / Check / Ball Valve	(a) For Demineralised water	For all sizes
		(b) Drinking Water	For sizes less than and equal to 40 NB
		(c) Service and Instrument Air	For all sizes. Ball valves to be used in air line.
3.0	Steel Body valves	(a) Clarified Water	For sizes less than and equal to 40 NB
		(b) Inhibited Demineralised Water for DMCW system	
		(c) Fuel oil system	For all sizes
4.0	Cast Iron body butterfly valve & Check valve	(a) For Demineralised Water	For sizes 50 NB and above. Rubber lining shall be provided for DM water application.
		(b) Raw water	
		(c) Clarified Water	
		(d) Filtered Water	
		(e) Inhibited Demineralised Water for DMCW system	

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<u>ANNEXURE-III</u>			
<u>SPECIFICATION OF VALVES</u>			
	(A)	(B)	(C)
	Cast Iron Body Gate/ Globe/Check Valve	Stainless Steel Body Gate/ Globe /Check/Ball Valve	Steel Body Gate / Globe / Check Valves
1.0 <u>BASIC DESIGN CODE</u>			
(a) Gate	(a)	(a)	(a)
	(i) IS-780 for 50 – 300 NB	(i) API 600 for 50 NB and above /ANSI-B-16.34	(i) API 600 for 50 NB and above/ ANSI-B-16.34
	(ii) IS-2906 for 350 NB & above or as per MSS- SP-70	(ii) API 602 for size below 50 NB / ANSI-B-16.34	(ii) API 602 for size below 50 NB/ANSI-B-16.34
(b) Globe	(b) MSS-SP-85	(b) BS 1873 /ANSI-B-16.34	(b) BS 1873 /ANSI-B-16.34
(c) Check	(c) IS-5312/MSS-SP-71	(c) BS 1868 /ANSI-B-16.34	(c) BS 1868 /ANSI-B-16.34
(d) Ball		(d) BS 5351	(d) BS 5351
2.0 <u>PRESSURE CLASS</u>	To be suitably chosen considering the pressure requirement.		
3.0 <u>CONSTRUCTION</u>	Cast body and bonnet/ cover	Forged body up to 50 NB and Cast body above that size	Same as Group B
4.0 <u>MATERIAL</u>			
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		(A)	(B)	(C)
		Cast Iron Body Gate/ Globe/Check Valve	Stainless Steel Body Gate/ Globe /Check/Ball Valve	Steel Body Gate / Globe / Check Valves
4.1	Body & Bonnet Cover	IS 210 Gr. FG 260	A 351 CF8 for cast Body and A 182 F304 for forged Body	A 216 Gr. WCB for Cast Body and A 105 for Forged body
4.2	Trim/Disc	IS 210 Gr. FG 260	A 182 F304 for 13% Cr. Steel as per Gate, Globe, Check valves and A 351 CF8 for Ball Valves	A 182 Gr.F6 heat treated and hardened (min. 250 BHN) for cast body and A 105 Hard faced with Stellited (min. 350 HB) for forged body.
4.3	Seating surface	13% Cr. Steel as per IS-1570	For Ball valves PTFE seats and seals	13% Cr. Steel as per A 182 Gr. F6.
5.0	<u>END PREPARATION</u>	Socket welded for size equal to and below 40 NB and flanged with counter flanges for 50 NB and above.		
6.0	<u>TESTING</u>			
(a)	Gate	(i) IS-780 for 50 – 300 NB	ANSI B-16.34/ API-598 /MSS-SP-61/ EN 12266-1	
(b)	Globe	(ii) IS-2906 for sizes equal to and above 350 NB		
(c)	Check	MSS-SP-85		
(d)	Ball	IS 5312 /MSS-SP-71		

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ANNEXURE A MINIMUM TESTING AND INSPECTION REQUIREMENTS		

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1.0 GENERAL

The testing and inspections listed herein are the minimum requirements as perceived by the owner; the bidder shall consider this only as a general guidance and is not meant to be exhaustive. The bidder shall consider requisite testing and inspections across the equipments/systems forming the proposed power plant unit based on his own experience and in line with the current industry practices for identically rated power plant for the technology under consideration and relevant codes and standards. The comprehensive list of tests considered for each of the equipment/systems shall be furnished as part of the bid.

2.0 H.P.PIPING FOR STEAM GENERATOR, TURBINE AND AUX.

2.1 TESTING OF PIPING AT WORKS

2.1.1 Piping & fittings:

2.1.1.1 All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.

2.1.1.2 Raw material of all forged/formed fittings shall be ultrasonically tested. All mother pipes used for fitting shall either be ultrasonically tested or hydraulic tested. Forged fittings shall be ultrasonically tested and formed fittings shall be MPI tested.

2.1.1.3 All pipe lengths shall be subjected to 100% ultrasonic examination or hydraulic tests and UT/RT on longitudinal welds at the tube mill.

2.1.1.4 Welded and cast fittings if any shall be subjected to suitable NDT as per applicable standards. However, 100% RT shall be carried out on alloy steel fittings and on carbon steel fittings for use above 71 bar design conditions.

2.1.1.5 The edge preparation for shop and site welds in stainless steel /alloy steel shall be subjected to a dye penetrate check.

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2.1.1.6 Thickness of pipe bend shall be checked by ultrasonic or other acceptable methods on sample basis for high pressure applications. Outer surface of bends shall be subjected to magnetic particle examination/LPI. The tests shall be done before fabrication on the piping system and results submitted to Owner/Engineer for approval. 2.1.1.7 Non-destructive examination of welds shall be carried out after post weld heat treatment, if any. 2.1.1.8 For welds in P91, X20 & X22 materials, induction type of heating shall be deployed for heat treatment or heat treatment can be carried out in furnace. 2.1.1.9 Non-destructive examination of welds shall be carried out in accordance with the relevant design/manufacturing codes. However, as a minimum, the following requirements shall be met. Further statutory requirement, wherever applicable shall also be complied with. (a) Temperature > 400 Deg, C and/Or pressure exceeding 71 bar. (i) 100% RT/UT on butt welds and full penetration branch welds. (ii) 100% MPE. (b) Temperature > 175 Deg, C upto 400 Deg. C and/or pressure exceeding 17 bar and upto 71 bar. (i) 100% RT/UT on butt welds and full penetration branch welds for pipe dia more than 100 NB. (ii) 10% RT/UT on butt welds and full penetration branch for pipe dia upto 100NB. (iii) 100% MPE. (c) 100% UT & 100% MPI on all butt welds of P 91 and X22 UT shall be carried out by digital recorded type. Wherever SR/PWHT is envisaged, above NDTs shall be after SR/PWHT.		

