

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
	Paints and varnishes, primers, thinners etc. as required for anti-corrosive protection of piping & equipment above ground. i) Bidder shall provide anti-corrosive protection anticorrosive tape or coating-wrapping on the external surfaces of pipes to all directly buried piping including galvanized carbon steel piping. j) On the internal surface of all pipes 1000 mm and above, a coat of primer followed by a hot coat of coal tar enamel paint or coal tar epoxy paint shall be applied. k) Excavation, preparation of bed, backfilling with compaction of soil and removal of extra-earth to designated places in case of pipes to be buried. l) Bidder shall also design, supply, fabricate, erect, set and commission all hangers, tie-rods, turn-buckles, supports, guides, restraints, anchors, etc. as required for the, piping system. This includes the provision of all associated steel work including brackets, cradle supports, duck feet, channels, angles, etc. It is Bidder's responsibility to estimate these requirements and include them in their offer price. Whenever, straight run of the yard pipes are more than 300 meters, flexibility analysis shall be conducted by the contractor to identify the requirement of loops, type of supports etc. m) In covered concrete trenches bidder shall supply necessary supporting materials such as stools, saddles, base plates, clamps, U-bolts, angles, clips etc. n) Bidder shall supply all necessary drains and vents with drain & vent valves including anti-flash funnels and moisture traps for compressed air system as required for the safe and effective draining-venting of the piping systems based on the approved flow scheme / single line diagram. It is bidder's responsibility to identify the requirements of drains, vents, and supply the necessary pipe work, fittings, hangers and supports etc. for the same. o) Bidder shall supply and install necessary matching pieces as may be needed for connection of piping systems with equipment terminals, valves and specialties. p) Bidder shall erect all instrument impulse piping and fittings from the tap-off point of the last root valve including the root valve and instruments. q) Bidder shall perform necessary internal machining of pipe for installing orifices, flow nozzles, straightening vanes etc. r) The Bidder shall prepare the flow diagrams, detailed dimensional piping layout/ Isometric/ fabrication/ As built drawings of all the systems along with Cross sectional drawings, showing all supports and equipment as required.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION-VI. PART-A BID DOC.NO. CS-9585-001-2	SUB SECTION- IIA-01 LOW PRESSURE PIPING	PAGE 3 OF 5

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
1.04.00	s) In addition to submission of drawings as stipulated above bidder shall also furnish the data/ documents with respect to following: 1) Thickness calculation of large diameter buried pipes as per AWWA-M-11. 2) System design calculation of Primary closed circuit ECW and secondary circuit ACW system for flow & pressure balancing. 3) Design calculations for condensate storage tank and Drinking water tank. 4) Static Analysis for Long (more than 300 metre straight run) above-ground piping wherever required. t) Bidder's scope of supply for fabrication, erection, cleaning, testing and commissioning of the piping systems installed by him shall include the following:- All welding consumables like welding electrodes, filler rods and wires; gases like oxygen, acetylenes, argon, carbon-dioxide, propane, backing rings etc. Films for radiographic examination of welds. X-ray and Gamma -ray equipment including isotopes, dye penetrants, and other required non-destructive testing materials and equipment (all to be taken back by the Bidder after completion of work). All heating and stress relieving equipment, thermocouples asbestos blankets, cables, temperature recorders, charts heat sensitive chalks and crayons etc. (All to be taken back by bidder after completion of work). All machinery, equipment tools and tackles as required for transportation handling, fabrication and erection (All to be taken back by Bidder after completion of work). All equipment/ materials as required for cleaning, flushing, blowing out and hydro testing of the piping systems; these shall include but not be limited to pumps and compressors with prime movers, instruments, pipe work with supports, valves, strainers and other specialties, blanks, plugs, spool pieces, dummy plates, electrical accessories, etc. (All to be taken back by Bidder after completion of work). All scaffolding materials and false work (To be taken back by Bidder after completion of work). The Bidder shall provide Services of erection superintendent and foremen, fitters and riggers, welders, transport and crane operators and other skilled and unskilled labour. The design engineering and providing all temporary pipe work as required for erection, cleaning, flushing, blowing out, testing and commissioning of the piping system is the responsibility of the Bidder.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-A BID DOC.NO. CS-9585-001-2	SUB SECTION- IIA-01 LOW PRESSURE PIPING	PAGE 4 OF 5

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
	The Bidder's scope shall include design, supply of required structural steel (except those which are specifically excluded), their fabrication and erection where ever required.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3X800 MW)	TECHNICAL SPECIFICATIONS SECTION-VI PART-A BID DOC.NO. CS-9585-001-2	SUB SECTION- IIA-0 LOW PRESSURE PIPING	PAGE 5 OF 5	



GENERAL TECHNICAL REQUIREMENT OF LOW PRESSURE PIPING (CONT.)

EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION EXPANSION
PHASE –I (3X 800MW)

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS:9585-001-2



CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	<u>LOW PRESSURE PIPING</u>			
1.00.00	EQUIPMENT SIZING CRITERIA			
1.01.00	All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.			
1.02.00	For all Low Pressure piping systems covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.			
1.03.00	Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:			
	a) Water Application			
	Pipe Size	Water Velocity in m/sec		
		Below 50 mm	50-150 mm	200 mm & above
	(a) Pump suction	-----	1.2-1.5	1.2-1.8
	(b) Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
	(c) Header	-----	1.5-2.4	2.1-2.4
	Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.			
	WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:			
	(i) Carbon steel pipe	100		
	(ii) Ductile Iron.	140		
	(iii) Rubber lined steel pipe	120		
	(iv) Stainless steel pipe	100		
	For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.			
	(b) Compressed Air Application			
	Compressed air	15.0 m/sec.(under Average Pressure & Temp. conditions)		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-10 (LOW PRESSURE PIPING)	PAGE 1 OF 20



CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC																																													
1.04.00	The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.																																														
1.05.00	Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.																																														
1.06.00	Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered (except stainless steel piping).																																														
1.07.00	Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.																																														
1.08.00	High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.																																														
1.09.00	Material of construction for pipes carrying various fluids shall be as specified elsewhere.																																														
1.10.00	Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.																																														
1.11.00	Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.																																														
1.12.00	Threaded joints shall be provided with Teflon sealant tapes.																																														
1.13.00	Following types of valves shall be used for the system/service indicated.																																														
	<table><tr><th>SYSTEM</th><th colspan="6">TYPES OF VALVES</th></tr><tr><th></th><th>Butterfly</th><th>Gate</th><th>Globe</th><th>Check</th><th>Ball</th><th>Plug</th></tr><tr><td>Water</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td></td></tr><tr><td>Air</td><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td></td></tr><tr><td>Drains & vents</td><td></td><td>x</td><td>x</td><td>x</td><td></td><td></td></tr><tr><td>Fuel oil (if any)</td><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td></tr></table>					SYSTEM	TYPES OF VALVES							Butterfly	Gate	Globe	Check	Ball	Plug	Water	x	x	x	x	x		Air		x	x	x	x		Drains & vents		x	x	x			Fuel oil (if any)		x	x	x	x	x
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1.14.0	Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.																																														
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2		SUB-SECTION-A-10 (LOW PRESSURE PIPING)		PAGE 2 OF 20																																									



CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
2.00.00	TECHNICAL SPECIFICATION		
2.01.00	GENERAL Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc.		
2.02.00	Pipes and fittings		
2.02.01	All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.		
2.02.02	Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.		
2.02.03	Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.		
2.02.04	Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).		
2.02.05	Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.		
2.02.06	The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.		
2.02.07	Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.		
2.02.08	For rubber lined ERW pipes, beads shall be removed.		
2.02.09	Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-10 (LOW PRESSURE PIPING)
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CLAUSE NO.	TECHNICAL REQUIREMENTS																				
2.02.10	At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.																				
2.02.11	For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code. Transient analysis /surge analysis where ever specified and required shall be conducted in order to determine the location , number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.																				
2.03.00	Material																				
2.03.01	Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified, The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.																				
2.03.02	No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.																				
2.03.03	All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.																				
2.03.04	All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.																				
2.03.05	Material of construction for pipes carrying various fluids shall be as follows:																				
	<table><thead><tr><th>SI No</th><th>Type of Fluid</th><th>Material</th></tr></thead><tbody><tr><td>1.</td><td>i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)</td><td>IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.</td></tr><tr><td>2.</td><td>i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)</td><td>Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below</td></tr><tr><td>3.</td><td>i) Drinking (potable) water ii)Compressed air (Instrument & service air)</td><td>ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.</td></tr><tr><td>4.</td><td>(Condensate) spill water</td><td>ASTM A 106 Gr. B</td></tr><tr><td>5.</td><td>Effluents from Neutralization pit</td><td>MSRL</td></tr></tbody></table>	SI No	Type of Fluid	Material	1.	i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)	IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.	2.	i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)	Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below	3.	i) Drinking (potable) water ii)Compressed air (Instrument & service air)	ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.	4.	(Condensate) spill water	ASTM A 106 Gr. B	5.	Effluents from Neutralization pit	MSRL		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
2.03.06	In water lines, pipes upto 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr.B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.		
2.03.07	Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.E-250B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr.E-250B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).		
2.03.08	In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness. Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.		
2.03.09	Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).		
2.03.10	Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.		
2.03.11	Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.		
2.03.12	If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.		
2.04.00	Field routed pipes:		
2.04.01	Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipes and submit to Employer for approval.		
2.05.00	Slope/Drains and Vents		
2.05.01	Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size		
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	up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes.			
2.05.02	Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.			
2.06.00	Pipe Joints In general all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.			
2.06.01	Screwed Joints (a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS: 554 unless specified otherwise. (b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be field joined by welding for protection of Galvanising Zinc layer. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test. (c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately. (d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing. (e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where			
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	galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.		
2.06.02	Welded Joints (a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.		
2.06.03	Flanged Joints (a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only. (b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification. (c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.		
2.07.00	Bends/elbows/mitre bends/ Tees/ Reducers & other fittings		
2.07.01	For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11. Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1). However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.		
2.07.02	For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.		
2.07.03	For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.		
2.07.04	Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes upto and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.		
2.07.07	In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.		
2.08.00	Flanges		
2.08.01	Flanges shall be slip on type. Welding of flanges in tension is not permitted.		
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2.08.02	All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. E-250B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 or equivalent.
2.09.00	Specific technical requirement of laying buried pipe with anti corrosive treatment The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.
2.09.01	Trenching (a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.
2.09.02	Preparation and cleaning of piping (a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand or grit blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager. (b) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.
2.09.03	Coating and wrapping/ Anti corrosive Protection Coal tar tape a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are: (1) Coating primer (coal tar primer) (2) Coating enamel (coal tar enamel) (3) Wrapping materials. All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable. Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat. Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of. Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available. Total thickness of completed coating and wrapping shall not be less than 4.0 mm. b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar
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	primer in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total thickness of the finished protective coating shall be 4.0 mm minimum.		
2.09.04	Trench bed preparation and back filling Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.		
2.09.05	laying of galvanized steel (GI) pipes All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste. All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and " anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.		
2.10.00	Cleaning and flushing		
2.10.01	All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.		
2.10.02	Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing . However for pipe sizes below 100nb the pipes may be cleaned internally by compressed air blowing as an alternative to internal blast cleaning. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done by air blowing only.		
2.10.03	After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.		
2.10.04	All compressed air pipe work shall be cleaned by blowing compressed air.		
2.11.00	Specification for hangers and supports		
2.11.01	All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.		
2.11.02	The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.		
2.11.03	At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.		
2.12.00	Design/Construction/Material Particulars of Gate/ Globe /Check /Butterfly / Ball / Air release /Float valves / Moisture Traps.		
2.12.01	GENERAL (a) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.		
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	(b)	Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required.		
	(c)	The valves coming in vacuum lines shall be of extended gland type and/or water sealed.		
	(d)	The actuator-operated valves shall be designed on the basis of the following:		
	(1)	The internal parts shall be suitable to support the pressure caused by the actuators;		
	(2)	The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.		
	(3)	All actuator-operated valves shall be provided with hand operated gearing mechanism also.		
	(4)	All actuators operated valves shall open/ close fully within time required by the process.		
	(e)	Valves coming under the purview of IBR shall meet IBR requirements.		
	(f)	All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.		
	(g)	Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer		
2.12.02	VALVE BODY MATERIAL			
	Valve body material for various services shall be as follows:			
	Valve body material for water application like Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) , drinking water etc. shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below.			
	For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.			
	DM water: SS body and disc along with SS internals. However for butterfly valves, Cast Iron /Ductile Iron/SG iron/carbon steel body and disc with elastomer lining are also acceptable.			
	Condensate: Cast Carbon Steel / Forged Carbon Steel.			
2.12.03	The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.			
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2.12.04	Standards and Codes			
	AWWA-C-504 Rubber seated butterfly valves.			
	BS-5155/EN-593 Cast iron and steel body butterfly valves for general purpose.			
	IS-778 Gun-metal gate, globe and check valves for general purpose.			
	BS-5154 Copper alloy globe/globe stop and check and gate valves for general purpose.			
	IS-780 Sluice valves for water works purpose (50-300 mm size)			
	IS-2906 Sluice valves for water works purpose (350-1200 mm size)			
	IS-5150 Cast iron wedge and double disc gate for general purpose.			
	BS-5152 Specification for cast iron globe valves.			
	BS-5153 Cast iron check valves for general purpose.			
	IS-5312 Swing check type reflux (non-return) valves.			
	ANSI B 16.34 Standard for valves.			
	API-594 Standard for Dual-check valves.			
	API-600 Steel gate valves.			
	ANSI-B-16.10 Valves face to face and other relevant dimension.			
	API-598 Valves inspection test.			
2.12.04	End Connections			
2.13.00	The end connections, shall comply with the following:			
	Socket welding (SW) - ANSI B 16.11			
	Butt Welding (BW) - ANSI B 16.25.			
	Threaded (SC) - ANSI B 2.1			
	Flanged (FL) - ANSI B 16.5& AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges).			
2.13.00	Gate/Globe/Check Valves			
	(a) All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).			
	(b) All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.			
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	(c) All gun metal body valves shall have screwed ends. (d) All flanged end valves/specialties. shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints. (e) Gate/sluice valves shall be used for isolation of flow. All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate. Gate valves shall be of the solid/elastic or articulated wedge disc. Gate valves shall be provided with the following accessories in addition to other standard items: (1) Hand wheel (2) Position indicator (for above 50 mm NB valve size) (3) Draining arrangement wherever required. (f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction. Preferably, the valves shall be of the vertical stem type. Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle. The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened. (g) Check valves shall be used for non-return service. They shall be swing. check type or double door (Dual plate)check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB. (h) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal); (i) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position. (j) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing. The valves shall be preferably outside screw & yoke type. (k) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable. (l) All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.			
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2.13.01	(m) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.			
	MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)			
	(a) The materials shall generally comply with the following:			
	(1) Cast Steel Valves			
	Body & bonnet		ASTM A 216 Gr. WCB/ ASTM A 105	
	Disc for non-return Valves		ASTM A 216 Gr. WCB/ ASTM A 105	
	Trim.		ASTM A 182 Gr. F6 or Equivalent	
	(2) Stainless steel valves			
	Body & Bonnet		SS 304	
	Disc		-do-	
	Trim.		SS 316	
	(3) Cast iron valves			
	Body & bonnet		BS 1452 Gr. 14/ IS-210 Gr. FG 260	
	Seating surfaces and rings		13% chromium steel/ 13% Chrome overlay	
	Disc for non-return valves		BS 1452 Gr. 14/IS-210 Gr FG 260	
	Hinge pin for non-return valves		AISI 316	
	Stem for gate globe valves		13% chromium steel or Equivalent	
Back seat		13 % chromium steel / 13% Chrome overlay		
(4) Gun Metal valves				
Body and bonnet		IS 318 Gr. 2/ Equivalent Standard		
Trim.		-do-		
(b) Cast iron body valves shall have high alloy steel stem and seat.				
(c) Material for counter flanges shall be the same as for the piping.				
(d) Forged carbon steel valves are also acceptable in place of Gun metal valves.				
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2.14.00	Air Release Valve (a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint. (b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure. (c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass. (d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.			
2.15.00	Butterfly valves			
2.15.01	Design/Construction (a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. E-250B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. (b) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable (c) Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same. (d) Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction. Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.			
2.15.02	Material of Construction (Butterfly Valves) Materials and other design details shall be as indicated below : (a) Cast Iron Butterfly Valves Body & Disc ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated			
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2.15.03	Shaft	BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.		
	Seat ring	18-8 Stainless steel		
	SEAL	NITRILE RUBBER		
	(b) Stainless Steel Butterfly Valves			
	Body & Disc	SS 304		
	Shaft	SS 316		
	Seat Rings	EPT/BUNA-N/Neoprene		
	(c) Carbon steel Butterfly Valves			
	Body & Disc	ASTM A 216, Gr. WCB		
	Shaft	SS 304		
	Disc & Seat Rings	EPT/BUNA-N/Neoprene		
	(d) Elastomer lined Butterfly Valves			
	Body & Disc	ASTM A48, Gr. 40 / IS: 210. Gr. FG-260 / SG Iron (ductile iron) IS 1865 Gr 400-15 or BSEN 1563, Gr EN GJS-400-15 / ASTM A 216, Gr. WCB with elastomer lining.		
	Shaft	SS 316		
	Proof of Design Test (Type Test) for Butterfly Valves			
Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder.				
All valves that are designed and manufactured as per AWWA-C-504 / AWWA-C-516 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504/AWWA-C-516. For Butterfly valves, designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504/AWWA-C-516.				
2.16.00	Float operated valves			
	(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.			
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	(b)	DESIGN AND CONSTRUCTION FEATURES		
		The following design and construction feature of the valve shall be the minimum acceptable.		
	(c)	Valves shall be right-angled or globe pattern.		
	(d)	Valves shall be balance piston type with float ball.		
	(e)	Leather liner shall not be provided.		
	(f)	The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats.		
	(g)	Valves shall be suitable for flow velocities of 2 to 2.5m/sec.		
	(h)	The valves shall have flanged connections.		
2.17.00	Tanks and Accessories			
2.17.01	The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803/IS804/IS 805/ IS 2825/ API 650/ IS 4049/ IS 4682 (part-I) and IS 4864 to 4870/ ASME B & PV code Sec.-VIII as the case may be.			
2.17.02	DESIGN AND CONSTRUCTION			
	(a)	Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS:803 & API 650.		
	(b)	Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement.		
	(c)	Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.E-250B (or equivalent) for ordinary wafer application when it is not corrosive in nature.		
	(f)	Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.		
	(j)	Tanks shall be provided with float operated level indicators/level gauges/level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.		
	(k)	In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing dm water, alkaline water or power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO2 absorber vessel shall be provided with the initial fill of chemicals.		
	(l)	Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.		
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2.17.03	(m) Tank supporting arrangement as approved by Employer shall be provided with all plates/angles/joints/flats and supporting attachment including lugs, saddles, legs etc.																																											
	(o) Tank fabrication drg. and design calculations shall be approved by the Project Manager.																																											
	Corrosion protection																																											
	(a) A corrosion allowance, applicable to surface in contact with corrosive media, when required after thorough cleaning by blast cleaning preceded by wire brushing shall be taken into consideration.																																											
	(b) Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.																																											
	(c) Each tank shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.																																											

	<table><tr><th>Sl. No.</th><th>Description</th><th>Tech. Particulars</th></tr><tr><td colspan="3">-----</td></tr><tr><td>1.00</td><td colspan="3">CONDENSATE STORAGE TANKS</td></tr><tr><td>1.01</td><td>Number required</td><td>one for each unit</td></tr><tr><td>1.02</td><td>Capacity of each tank (Effective)</td><td>450 Cu.m (for 800MW units),</td></tr><tr><td>1.03</td><td>Size (Dia & Height)/Plate Thickness</td><td>9mx8.2m minimum), Shell & Roof plate Thickness 8mm and Base plate thickness 10mm</td></tr><tr><td>1.04</td><td>Type and pressure class</td><td>Vertical, cylindrical, atmospheric</td></tr><tr><td>1.05</td><td>Material of construction</td><td>MS- (IS-2062 Gr.B or equivalent) as per specified code, 8mm thickness (minimum)</td></tr><tr><td>1.06</td><td>Location</td><td>Outdoor</td></tr><tr><td>1.07</td><td>Overflow, drain, vent and Sample connection(piping &valve)</td><td>required</td></tr><tr><td>1.08</td><td>Level Indicator</td><td></td></tr><tr><td>a)</td><td>Number</td><td>One for each tank</td></tr><tr><td>b)</td><td>Type</td><td>Mechanical float type with dial type indicator (Guide wire, Float and Housing of Stainless steel - 316 Gr. construction)</td></tr></table>				Sl. No.	Description	Tech. Particulars	-----			1.00	CONDENSATE STORAGE TANKS			1.01	Number required	one for each unit	1.02	Capacity of each tank (Effective)	450 Cu.m (for 800MW units),	1.03	Size (Dia & Height)/Plate Thickness	9mx8.2m minimum), Shell & Roof plate Thickness 8mm and Base plate thickness 10mm	1.04	Type and pressure class	Vertical, cylindrical, atmospheric	1.05	Material of construction	MS- (IS-2062 Gr.B or equivalent) as per specified code, 8mm thickness (minimum)	1.06	Location	Outdoor	1.07	Overflow, drain, vent and Sample connection(piping &valve)	required	1.08	Level Indicator		a)	Number	One for each tank	b)	Type	Mechanical float type with dial type indicator (Guide wire, Float and Housing of Stainless steel - 316 Gr. construction)
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	1.09 Manhole (minimum 500mm size) Two (2)-one on shell and the other on roof 1.10 Special Fittings a) Hydraulic Seal of Overflow/Drain Required b) Additional nozzle Connection number and size to be indicated to successful Bidder c) Nozzle connection for Instrument/spare Three (3) nos. for each tank d) CO2 Absorber for vent (not to be kept on roof of tank, but to be kept on ground level) required e) Outside stair case (spiral) required f) Inside Ladder Required g) Draw off sump required h) Root valve for level Transmitter Root valves for two (2) nos. level transmitter for each tank Required -----
2.18.00	RUBBER EXPANSION JOINTS
2.18.01	All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.
2.18.02	The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.
2.18.03	The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.
2.18.04	The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.
2.18.05	Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.
2.18.06	Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipe lines.
2.18.07	The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the 'duck' shall be either
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2
SUB-SECTION-A-10 (LOW PRESSURE PIPING)	PAGE 18 OF 20



CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC											
	a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.												
2.18.08	The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.												
2.18.09	All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr E-250B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.												
2.18.10	The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges. The flanges shall be as per ANSI B 16.5. For higher sizes, not covered under ANSI B 16.5, the same shall be as per AWWA.												
2.18.11	All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.												
2.18.12	Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.												
2.18.13	Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.												
2.18.14	Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless Steel material.												
2.19.00	STRAINERS												
2.19.01	Simplex type												
	The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition shall not exceed 1.5 MCW at full flow. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The material of construction of various parts shall be as follows: <table><tr><td>(a)</td><td>Body</td><td>IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)</td></tr><tr><td>(b)</td><td>Strainer Element</td><td>Stainless steel (AISI 316)</td></tr><tr><td>(c)</td><td>End connection</td><td>Screwed upto 50 mm Nb, and Flanged above 50 mm Nb</td></tr></table>	(a)	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)	(b)	Strainer Element	Stainless steel (AISI 316)	(c)	End connection	Screwed upto 50 mm Nb, and Flanged above 50 mm Nb			
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(b)	Strainer Element	Stainless steel (AISI 316)											
(c)	End connection	Screwed upto 50 mm Nb, and Flanged above 50 mm Nb											
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-10 (LOW PRESSURE PIPING)	PAGE 19 OF 20									



CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.19.02	Duplex type			
	(a)	The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.		
	(b)	Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.		
	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. E-250B and internally epoxy-painted above 50 mm NB.		
	Strainer element	Stainless steel (AISI 316)		
	End connection	Screwed up to 50mm Nb, and Flanged above 50 mm Nb. Gasket shall be of full face type		
	(c)	The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.		
	(d)	The size of the strainer and the flow direction will be indicated on the strainer body casting.		
	(e)	Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-10 (LOW PRESSURE PIPING)	PAGE 20 OF 20



SUB – SECTION – A-11

MAKE-UP WATER PIPING

**EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION EXPANSION
PHASE –I (3X 800MW)**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS:9585-001-2**