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2.1.1.10 For all other pipes not covered above, shall be subjected 100% MPE/ DPT in case of under ground pipes and 10% MPE/DPT in case of piping above the ground. Further, 10% of butt welds of underground piping shall be subjected to RT. 2.1.1.11 Hardness survey of welds shall be carried out on alloy steel/stainless steel piping (100% Hardness survey of welds on P91, X20 & X22 material grade piping) and 3% hardness survey on welds of other alloy steel). 2.1.1.12 Testing of piping at works All piping shall be subjected to the hydrostatic test pressure at shop as required by the IBR or any other applicable standards. Test pressure shall however be not less than the following: Test Pressure $= 1.5 \times \frac{\text{Allowable Stress at Room Temperature}}{\text{Allowable Stress at Design Temperature}} \times \text{Design Pressure}$ The Contractor shall guarantee his work as capable of withstanding such hydrostatic tests and consent to repair or replace at his expense any item, which fails to pass such tests at site. Hydrostatic test of all pipes coming under IBR shall be offered for witnessing by the representative of the Inspecting Authority recognised by IBR. 2.1.2 Hangers & Supports: (a) All raw materials used shall have co-related mill test certificate meeting mandatory checks of material specification. (b) Completed springs shall be tested for Scragging Test & Load vs Deflection Test and for dia. > 25mm MPI shall be carried out. (c) Each constant load and spring support shall be tested before delivery to ensure that the variation in support capacity provided through the specified ranges (i.e. the difference in load between hot conditions and		

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cold condition) does not exceed 6 percent for constant load supports and 20 percent for variable spring supports. (d) Butt Welds shall be tested for UT and fillet welds shall be tested for MPI. (e) Turn buckle/pipe clamps/Hangers of thickness > 25mm shall be checked by MPI/DPT on bent portion. 2.1.3 Assembled Hangers shall be checked for Variation in deflection and Travel vs Load test and shall meet the requirements of data sheet. 2.1.4 Thermal Insulation & Lagging, Cladding: (a) Light resign bound mineral wool: LRB mattresses of Rockwool/Glass wool from approved manufacturing sources confirming to 8183, tested as per relevant clauses of IS 3144 and shall meet the requirements of data sheet. Wire mesh of diameter 0.71 mm (min.) as per data sheet shall only be used. (b) Lagging & Cladding: Aluminium sheeting confirming to ASTM B-203-1060 temper H14 from reputed manufacturer meeting the requirements of data sheet. 2.1.5 Valves: (a) All materials shall be of tested quality and the contractor shall submit the relevant material test certificate for the approval of Owner/Consultant. (b) All Valves and Specialties as well as counter flanges to be used in steam service shall have IBR certification marked on them and IBR certificates in appropriate pro-forma shall be submitted. (c) Pressure retaining parts of valves shall be subjected to (min.) NDT as per Table 1.		

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(d) Hardened/stellitted valve disc and seat are to be subjected to LPI and hardness check. (e) Color matching of valve disc/plug and seat shall be carried out to ensure min. 80% contact and no through passage. (f) Hydraulic pressure test and seat leak test shall be carried out as per ANSI 16.34/IBR. (g) Air seat leak test shall be carried out as per applicable Standards/Codes. (h) Functional testing shall be carried out on each valve to check the following as per the approved valve data sheet (i) Smooth operation (ii) Valve travel, closing and opening time. (iii) Current drawn by actuators. (i) Springs for safety valves shall be tested with suitable NDT and for spring rate. (j) Gate valves shall be subjected to shop tests in accordance with API-598 including the high-pressure closure test. Globe valves shall be tested in accordance with BS-1873 and check valves in accordance with BS-1868. (k) All gaskets used for test shall be of the same material and design as specified for the finished product. (l) Each relief valve shall be subjected to hydrostatic test, seat pressure test, seat leakage test and test for relieving capacity. The valve body test pressure shall be at least twice the set pressure. The seat test pressure shall be at least equal to the set pressure. During this test, the valve seat shall be demonstrated to be watertight for a period of at least two (2) minutes.		

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2.1.6 Strainers and Traps (a) All strainers shall be subjected to hydrostatic test. The test pressure shall be twice the design pressure. (b) All steam traps shall be subjected to hydrostatic test at twice the design pressure. IBR certification shall be furnished for all steam traps. 2.2 <u>TESTS AT SITE</u> Contractor shall carry out tests at site to prove to the Owner that the equipment of the plant complies with requirements stipulated and is erected in accordance with requirements. Before the plant is put on trial run, the Contractor will be required to conduct tests to demonstrate to the Owner that each item of the plant is capable of correctly performing the functions for which it was specified. These tests may be conducted concurrently with those required under commissioning sequence. Tests required shall in general be as follows: 2.2.1 All piping, valves and specialties after installation, shall be tested hydraulically at a pressure, one half times that of the maximum attainable pressure in the system or two (2) times the design pressure whichever is higher, to check against leak tightness. 2.2.2 All manually operated valves/gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever. 2.2.3 Visual check on all structural components, welding, painting etc and if doubt arises, these shall be tested again. 2.2.4 All test instruments and equipment shall be furnished by the Bidder to the satisfaction of the Owner. 2.2.5 Checks on electrical items as mentioned in relevant electrical specification. 2.3 <u>PRE-COMMISSIONING TESTING</u> 2.3.1 Alignment Test		

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After completion of erection and before start-up, alignment test shall be carried out to check levelling, clearance, eccentricity etc. Measurement will be witnessed and acceptance will be certified by the Engineer. 2.3.2 Heat Treatment - All necessary preheating, post heating and stress relieving operation of welds/fabricated items are part of the erection work in accordance with relevant regulations and standard. All required supervising staff for heat treatment and stress relieving works shall be arranged. Heat treatment may be required to be carried out at any time during day and night to ensure the continuity of the progress. Supervising staff shall be arranged accordingly. All data such as heating temperature, heating rate, sparking time, maximum temperature during heat treatment shall be properly recorded. All the data recorded during heat treatment shall be the property of the Owner. 2.3.3 Radiography Test Radiography tests of all field-welded joints coming under IBR shall be carried, the acceptability standard of which shall be as per IBR. For other field welded joints, radiography or other NDT methods shall be employed as per ASME or equivalent. All radiography shall be carried out in presence of a competent supervisor and his certificate of identification of the films of the radiographs shall be given invariably in all cases. The repair work shall be suggested immediately after detection of the defective zone to the complete satisfaction of the Engineer. Regarding acceptance of the joints, decision of the Engineer shall be final. All X-ray films of joints radiographed at site shall become the property of the Owner. Following optional non-destructive tests after completion of erection of all piping and equipment shall be carried out: (a) Ultrasonic test per weld joint		

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(b) Hardness test for 10% weld joints for each system of piping and/or as specified in the approved Field Quality Plan (FQP).		