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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
1.02.06	All materials shall be new and procured directly from the manufacturers for this projects.		
1.02.07	All the pipes shall be applied with a protective coat of red oxide primer or varnish externally to prevent rusting during the period of transportation & storage before the pipes are used for installation.		
1.03.00	INSPECTION AND TESTING		
1.03.01	All Material shall be tested as per relevant design standard.		
1.03.02	All the mechanical and chemical tests including optional tests if any as per the relevant standards shall be carried out and the test certificates for the same shall be submitted for Employer's approval.		
1.03.03	The hydraulic tests shall be conducted as per the piping standard (i.e.) IS: 3589 or Equivalent Standard.		
1.03.04	Prior to testing, the pipe shall be inspected thoroughly and all the apparent defects in welding such as porosity etc. shall be repaired by gouge and re-welding.		
1.04.00	TRANSPORTATION AND DELIVERY OF PIPES		
1.04.01	All pipes fabricated in the factory and temporarily stacked in the Contractor's yard or factory shall be transported to the Employer's storage site after shop testing & cleaning them internally. The loading in the factory shall be carried out by means of either a crane, gantry or with shear legs, so as not to cause any damage to the finished material. Similarly, while unloading and stacking, great care shall be taken to ensure that the material is not damaged or dented. The equipments to be used for loading / unloading shall be as approved by the Employer or his representative.		
1.04.02	The material being delivered at site shall be jointly inspected by the Employer or his representative and the Contractor and defective or damaged pipe shall be rejected by Employer or Employer may allow repair of the pipe to the satisfaction of the Employer or his Representative.		
1.04.03	Props of approved designs shall be fixed to the pipes during transit to avoid undue sagging and consequent distortion. After the pipes are carefully stacked, props may be removed and re-used for subsequent operations.		
1.04.04	At Employer's storage site, pipes shall be stacked in such a way that suitable gaps shall be left in the pipes at intervals to permit access from one side to the other.		
1.04.05	For Tech Specification details not covered in this chapter, bidder to refer sub section A-08A (chapter- Low pressure piping).		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO. CS-9585-001-2	SUB-SECTION- A-11 MAKE-UP WATER PIPING
			PAGE 2 OF 2



TITLE: 3 X 800 MW PATRATU STPP STAGE - I
TECHNICAL SPECIFICATION FOR EFFLUENT TREATMENT PLANT

SPECIFICATION NO. PE-TS-434-164-A001	
REV. NO. 00	DATE : 29/05/2019

GENERAL TECHNICAL REQUIREMENT OF PUMPS

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CLAUSE NO.	TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
	Sound	Absorbed power	Sound pressure	
	1500 rpm and below	75.0 micron	75.0 micron	
	3000 rpm	50.0 micron	65.0 micron	
	The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.			
3.05.00	The pumps shall be capable of starting with discharge valve fully open and close condition.			
4.00.00	DESIGN CONSTRUCTION			
4.02.00	Pump casing shall have radially/axially split type construction. The casing shall be designed to withstand the maximum shut - off pressure developed by the pump at the pumping temperature.			
4.03.00	Pump casing shall be provided with a vent connection and piping with fittings & valves Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pr. Gauge as standard feature.			
4.04.00	Impeller			
	Impeller shall be closed or semi-closed as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying pinning or lock rings.			
4.05.00	Impeller/ Casing Wearing Rings			
	Replaceable type wearing rings shall be provided at suitable locations pumps. Suitable method of locking the wearing ring shall be used.			
4.06.00	Speed			
	The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.			
4.07.00	Shaft sleeves			
	Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening shaft and shaft sleeve assembly should ensure concentric rotation.			
4.08.00	Bearings			
	Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble - free operation shall be furnished.			
	The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Anti-friction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hours of continuous operation at maximum axial and a radial loads and rated speed.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2		SUB SECTION-A-15 ACW SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC		
4.09.00	Proper lubricating arrangement for the bearings shall be provided such that lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing. Stuffing Boxes Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standard. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping, valves, fitting etc. for the sealing connection.			
4.10.00	Mechanical Seals: Wherever specified in pump data sheet, mechanical seals shall be provided The sealing face should be highly lapped surfaces of material known for their low frictional co-efficient & resistance to corrosion against the liquid being pumped.			
4.11.00	Pump and Motor Shaft Coupling The Pump and motor shaft shall be connected with a adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor.			
4.12.00	Base Plate A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, suitable ribbed and reinforced.			
4.13.00	Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.			
4.14.00	Drive Motor (Prime Mover) The KW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps is specified, the actual motor rating is to be selected considering overloading of the pump in the event of tripping of operating pumps. Continuous motor rating (at 50 deg. Cent, ambient) for pump shall be at least 10% above the maximum load demand of the driven equipment in the complete range.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM	PAGE 40 OF 55

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Appendix-2 of ACWR System " VERTICAL PUMPS			
1.00.00	SCOPE			
1.01.00	This specification covers general requirements in respect of design, construction features, manufacture, inspection and performance at Vendor's / sub-vendor's works delivery to site, erection field testing and commissioning of Makeup Water & Raw Water Pumps.			
2.00.00	CODES AND STANDARDS			
2.01.00	The design, material, construction, manufacture, inspection, testing and performance of Vertical Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment supplied shall comply with the latest applicable Standards listed below. Other national standards are acceptable, if they are established to be equal or superior to the listed standards.			
2.02.00	List of Standards IS: 1710 : Vertical Turbine Pumps for clear cold fresh water. IS: 5120 : Technical requirement of rotor dynamic special purpose pumps. HIS : Hydraulic Institute Standards U.S.A. PTC 82 : Centrifugal pumps-power test code API 610 : Centrifugal pumps for general refinery purposes. In case of any contradiction with aforesaid standards and the specifications requirements as specified hereinafter the stipulations of the technical specifications shall prevail.			
3.00.00	DESIGN AND PERFORMANCE REQUIREMENTS			
3.01.00	The maximum efficiency point of the pumps shall preferably lie within 10% of the rated design flow.			
3.02.00	Pumps of a particular category shall be identical, suitable for parallel operation and provided with interchangeable components. Head vs. capacity and BHP vs. Capacity characteristic should match to ensure even load sharing and trouble free operation throughout the range.			
3.03.00	The pumps shall have stable Head vs. Capacity characteristic continuously rising towards shut-off with the highest at shut-off and with an approximate shut-off head of 15% or more than the design head for radial flow pumps and 50% more than the design head for mixed flow/ turbine type pumps.			
3.04.00	The operating range of operation of pumps shall generally be 40% to 120% of rated flow for sustained period of operation.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM	Page 41 of 55