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TABLE-1				
Valve size NB in mm	ANSI Class upto 300	ANSI Class above 300 upto 600	ANSI Class above 600 below 900	ANSI Class 900 & above & below 4500
Less than 50	Visual	Visual	Visual	MPI
50 & above but below 100	Visual	Visual	MPI	MPI & RT (on 10% of valves on 100% area)
100 & above but less than 300	Visual	MPI	MPI & RT (on 10% of valves on change of section & weld ends)	MPI & RT (on 100% area)
300 and above	MPI	MPI	MPI & RT (on change of sections & weld ends)	MPI, RT on 100% area)

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3.0 <u>LOW PRESSURE PIPING SYSTEM (INCLUDES LARGE DIA CW PIPE)</u>																
Tests/Check Items / Components		Material Test	DPT/MPI	Ultrasonic Test	WPS/ WQS/PQR	Balancing	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operational Test	Performance Test	Other Tests	All Tests as per relevant Std	Adhesion/Spark Tests	REMARKS
3.1	Pipes & Fittings and Metered Bends	Y ^a	Y ^b		Y		Y									
3.2	Diaphragm Valves	Y ^a					Y ⁵			Y				Y ⁶		
3.3	Butterfly Valves (Low Pressure)															
(a)	Cast Butterfly Valves															
	i. Body (Cast)	Y ^a	Y ^b				Y		Y	Y	Y		Y ⁷			
	ii. Disc (Cast)	Y ^a	Y ^b													
	iii. Shaft	Y ^a	Y	Y ^c												

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(b)	Fabricated Butterfly Valves														Ref Note 14
3.4	Gate/ Globe/ Swing Check Valves	Y ^a	Y ^b	Y ^c			Y ⁵	Y	Y				Y ⁸		
3.5	Dual Plate Check Valves	Y ^a	Y ^b	Y ^c			Y	Y	Y				Y ⁴		
3.6	Rolled & Welded Pipes	Y ^a	Y ³		Y		Y ¹			Y					
3.7	Coating & Wrapping of Pipes	Y ²											Y ²		
3.8	Strainers	Y ^a	Y ^b				Y						Y ¹ ₁		
3.9	Rubber Expansion Joints	Y ^a					Y ¹²		Y	Y			Y ¹ ₃		
3.10	Rubber Lining of Pipes	Y ^a	Y ^b		Y		Y			Y			Y ⁹	Y	
3.11	Hangers & Supports	Y ^a						Y							
3.12	Fasteners	Y ^a		Y _b				Y							
3.13	Site Welding		Y ¹		Y		Y								
<u>Notes:</u>															

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1. Weld Joints not subjected to hydraulic test shall be subjected to 100% RT. 2. Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes shall be as per AWWA-C-203-91. 3. DPT on route run and after back gouging and on finish welds. 4. Dry Cycle Test (Spring Cycle Test) for one lac Cycles shall be carried out as a type test. 5. Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator. 6. Tests on rubber parts per batch of rubber mix such as hardness, adhesion, spark test, bleed test and flex test on diaphragm, type test for diaphragm for 50,000 cycles. 7. Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with AWWA-C-504 in presence of owner's representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. Seat Leakage Test shall be carried out in both directions. 8. Blue matching, wear travel for gates, valves, pneumatic seat leakage, reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes. 9. Hardness, Bleeding Test and Ozone resistance test shall be done on rubber material. 10. 2% of welds shall be subjected to DPT. 11. Pressure drop across the strainer for each type and size as a special test shall be carried out. 12. During hydraulic and vacuum tests at 25 mm Hg (abs) in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test, permanent set in dimension should not exceed 0.5%.		

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13. Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149, aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out. 14. For fabricated butterfly valves: UT as per ASTM A-435 on plate material for body and disc. 100% RT as per ASTM, Section-VIII, Division-I, on butt joints of body and disc and post weld heat treatment as per ASME, Section-VIII, Division-I on butt joints of body and disc of thickness above 30mm shall be carried out in addition to other tests indicated for cast butter fly valves. (a) One per heat/heat treatment batch/lot. (b) On machined surfaces only for castings and on finished butt welds. (c) For shaft/spindles > or = 50 mm. 4.0 <u>THERMAL INSULATION</u> 4.1 The Contractor shall furnish test certificates from any one of the independent authorities listed below or any other reputed body subject to Purchase's/Consultant's prior approval for all the tests as mentioned later. (a) National Test House - Calcutta/Bombay (b) Central Glass & Ceramic Research Institute, Calcutta (c) National Metallurgical Laboratory, Jamshedpur (d) Central Mechanical Engineering Research Institute, Durgapur (e) National Physical Laboratory, Delhi (f) Central Building Research Institute, Roorke, U.P. (g) Any other internationally reputed Test House. 4.2 The Contractor shall carry out all the tests according to IS: 8183/3144 or according to any other internationally accepted standards. The tests shall be		

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done on representative samples drawn from the insulating material supplied under this section of specification. All the tests mentioned in IS: 3144 shall be carried out for establishing various chemical and physical properties (as mentioned below) in accordance with the procedure laid down therein. Owner shall have the right to witness any or all of the tests conducted by the contractor at the shop or laboratory.

Following shall be met by testing as per relevant clauses of IS: 3144.

(a)	Shot content	5% by weight (max.), size of any shot not to exceed 5 mm in diameter
(b)	Weight gain by moisture Absorption	2% (max.)
(c)	Sulphur Content	Not exceeding 0.6%
(d)	Alkalinity as Percentage of Na ₂ O	Not exceeding 0.6%
(e)	Maximum oil content	Not exceeding 0.3% by weight
(f)	Total carbon content	Not exceeding 0.3% by weight
(g)	Settlement	Nil (When tested as per Cl. 21.1 & 21.2 of IS:3144)
(h)	Handability	Fully handable, without any lump formation and disintegration of material
(i)	Loss of weight after	Not exceeding 5% by weight combustibility test

4.3 The Bidder shall furnish the following test reports along with the offer:

(a)	Thermal conductivity of the insulating material at various mean temperatures.
(b)	Retention of binder at elevated temperature

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(c) All other tests as per IS: 9842/8183. 4.4 The Contractor shall guarantee that if, on actual measurement, the specified maximum insulation surface temperatures are exceeded and the contractor shall either replace the insulation with a superior material or provide additional insulation thickness at no extra cost.		

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	TITLE:		SPECIFICATION NO. PE-TS-415-673-A001	
	1X660 MW BHUSAWAL THERMAL POWER STATION UNIT -6		SECTION : II	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		SUB-SECTION : IIB	
			REV. NO. 00	DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

SUB-SECTION IIB - GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)

20/PS-PEM-MAX 29/08/2005 	FILE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
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1.0

INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0

CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0

DESIGN REQUIREMENTS

3.1

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2

Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3

Starting Requirements

3.3.1

Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2

Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.



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FOR
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The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 Running Requirements

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 Stress During bus Transfer

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

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4.4. 4.5 4.6 4.7 4.7.1 4.7.2 4.7.3 4.7.4 4.7.5 4.7.6 4.7.7 4.7.8. 4.7.9 4.8 4.9	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C. Terminals and Terminal Boxes Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A". unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end. Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively. Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation. Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A. Degree of protection for terminal boxes shall be IP 55 as per IS 4691. Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors. Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type. Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal. General	

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	4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.	

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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 protection

4. Applicable standard to which motor generally conforms

5. Efficiency class as per IS 12615

6. (a) Whether motor is flame proof Yes/No

(b) If yes, the gas group to which it conforms as per IS:2148

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 equipment in KW

12. Rated Voltage (volts)

13. Permissible variation of :

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- a. Voltage (Volts)
 - b. Frequency (Hz)
 - c. Combined voltage and frequency
14. Rated speed at rated voltage and frequency(RPM)
15. At rated Voltage and frequency:
 - a. Full load current
 - b. No load current
16. Power Factor at
 - a. 100% load
 - b. NO load
 - c. Starting.
17. Efficiency at rated voltage and frequency,
 - 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

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21. Safe stall time with 100% and 110% of rated voltage
 - a. From hot condition
 - b. From cold condition
22. Torques :
 - a. Starting torque at min. permissible voltage(kg-mtr.)
 - 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 Deg.C.)
24. GD^2 value of motors
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)

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- 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 power cable)
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)

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)
No of contacts and contact ratings of speed switch

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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)

ii) Full load Field current (Amp)

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- iii) No load Armature current (Amp)
6. Full load Field current (Amp)
7. No load Armature current (Amp)
8. Minimum permissible field current(Amp) to avoid overspeeding at
 - 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 deg.C
 - 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 obtain rated speed at
 - 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

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16. Starter resistance design calculation
17. Electrical connection diagram of motor

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DOCUMENT TITLE

CONDUITS AND PIPES

SPECIFICATION NO. PES-507-27

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**GENERAL TECHNICAL REQUIREMENTS
OF
CONDUITS AND PIPES
SPECIFICATION NO. PES-507-27
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1.0 GENERAL

- 1.1 This specification covers the manufacture, inspection & testing at vendor's works and delivery to site of conduits, pipes and their fittings for electrical installation.

2.0 CODES AND STANDARDS

- 2.1 The material, constructional features and various processes involved in manufacture shall comply with currently applicable Indian Standards.
- 2.2 The following Indian Standards shall be applicable, in general. However if Data Sheet A specifies conformance to other international standards, the equivalent IEC/BS/other standards shall be considered.

- a) IS:9537 (All Parts) Conduits for electrical installation.
- b) IS:3480 Flexible steel conduits for electrical wiring.
- c) IS:6946 Flexible non-metallic conduits for electrical installation.
- d) IS:1239 Mild steel tubes, tubulars and other wrought steel fittings.
(for size above 63mm dia of rigid conduits)
- e) IS:2667 Fittings for rigid steel conduits for electrical wiring.
- f) IS:3837 Accessories for rigid steel conduits for electrical wiring.
- g) IS:3419 Fittings for rigid non-metallic conduits.
- h) IS:6005 Code of practice for phosphating iron & steel.
- i) IS:2629 Recommended practice for hot dip galvanizing on iron and steel.
- j) IS:4759 Specification for hot dip zinc coatings on structural steel and allied products.
- k) IS:6745 Methods for determination of mass of zinc coating on zinc coated iron and steel articles.

3.0 DESIGN REQUIREMENTS AND CONSTRUCTIONAL FEATURES

The conduit and conduit accessories shall include conduit plugs & caps, gaskets and box cover etc in addition to any specific requirement given in Data Sheet A. The diameter of conduits and accessories shall be uniform throughout the length.

3.1 Rigid Conduits and Fittings

- 3.1.1 Rigid conduits shall generally conform to the requirements of IS:9537 (Part I & Part II). However conduits above 63mm diameter shall conform to the requirements of IS:1239. Unless specified otherwise in Data Sheet A, all conduits and pipes shall be of medium duty.

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- 3.1.2 The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS:4759. Conduits shall be thoroughly cleaned and pretreated, conforming to IS:6005.
- 3.1.3 Conduits shall be supplied in approximate length as specified below
- Rigid Conduits 5 metres
 - Flexible Conduits 10 - 30 metres
- 3.1.4 Each end of conduit length shall be threaded. The ends of conduits shall be sealed with protective caps to prevent damage to threaded portions and entrance of moisture and foreign material.
- 3.1.5 The inside surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.
- 3.1.6 Conduit fittings shall be made out of tube or cast to the shape as to match with corresponding conduit sizes and meet their purpose without any special adjustment.
- 3.1.7 All fittings shall be screwed type and hot dip galvanized inside and outside.
- 3.2 Flexible Metallic Conduits and Fittings
- 3.2.1 Flexible metallic conduits shall generally conform to the requirements of IS:3480.
- 3.2.2 Flexible conduits shall be made of strip steel which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout.
- 3.2.3 The strip shall be electro galvanized to a minimum thickness of 25 microns as specified in IS:3480. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pretreatment, before galvanization, shall conform to IS:6005.
- 3.2.4 The strip for making flexible conduit shall be wound tightly and so overlapped in subsequent helicals that no openings are seen in normal position.
- 3.2.5 Flexible conduits shall be lead coated for application in high temperature zones, if specifically mentioned in Data Sheet A.
- 3.2.6 The conduit shall have uniform diameter throughout its length. The internal surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.
- 3.3 PVC Conduits
- 3.3.1 PVC conduits shall generally conform to the requirements of IS:9537(Part I & Part III).
- 4.0 INSPECTION
- 4.1 The following stages of manufacture shall be stage inspected by Purchaser or his duly authorized representative.
- Inspection of manufacturing processes such as shearing, punching, bending, welding, galvanizing etc.
 - Inspection of packing material and procedure.

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4.1.3 Inspection of finished product.

4.2 The inspection will be carried out as per agreed quality plan.

5.0 TESTING

5.1 Rigid Conduits

- a) Acceptance Tests - as per IS:9537 Part 1 & 2 upto 63mm OD
 - as per IS:1239 above 63mm OD
 - i) Dimension checks
 - ii) Bending test (below 32mm OD)
 - iii) Compression test
- b) Special Tests (as acceptance test) as applicable to galvanizing.

5.2 Flexible Steel Conduits

- a) Acceptance Tests - as per IS:3480
 - i) Dimension checks
 - ii) Linear breaking test
 - iii) Test for flexibility
 - iv) Bend fracture test
 - v) crushing test
- b) Special Tests (as acceptance test) as applicable to galvanizing.