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC		
3.05.00	The power requirement of the pump shall be non-over loading type for mixed flow/turbine type pumps.			
3.06.00	The critical speed of the pump shall be less than 80% of the rated speed or more than 130% of the rated speed. Also, the critical speed of the pump-motor assembly shall be more than the maximum reverse run-away speed.			
3.07.00	Pump shall run smoothly without undue noise and vibration. The vibration limit measured at motor end shall not exceed the limit specified in Hydraulic Institute Standards. The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.			
3.08.00	The base plate, foundation bolts, motor stool and other components shall be designed to take the full force coming on the discharge elbow under shut-off condition due to provision of expansion joint (untied condition prevailing)) on the discharge pipe.			
3.09.00	Water for motor cooling and thrust bearing cooling, if required, shall be tapped from the discharge of the pumps and/or fed from an over-head tank. All piping, valves, strainer, instruments etc. required for this purpose and line shaft bearing lubrication (if required) shall be provided by the Contractor. Hence the coolers shall be designed to operate satisfactorily with the cooling water discharge pressure available. Cooling water if required during starting of the pumps shall be arranged by the bidder by provision of water supply tank, valves piping etc.			
3.12.00	Reverse Rotation Protection a) The pump shall be provided with an approved mechanical device to protect reverse rotation on loss of drive motor power and failure of discharge valve to close. b) It is possible that the pump may rotate in the reverse direction in case the discharge butterfly valve is not fully closed or is passing. Hence to prevent starting of the pump, a reverse rotation detection switch shall be provided to prevent starting of motor while rotating in reverse direction.			
3.13.00	Motor Requirements The pumps shall be capable of starting with discharge valve fully closed as well as fully open conditions. Motors shall be selected to suit to the above requirements. Continuous motor rating (at 50°C ambient) for all pumps shall be at least ten per cent (10%) above the maximum load demand of the driven equipment in the complete operating range (including run out condition) to take care of the system frequency/voltage variation. Drive motors shall be connected directly to the line shaft of the pump.			
4.00.00	DESIGN AND CONSTRUCTION			
4.01.00	Pumps and Turbines Pumps shall be of vertical shaft, single stage/multi-stage, submerged suction, complete with bowl, column & head assembly and drive assembly. The pump design shall be of pullout/non-pull-out type as specified			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM	Page 42 of 55

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC		
4.02.00	Discharge The pump discharge shall be of above-floor type/sub-floor type as indicated. In certain cases of pump installation where expansion joint is located immediately at the pump discharge, the pump assembly will be subjected to the unbalanced hydraulic thrust. A thrust pad will be built in with the discharge head for transmitting the hydraulic thrust to external structures such that this hydraulic thrust is not transmitted to the foundation bolts for which they may not be designed.			
4.03.00	Column Pipes Column pipes shall be flanged and bolted and shall be complete with gaskets, nuts and bolts.			
4.04.00	Impeller The impeller shall be closed, or semi-open or open as specified elsewhere.			
4.05.00	Wearing Rings Replaceable type wearing rings shall be provided for both casing and the impeller. For open impellers replaceable casing liners shall also be provided. The difference in hardness of the casing & impeller wearing rings shall be minimum 50 BHN.			
4.06.00	Shaft & Line Shafts Shaft size selected on the basis of maximum combined shear stress must take into consideration the critical speed as per API - 610.			
4.07.00	Bearings & Seals			
4.07.01	Adequate number of properly designed bearings shall be furnished. All interconnected piping, valves, instruments and fittings for bearing lubrication shall be provided. The type of lubrication i.e. self water lubrication or forced water lubrication shall be provided.			
4.07.02	Line Shaft Lubrication The line shaft bearings shall be lubricated by the water being pumped. The main pump and line shaft bearings which are above minimum water level shall be of 'Thordon' type/equivalent. For other line shaft bearings located below minimum water level, cutless rubber bearings can be used.			
4.07.03	Forced Water Lubrication The line shaft shall be provided with shaft enclosing tube to exclude pumped water from shaft and bearings. Lubricating water pumps shall be provided to supply lubricating water for bearings. These lubricating water pumps shall get supply from the overhead water storage tank. This tank shall be fed water from the pump discharge header as indicated in tender drawings. Strainers downstream of each lubrication water pumps shall be provided to ensure clean water for the bearings. The lubrication water pumps shall conform to Specification titled "Horizontal Centrifugal Pumps" Complete instrumentation, piping, valves to ensure reliable operation of lubrication system			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM	Page 43 of 55

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC		
4.08.00	shall be provided. During initial filling and normal operation the lubricating water shall be tapped from water filling line/potable/nearest source and fed to overhead tank. Thrust Bearing Single thrust bearing at motor top or separate thrust bearings at pump and motor shall be provided to take care of hydraulic thrust and weight of the rotating assembly. Thrust bearing shall be spherical roller type or superior, capable of absorbing axial thrust in both directions of rotation. Water required for cooling of thrust bearing shall be taken from pump discharge, wherever applicable. The thrust bearing shall be rated for continuous operation with thrust as developed in shut-off condition with clearance between the wearing rings in worn out condition to be at least four (4) times the clearance between the wearing rings in new condition.			
4.09.00	Pump and Motor Support Bearing The pump and motor shall have a common support. The necessary supporting frame, base plates, mounting plates etc. as required shall be supplied under this specification.			
4.10.00	Stuffing Box Gland packing shall be provided at the top of the line shaft. Shaft sleeves shall be provided at the stuffing box. The stuffing box shall be of sufficient depth to provide ample packing. The packing glands shall be split type to facilitate repackaging of the stuffing boxes. The space between motor and the stuffing box shall be sufficient to permit removal of gland packing and insertion of new gland packing without dismantling of pump.			
4.11.00	Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouted base/sole plate or alignment.			
5.00.00	MATERIALS OF CONSTRUCTION Materials of construction of the pumps shall not be inferior to those specified in this sub-section.			
6.00.00	OPERATION PHILOSOPHY			
6.01.00	The Pumps shall be controlled from the Central Control Room (CCR). The start/stop commands of these pumps, all associated auxiliaries/drives including all the motor operated discharge valves, shall be routed through control system where all interlocks & permissive shall be implemented and start/stop signals shall be issued to MCC/Switchgear. The operation of interconnecting valve and any other common drive shall be possible from pump house as well as DDCMIS. The exact details of the same shall be finalised during detailed engineering.			
6.02.00	A local pushbutton switch shall be used for emergency tripping of the motor.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM	PAGE 44 OF 55