5.3 PVC Conduits

- a) Type Tests - as per IS : 9537 (Part 1 & 3)
 - i) Dimension checks
 - ii) Bending test
 - iii) Compression test
 - iv) Impact test
 - v) Collapse test
 - vi) Resistance test
 - vii) Resistance to burning

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viii) Electrical Characteristics

b) Acceptance tests - as per IS:9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Collapse test

v) Resistance to burning

vi) Electrical characteristics

5.4 Sampling for the tests shall be done as per applicable standards mentioned above.

5.5 The testing shall be carried out as per agreed quality plan.

6.0 PACKING

6.1 The material shall be packed as per manufacturer's standard. Packing procedure shall be to the purchaser's approval.

7.0 DRAWING, DATA AND DOCUMENTS REQUIRED

7.1 The following information shall be furnished within two weeks of award of contract, for purchaser's approval.

a) Manufacturing drawings/details.

b) Recommended Field quality plan covering site handling, storing, laying etc.

c) Final quality plan.

7.3 The following information shall be furnished after testing and inspection

Type Test, routine test and special test certificates in bound volume in requisite number.

	DOCUMENT TITLE CONDUITS AND PIPES	SPECIFICATION NO. PES-507-27	
		VOLUME II B	
		SECTION D	
		REVISION 0	DATE: 27/10/2010
		SHEET 6	OF 6

DATASHEET A

SPECIFIC TECHNICAL REQUIREMENTS

- 1.0 APPLICABLE STANDARDS: IS:9537,IS: 1239, IS:3480
- 2.0 RIGID STEEL CONDUITS & STEEL PIPES
- a) Material: Cold rolled mild steel to IS:226
 - b) Applicable standard
 - i) Upto 63mm OD: IS:9537 Part I & II
 - ii) Above 63mm OD: IS:1239
 - c) Surface treatment: Hot dip galvanizing inside & outside as per IS:2629
 - d) Wt. of zinc: as per IS 4759
 - e) Duty: Medium
 - f) Fittings: Screw type as per IS:2667
- 3.0 FLEXIBLE CONDUITS:
- a) Material: Strip steel cold rolled and annealed
 - b) Standard applicable: IS: 3480
 - c) Surface treatment: Electro galvanized as per IS: 3480
 - d) Whether lead coated: YES
 - e) Minimum thickness: 25 microns
of zinc coating
- 4.0 PVC CONDUITS
- a) Material: PVC
 - b) Applicable standard: IS: 9537 (Part I & III)

	Design Calculations For LT Cable Selection & Sizing	
	1 x 660MW BHUSAWAL T.P.S UNIT-6	

CONSTRUCTIONAL DETAILS OF CABLES SELECTED**(A) LT POWER & CONTROL CABLES**

S.NO.	PARTICULARS	DETAILS	
		LT POWER CABLES	LT CONTROL CABLES
1	REFERENCE STANDARD	IS: 7098 -PART -1	IS -1554 PART -1
2	SYSTEM	415 V AC , 240 V AC & 220V DC	220V DC & 110 V AC
3	VOLTAGE GRADE	1.1 KV	1.1 KV
4	CONDUCTOR		
4.1	MATERIAL	STRANDED COMPACTED PLAIN ALUMINIUM CONDUCTOR OF H2 GRADE CLASS 2 / STRANDED HIGH CONDUCTIVITY ANNEALED PLAIN COPPER.	STRANDED, NON COMPACTED, HIGH CONDUCTIVITY ANNEALED PLAIN COPPER
4.2	REFERENCE STANDARD	IS 8130	IS 8130
4.3	SHAPE	CIRCULAR/ SHAPED	CIRCULAR
4.4	MINIMUM SIZE	ALUMINIUM- 16 SQ.MM. COPPER- 2.5 SQ. MM.	2.5 SQ.MM.
4.5	MAXIMUM CONDUCTOR TEMPERATURE WHEN CARRYING CONTINUOUSLY CURRENT	90°C	70°C
4.6	MAXIMUM CONDUCTOR TEMPERATURE AT THE TERMINATION OF SHORT CIRCUIT CURRENT	250°C	160°C
5	NO. OF CORES	1C,2C,3C,3.5C,4C	AS PER CLAUSE 4.2.1
6	INSULATION	EXTRUDED XLPE	EXTRUDED HRPVC, TYPE-C
6.1	REFERENCE STANDARD	IS: 7098 -PART -1	IS -5831 & IS-1554 PART-I
7	CORE IDENTIFICATION	BY COLOR CODING AS PER IS: 7098 -PART -1	i) CONTROL CABLES UPTO 5 CORE- COLOR CODING AS PER IS 1554 (Part-1) (ii) CONTROL CABLES ABOVE 5 CORES- BY NUMBERING AS PER IS 1554 (Part-1). INSULATION TO HAVE BLACK COLOR.
8	INNER SHEATH	EXTRUDED HRPVC FRLS TYPE -ST2 FOR MULTI CORE CABLES. SINGLE CORE SHALL HAVE NO INNER SHEATH.	EXTRUDED HRPVC TYPE -ST2 FRLS FOR MULTI CORE CABLES. SINGLE CORE SHALL HAVE NO INNER SHEATH.
8.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I	IS: 5831 & IS-1554 PART I
9	ARMOUR	NON-MAGNETIC HARD DRAWN ALUMINIUM ROUND WIRE ARMOUR OF H4 GRADE FOR SINGLE CORE CABLES AND GS ROUND STEEL WIRE ARMOUR FOR MULTI- CORE CABLES	GS ROUND STEEL WIRE ARMOUR FOR TWIN & MULTICORE CABLES
9.1	REFERENCE STANDARD	IS:3975 & IS 7098 PART I	IS 3975 & IS-1554 PART I
10	OUTER SHEATH	EXTRUDED FRLSH HRPVC TYPE ST2	EXTRUDED FRLSH HRPVC TYPE ST2
10.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I	IS: 5831
11	MARKING	(i) CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES, VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE-AT EVERY 5M (BY EMBOSSING), 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing), (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY EMBOSSING/PRINTING)	
12	CABLE DRUMS		
12.1	TYPE OF DRUM	WOODEN (HEAVY CONSTRUCTION) AS PER IS 10418	
12.2	STANDARD DRUM LENGTH	500M FOR LARGER SIZES / 1000M FOR SMALLER SIZES (±) 5% (AS SPECIFIED IN BOQ)	
12.3	PAINTING	ENTIRE SURFACE TO BE PAINTED. ALL FERROUS PARTS USED SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING TO AVOID RUSTING DURING TRANSIT OR STORAGE. WOODEN CABLE DRUMS SHALL BE TREATED BY IMMERSING IN COPPER-NITRATE SOLUTION. DRUM NUMBER SHALL BE INDICATED ON EACH DRUM.	
12.4	OUTERMOST LAYER	TO BE COVERED WITH WATERPROOF POLYETHYLENE	
12.5	CONSTRUCTION	ALL WOODEN PARTS FROM SEASONED WOOD AND FERROUS PARTS SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING. WOODEN DRUM SHALL BE TREATED BY IMMERSING IN COPPER NITRATE SOLUTION.	

	Design Calculations For LT Cable Selection & Sizing	
	1 x 660MW BHUSAWAL T.P.S UNIT-6	

12.6	PARTICULAR INFORMATION ON DRUM	BOTH THE END OF CABLES SHALL BE PROPERLY SEALED WITH HEAT SHRINKABLE SEAL. THE CABLE DRUMS SHALL CARRY THE FOLLOWING DETAILS IN PRINTED FORM: A) MSPGCL B) MANUFACTURER'S NAME OR TRADE MAKE C) TYPE OF CABLE & VOLTAGE GRADE D) YEAR OF MANUFACTURE E) TYPE OF INSULATION E.G. XLPE/HRPVC/IE2 F) NO. OF CORE AND SIZES OF CABLES G) CABLE CODE E.G. FRLS/FS H) SINGLE LENGTH OF CABLE ON DRUM I) DIRECTION OF ROTATION, BY ARROW J) APPROX GROSS MASS
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(B) **SCREENED CONTROL CABLES**

S.NO.	PARTICULARS	DETAILS
1	VOLTAGE GRADE	1100V
2	TYPE OF CABLES	TYPE F (INDIVIDUAL & OVERALL SCREENED) & TYPE G (OVERALL SCREENED)
3	CODES AND STANDARD	IS-1554 PART-1, IS-5831, IS-8130, IS-694, SEN-4241475, IEC-60332 (I).
3(i)	CONDUCTOR	
(a)	CROSS SECTION AREA	0.5 sq.mm
(b)	CONDUCTOR MATERIAL	STRANDED, TINNED ANNEALED HIGH CONDUCTIVITY COPPER
(c)	CONDUCTOR GRADE	ELECTROLYTIC
(d)	NO. & DIA OF STRANDS	7 X 0.3 mm
(e)	NO. OF PAIRS	0.5 sq.mm. - 2P, 4P, 8P, 12P, 24P
(f)	REFERENCE STANDARD	IS-8130
(ii)	INSULATION	
(a)	MATERIAL	EXTRUDED HR PVC TYPE-C AS PER IS-5831
(b)	THICKNESS IN mm	0.6 (NOMINAL) AS PER IS-694
(c)	VOLUME RESISTIVITY (MIN) IN ohm-cm	i. 1×10^{13} Ohm-cm at 27 deg.C / room temp. (Min). ii. 1×10^{10} Ohm-cm at 85 deg.C (Min.)
(d)	VOLTAGE RATING	1100V
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831
(f)	OD OF COND. INCLUDING INSULATION	AS PER MANUFACTURER'S CALCULATIONS / STD. PRACTICE
(iii)	PAIRING & TWISTING	
(a)	MAX. LAY OF PAIRS (mm)	60
(b)	CONDUCTOR / PAIR IDENTIFICATION	AS PER ATTACHED ANNEXURE D
4	SHIELDING	
(a)	TYPE OF SHIELDING	AL-MYLAR TAPE
(b)	INDIVIDUAL PAIR SHIELDING	TO BE PROVIDED FOR TYPE-F CABLE ONLY
(c)	OVERALL SHIELDING	TO BE PROVIDED FOR BOTH TYPE-F & TYPE-G CABLES
(d)	MINIMUM THICKNESS OF INDIVIDUAL PAIR SHIELDING	28 MICRONS
(e)	MINIMUM THICKNESS OF OVERALL CABLE ASSEMBLY SHIELDING	60 MICRONS
(f)	SHIELDING COVERAGE	100% WITH AT LEAST 25% OVERLAP
5	DRAIN WIRE (To be provided separately for individual pair shield and overall shield.)	
	Material	Multi stranded Annealed tinned copper drain wire.
	Size (No. of strands/ Dia. of each strand)	0.5 sq. mm. (7/0.3 mm.)
6	FILLERS (if applicable)	
(a)	TYPE	NON -HYGROSCOPIC WITH FRLS PROPERTY (AS REQUIRED FOR MAINTAINING CABLE CIRCULARITY)
7	INNER SHEATH	
(a)	MATERIAL	EXTRUDED HR PVC TYPE ST-2 AS PER IS-5831
(b)	THICKNESS	AS PER IS-1554 PART-1
(c)	Whether FR-LSH Applicable	YES
(d)	COLOUR	BLACK
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831
8	RIP CORD	NON-METALLIC RIP CORD UNDER THE INNER SHEATH
9	ARMOUR	GALVANISED STEEL ROUND WIRE / STRIP AS PER IS-3975 & IS-1554 PART-1

	Design Calculations For LT Cable Selection & Sizing	
	1 x 660MW BHUSAWAL T.P.S UNIT-6	

10	OUTER SHEATH		
(a)	MATERIAL	EXTRUDED HR PVC TYPE ST-2 AS PER IS-5831	
(b)	THICKNESS	AS PER IS-1554 PART-1	
(c)	Whether FR-LSH Applicable	YES	
(d)	COLOUR	GREY	
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831	
(f)	MARKING	(i) CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES, VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE-AT EVERY 5M (BY EMBOSSING), 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing), (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY EMBOSSING/PRINTING)	
11	TECHNICAL PARAMETERS (C & I) AT 20 DEG C	0.5 sqmm (IS & OS) Type F	0.5 sqmm (OS) Type G
(a)	MUTUAL CAPACITANCE (MAX.) AT 0.8 KHz, nF / Km	120	100
(b)	CONDUCTOR LOOP RESISTANCE (MAX.), Ohm / Km	78	78
(c)	INSULATION RESISTANCE (MIN.), M Ohm / Km	100	100
(d)	CROSS TALK ATTENUATION (MIN.) AT 0.8KHz, dB / Km	60	60
(e)	CHARACTERISTIC IMPEDANCE (MAX.) AT 1KHz, Ohm	320	340
(f)	ATTENUATION (MAX.) AT 1KHz, dB / Km	1.2	1.2
12	FR-LSH CHARACTERISTICS		
(b)	SMOKE DENSITY RATING	Max. 60% (As per ASTM D 2843): Area under coverage.	
(c)	ACID GAS EMISSION	Max. 20% by weight (As per IEC-60754-1)	
(d)	OXYGEN INDEX	Min 29 at room temperature (As per ASTM D 2863)	
(e)	TEMPERATURE INDEX	Min. 250 deg.C at oxygen index value of 21 (As per ASTM D 2863)	
13	FLAMMABILITY TEST	(1) AS PER IEC-332-1 (2) Swedish Chimney test SEN-SS-424-1475-F3	
14	TEST VOLTAGE & DURATION (High Voltage Test)		
(a)	Core to core	1.5 kV for 1 minute	
(b)	Core to shield	1 kV for 1 minute	
15	CABLE DRUM DETAILS		
(a)	Material Type	Wooden, as per IS 10418	
(b)	Standard drum length	1000 metres: upto and including 12 Pairs. 500 metres: above 12 pairs.	
(c)	Tolerance on drum length	±5%	
(d)	Painting	ENTIRE SURFACE TO BE PAINTED. ALL FERROUS PARTS USED SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING TO AVOID RUSTING DURING TRANSIT OR STORAGE. WOODEN CABLE DRUMS SHALL BE TREATED BY IMMERSING IN COPPER-NITRATE SOLUTION. DRUM NUMBER SHALL BE INDICATED ON EACH DRUM.	
(e)	Outermost layer	TO BE COVERED WITH WATERPROOF POLYETHYLENE	
(f)	Construction	ALL WOODEN PARTS FROM SEASONED WOOD AND FERROUS PARTS SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING. WOODEN DRUM SHALL BE TREATED BY IMMERSING IN COPPER NITRATE SOLUTION.	