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.03.00	The pump can be started either with pump discharge valve partially open or in closed position depending upon contractor's standard practice.			
6.04.00	An interlock shall prevent the starting of pump unless bearing lubricating water flow and motor bearing cooling water flow has been established over a period of time. Low flow of either pump or motor bearing cooling water when the pump is running will give alarm(s) and trip the pump with alarm in case of sustained low value over a preset time.			
6.05.00	In case of high pressure at pump discharge due to accidental closure of any of the butterfly valves, an alarm shall be generated.			
6.06.00	In case of normal stopping, when a pump control switch is turned 'OFF', the butterfly valve at its discharge first closes (25-30) % before the respective pump motor is de-energised.			
6.07.00	On tripping of motor due to any reason, the butterfly valve at the discharge shall close fully automatically.			
6.08.00	If water level in pump sump is low, an alarm shall be initiated. Pump shall be tripped in case of very low level of water in the intake sumps and very high discharge header pressure. Ultrasonic type Level transmitters to be provided for sump level measurement.			
6.09.00	Pump shall be tripped from very high winding temperature of motor and very high metal temperature of thrust bearings. Alarm shall be provided for high motor winding temperature and high motor/ pump bearing temperature.			
6.10.00	The operation philosophy as detailed above is suggestive only. .The control and interlock scheme to be adopted shall be finalised in consultation with the successful bidder after award of contract and shall be subject to Employer's approval.			
7.00.00	INSTRUMENTATION			
7.01.00	Vibration monitoring system if necessary shall be provided. The alarm and trip signals from vibration system shall be connected to the Control system.			
7.02.00	Bidder shall provide Duplex temperature elements for bearing & winding temperature monitoring points if specified. The excessive bearing/winding temperature shall be used for alarm and tripping of pumps/ motors.			
7.03.00	Further, Bidder shall provide required level & pressure sensing instruments as specified elsewhere in relevant Subsections of Control & Instrumentation and/or tender drawings.			
8.00.00	PERFORMANCE TESTS			
	The requirements of Performance Tests of pumps shall be same as that Performance Test specified for the CW Pump of Vertical wet pit type as referred in relevant clauses of Technical Specification.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM	PAGE 45 OF 55

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Appendix-3 of Circular "AWS Section "			
	SUBMERSIBLE PUMPS			
1.00.00	SCOPE			
1.01.00	This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's/sub-vendor's delivery to site, of submersible pumps.			
2.00.00	CODES AND STANDARD			
	The design manufacture and performance of submersible pumps shall comply with all currently applicable statutes, regulation, and safety codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable Indian standards listed below/equivalent standards.			
2.01.00	Listed Standards			
	IS: 5120- Technical requirement of Rotodynamic Special Purpose pumps.			
	In case of any contradiction with aforesaid standards and the technical specification requirements, the stipulation of the technical specification shall prevail.			
3.00.00	General			
3.01.00	The submersible pumps shall be of proven design. The Pumps shall be purchased from a pump manufacturer who has manufactured and supplied at least One (1) no. of submersible pump set for continuous duty for similar application, of type and capacity as offered or higher and which has been in successful operation for at least one (1) year prior to the date of Techno-Commercial bid opening. The pump set shall be suitable for pumping raw water with high turbidity and soft solids/fibrous solids which are generally observed in contaminated rivers / canal water. Components of Identical pumps shall be interchangeable.			
3.02.00	Pumps shall have continuously rising head characteristics. The pump sets shall be suitable for parallel operation as well as solo operation in the system. The performance characteristics of the pumps running in parallel shall be identical. The manufacturer shall have to submit the parallel operation curve superimposed with system resistance curve to know the exact point of pump operation with various combinations.			
4.00.00	FEATURES OF CONSTRUCTION			
	a) The pump set shall be single stage, submersible type, monoblock, volute type driven by squirrel cage induction motor. The motor shall be an integral part of the pump set. It shall be a totally sealed unit suitable for completely as well as partially submerged condition. The pump shall operate continuously even if the water level in the sump is low (motor portion not in submerged condition). The pump shall be suitable for reverse rotation and shall not have any adverse effect on the operation of mechanical seal or any other component.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2		SUB SECTION-A-15 ACW SYSTEM
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	b) Pumps shall be able to pass through solids upto 40 mm. c) The impeller shall be multi vane. The impeller shall not get blocked with solids. The impeller shall be keyed on shaft, retained with an expansion ring. The impellers shall be dynamically balanced to the grade 6.3 as per ISO 1940. d) Coupling device when provided shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc. e) Pumps shall be portable/ fixed type and capable of using in any sump as and when required. Pump shall be provided with required duck foot bend, guide pipe, chain connection etc. for easy installation, removal and maintenance. Adequate length of chain required for lowering the pump into the sump and discharge pipe or duck foot shall be provided. f) Bearing: The shaft shall rotate on grease lubricated bearings. The upper bearing, provided for radial forces, shall be a single roller bearing. The lower bearing shall consist of at least one roller bearing for radial forces and one angular contact ball bearing for axial thrust. The bearings shall be pre-lubricated and packed for life. External lubrication for any of the bearings will not be accepted. The lower bearing housing shall include an independent thermal sensor to monitor the bearing temperature. If a high temperature occurs, the sensor shall activate an alarm and shut the pump down. Any other proven arrangement which is manufacturer’s standard is also acceptable. g) Seal: Each pump shall be provided with a mechanical seal assemblies. The seal faces shall be of corrosion resistant tungsten carbide. The seal shall not require any maintenance or adjustment and shall be bi-directional. Should the seals fail and allow fluid to enter the stator housing, the fluid shall not come in contact with the lower bearing or stator. h) Shaft: The pump shaft and motor shaft shall be one piece construction. The pump shaft is an extension of motor shaft and no coupling for pump shaft and motor shaft is allowed. The shaft should not come in direct contact with pumped liquid. Use of stainless steel sleeves will not be considered as substitute for stainless steel shaft. i) Installation Arrangement: For transportable type of installation, a suitable stand / base frame type of arrangement shall be provided in such a way that in no case the pump will tilt. Each pump set shall be provided with the suitable length of stainless steel lifting chain.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM	Page 40 of 55