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
 C = 3.3KV (Power cables)
 D = 1.1KV (LV & DC system power & control cables)
 E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

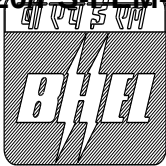
J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
 T = TOUGH RUBBER SHEATH
 U = OVERALL SCREENED
 V = PAIRED OVERALL SCREENED
 W = PAIRED INDIVIDUAL SCREENED
 Y = COMPENSATING CABLES
 I = PRE-FABRICATED CABLES
 Z = JELLY FILLED CABLES

5185/2020/PS-DEM-MAX

	TITLE: 1X660 MW BHUSAWAL THERMAL POWER STATION UNIT -6	SPECIFICATION NO. PE-TS-415-673-A001	
		SECTION : II	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION : IIC	
		REV. NO. 00	DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

SUB-SECTION IIC - GENERAL TECHNICAL REQUIREMENTS (C&I)

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION: C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
C&I DELIVERABLES LIST		

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT							
1X660 MW BHUSAWAL TPP							
DOCUMENT NUMBER PE-GL-415-145-I100							
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-415-XXX-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-415-XXX-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-415-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-415-XXX-I904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-415-XXX-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
6	PE-V9-415-XXX-I908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
7	PE-V9-415-XXX-I909	DCS INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
8	PE-V9-415-XXX-I913	CONTROL PANEL LAYOUT/ GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-415-XXX-I918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	`	VENDOR	C&I	
10	PE-V9-415-XXX-I919	PROCESS GRAPHIC MANUSCRIPTS FOR DCS	I	-	VENDOR	C&I	
11	PE-V9-415-XXX-I920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
12	PE-V9-415-XXX-I921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS (from Field to JB to DCS)	I	-	VENDOR	C&I	
13	PE-V9-415-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
	Notes:	415 - Project No.					
		XXX -MAX Package Code					
		\$\$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item					

5185/2020/PS-PEM-MAX

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR MOTORISED VALVE ACTUATOR		

 MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 11
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 385 of 440
1.0	<u>SCOPE</u> 1.1 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates. 1.2 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. <u>2.0 STANDARDS</u> 2.1 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification. 2.2 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed: (a) IS-9334 (b) IS-325 <u>3.0 SERVICE CONDITIONS</u> 3.1 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash. 3.2 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification. <u>4.0 RATING</u> 4.1 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer. 4.2 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 11
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 386 of 440

5.0 PERFORMANCE

The actuator shall meet the following performance requirements:

- 5.1 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.2 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).
- 5.3 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.4 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.5 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.0 SPECIFIC REQUIREMENT

6.1 CONSTRUCTION

- 6.1.1 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be integral type. Integral starter shall have facility to hook-up with Plant DCS for positioning of limit and torque switches.
- 6.1.2 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.
- 6.1.3 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.1.4 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

CONSULTANT : PROCON ENGINEERS

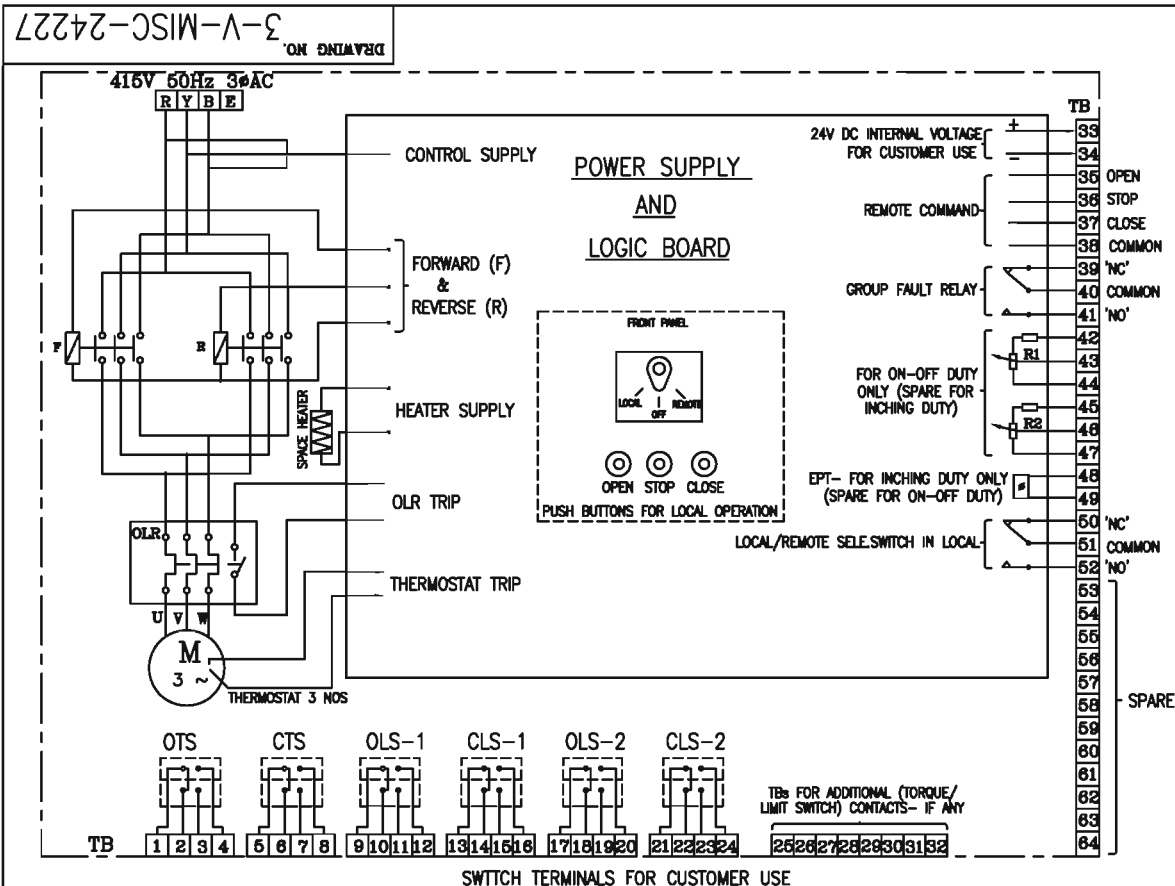
 MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 11
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 387 of 440
6.2	<u>MOTOR</u> 6.2.1 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. 6.2.2 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current. 6.2.3 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each. 6.2.4 Earthing terminals shall be provided on either side of the motor. 6.3 <u>LIMIT SWITCHES</u> Each actuator shall be provided with following limit switches: 6.3.1 Two (2) torque limit switches, one for each direction of travel, self-locking, adjustable torque type. 6.3.2 Four (4) end-of-travel limit switches, two for each direction of travel. 6.3.3 Two (2) position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper. 6.3.4 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C. 6.4 <u>HAND WHEEL</u> Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.	

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 MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 12
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 388 of 440
6.5	<u>POSITION INDICATOR/TRANSMITTER</u> The actuator shall have: 6.5.1 One (1) built-in local position indicator for 0-100% travel 6.5.2 One (1) position transmitter, potentiometer type, for remote indicator. 6.6 <u>SPACE HEATER</u> A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply. 6.7 <u>WIRING</u> All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. 6.8 <u>TERMINAL BOX</u> The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor. 7.0 <u>TEST</u> 7.1 The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed. 7.2 <u>TEST WITNESS:</u> Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.	

CONSULTANT : PROCON ENGINEERS

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.



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.	VALVE POSITION	
		FULL OPEN	FULL CLOSE
		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 OF 100 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:-

- 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
- CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
- OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
- OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
- CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
- EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
- R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
- FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
- M - MOTOR 3Φ 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CHD & APPD

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TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)			
BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPALLI-620014.		DRN N.P.ESWAR	SIGN N.P	DATE 07.10.04	NO. OF VAL.
DEPT VL	SCALE	WEIGHT (KG).	REFERENCE INFORMATION		NO. OF THUMB
CODE					
TITLE WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER		CARD CODE U 01	DRAWING NO. 3-V-MISC-24227		REV 0

Size A3

5185/2020/PS-PFM-MAX

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR FIELD INSTRUMENTS		

22.00.00 SPECIFICATIONS OF EFFLUENT QUALITY MONITORING SYSTEM (EQMS)

22.01.00 COMMON REQUIREMENTS FOR ALL ANALYSERS

Sno	Features	Minimum Requirement
1.	Output signals	Analog 4-20 mA DC galvanically isolated.
2.	Zero & span Adjustment	To be provided with range selection facility
3.	Ambient temp	50 degC
4.	Sample Temperature	40 degC
5.	Indication	Digital Alphanumeric Display of reading in engineering units shall be provided.
6.	Type of Electronics	Microprocessor based with self-diagnostic
7.	Others	All interconnection tubing and cabling

		between sensor and analyzer / analyzer panel etc to be provided. All chemical reagents required for EQMS analyzers for entire AMS period is to be supplied in phased manner depending on shelf life.
8.	Location of the Temp & flow measurement	Effluent Treatment plant outlet (Exact location to be decided by contractor in consultation with site)
9.	Location of the Analyser cabinet/enclosure	
10	Accessories	All the accessories required for mounting the sensor/analyser are to be provided
11	Digital Signal Transmission	Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer's central cloud server in addition to 4-20 ma connectivity to DDCMIS.
12	Compliance to standards	Latest regulatory requirements of CPCB/SPCB/other regulatory/statutory body prevailing at the time of award of the contract.

22.04.00**BOD BIOLOGICAL OXYGEN DEMAND / COD CHEMICAL OXYGEN DEMAND ANALYSER**

Principle	COD/BOD measurement by: Option A. Total Organic Carbon (TOC) measurement complying to US EPA 415.1 / 415.2 or equivalent standard for effluent/sewage/waste water. Option B. UV-VIS spectrometer measuring absorption in UV-VIS spectrum.
Measuring Range	0-50 mg/L for BOD, 0-500 mg/L for COD
Response Time	<= 15 min
Power	To be arranged by contractor
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 3%

22.07.00**ENCLOSURE/CABINETS / PANELS FOR EQMS AND ANALYSERS**

The enclosure shall accommodate all EQMS Analyzers. The enclosure of all analyzers shall provide protection from dust, humidity, precipitations, sunlight and environmental pollution. The material for the enclosure shall be of steel plate (SS304) with minimum 2 mm thick frame and minimum 2 mm thick steel (SS-304)

sheet of protection IP 65 or better with safety lock of good quality. The lighting provision in the cabinet is to be provided. The cabinets shall be designed such that the wet section and dry section are separate, the exact details shall be finalized during detailed engineering. The panel shall be free standing type constructed of suitable 3 mm thick channel frame of SS and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.

In order to ensure the healthy operation of the installed electronic modules, cards, analyzers, etc inside the enclosure during continuous operation, the EQMS enclosure shall be provided with Air conditioner unit.

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
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5.1 CONDUCTIVITY ANALYZER		
5.1.1 Sensor		
(a)	Type of Cell	: Flow thru'.
(b)	Conductivity Range	: As per instrument schedule
(c)	Cell Constant	: 0.01/0.1/1.0 depending upon range.
(d)	Temp. Compensation	: Manual and Automatic (Integral) 0-100°C.
(e)	Process Connection	: Screwed.
(f)	Wetted Parts	: Electrodes-SS316L/ Insulators KYNAR/Viton.
(g)	Pressure Rating	: 10 kg/cm ² .
(h)	Accessories	: Vessel (SS 316) with ½" NPT connection.
(i)	Cable	: Upto transmitter in flexible conduct.
5.1.2 Transmitter		
(a)	Type	: Microprocessor based, Single stream
(b)	Mounting	: Flush Panel.
(c)	Protection Class	: IP-55 or better.
(d)	Output	: 4-20 mA DC (isolated).
(e)	Display	: Digital Display in Engineering Unit, Alarm Status.
(f)	Zero/Span Adjustment	: Front Panel Membrane type

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
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Keyboard. (g) Temp. Compensation : Manual or Automatic. (h) Diagnostic : Self diagnostic for electronics, electrode etc. (i) Alarm : Dual set point, hysteresis and time delay adjustable. (j) Enclosure : Die cast aluminium, epoxy coated. (k) Cable Termination : Internal (cable entry through conduit). (l) Accuracy : ± 1.0 % of measured range. (m) Response time : Less than 5 sec. (n) Stability : ± 1.0 % of output range / month non-cumulative. (o) Accessories : For cation conductivity- Dual Ion-Exchange column, resin, etc. (minimum 12 months' requirements). 5.2 <u>pH ANALYZER</u> : 5.2.1 Sensor : (a) Type of Cell : Flow thru'. (b) Range : 0-14 pH. (c) Type of measurement : Combination electrode. (d) Temp. Compensation : Manual and Automatic (Integral) 0-100 °C.			

CONSULTANT : PROCON ENGINEERS