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC	
	Following accessories to be included in scope of supply for pumps supported on discharge bend: i. Pump pedestal and discharge connection(“duck foot’ type discharge bend) ii. Guide rails, guide rail support brackets and lifting chain as appropriate iii. Fasteners and anchor bolts j) The major pump components shall be of material mentioned at CI 9.00.00 of this sub-section and shall be with smooth surfaces, free of blow holes or other casting irregularities.		
5.00.00	MOTOR RATING Continuous motor rating (at 50 deg. C ambient) for pumps shall be at least ten percent (10%) above the maximum load demand of the driven equipment in the complete operating range (including run out condition) to take care of the system frequency variations.		
6.00.00	Painting and Protection All metal surfaces coming in contact with the pumping media, other than stainless steel shall be protected by factory applied water based primer and finally covered by a two component high-solid top coating.		
7.00.00	Control and Monitoring For Submersible Type pumps all Control & Instrumentation is to be provided as per manufacturer’s standard proven practice. If integral control system is provided for each pump, then Microprocessor / PLC / GIU based control system as per manufacturer’s practice shall be provided. If Control system is provided externally for each pump, then it shall be implemented from DDCMIS. For both the cases, over all Control will be through DDCMIS. For details of DDCMIS refer C&I sections.		
8.00.00	PERFORMANCE GUARANTEE TESTS		
8.01.00	Storage Test		
8.01.01	After the manufacture, all the pumps shall be subjected for performance test at the manufacturer's works to determine the power consumption and the head capacity characteristic in the presence of Employer’s representative, as per requirements of Hydraulic Institute Standards, (HIS 11.6)		
8.01.02	Hydrostatic test to be conducted to demonstrate that the hydraulic end, when assembled to the motor, will not leak or fail structurally when subjected to hydrostatic pressure as per HIS 11.6. NPSHR test also to be conducted to demonstrate the NPSHR requirement of pump.		
8.01.03	Contractor shall submit along with his offer details of the proposed test facilities available for testing the pumps. The details must include the capacity, head, maximum motor rating, voltage level, sanctioned load and permissible starting current.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
8.01.04	It may be noted that during shop tests no negative tolerance shall be permitted on head (H), capacity (Q) and the pump efficiency (n). Instruments accuracy used shall be plus or minus 1.5% or better for measurement of flow and plus or minus 0.5% or better for measurement of pressure and power.			
8.01.05	Apart from the above, any testing if specified in subsection titled “Functional Guarantees and Liquidated damages” [subsection –IV of Part-A] of this Technical Specification shall also be conducted.			
8.02.00	S T a) Manufacturer shall demonstrate at site the trouble free mechanical running of individual pumps. b) The following parameters shall be measured during the demonstration test. i) Current, Voltage and Motor Input Power. ii) Frequency iii) Bearing temperature & Motor winding temperature. c) All interlocks and protections relating to the pumps, motors and motorised valves shall be tested. c) <u>Parallel operation:</u> There should be equal load sharing between pumps running in parallel with no abnormal vibrations, sound or hunting of head and flow. Load sharing between any pumps running in parallel should be within 10%.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-9585-001-2	SUB SECTION-A-15 ACW SYSTEM	PAGE 49 OF 55



GENERAL TECHNICAL REQUIREMENT OF ELEVATORS, CRANES AND HOISTS, WEIGH BRIDGE

EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE-1 (3x800 MW)

TECHNICAL SPECIFICATION
SECTION-VI PART-A
BID DOC NO: CS-9585-001-2

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	ELEVATORS CRANES AND HOISTS			
1.00.00	ELEVATOR			
1.01.00	Passenger Elevator for TG Building Service Building Administration Building and ESP control room (If applicable) The Passenger elevators for TG Building, Service Building, ESP control room (if applicable) and Administration Building shall be as under. (i) Two (2) nos. conventional type elevator having capacity of 13 persons for TG Building. (ii) Two (2) nos. conventional type elevator having capacity of 13 persons for Service Building. (iii) One (1) no. temporary Rack and pinion type elevator having capacity of 1000 kg for TG Building. (iv) Two (2) nos. panoramic type elevator with five glass panels on rear side having capacity of 13 persons, for Administrative building. (v) Three (3) nos. conventional type elevator having capacity of 10 persons for ESP control room (If applicable).			
1.01.01	The scope shall include all items / accessories, service along with all electrical equipment etc. required to meet all design, installation, operation, safety, protection and other requirements of IS: 14665 (latest edition) (all parts), 'Lift' and service lifts'. This scope shall include all items / devices needed to comply with the requirements indicated elsewhere in the specification. The scope shall include but not limited to the following: (a) 1 No. fireman's switch for each elevator. (b) Machinery supporting Beam.			
1.01.02	The location of Elevators shall be as per tender drawings enclosed with the specification.			
1.01.03	Complete erection, testing and commissioning including all testing and commissioning materials, consumables and other tools and tackles required for erection.			
1.01.04	To obtain necessary local administration permits / approvals and make arrangements for inspection and tests required thereby.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION-VI. PART-A BID DOC.NO. CS-9585-001-2	SUB SECTION- IIA-19 ELEVATORS CRANES AND HOIST	PAGE 1 OF 2

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
2.00.00 2.01.00	CRANE & HOIST Suitable EOT Crane/HOT crane/monorail beams with hoists/chain pulley blocks of adequate capacity, to meet the erection and maintenance requirements are to be provided by the vendors for the various equipment/areas. Some of the areas/equipment not covered by TG hall EOT crane are indicated below. For balance areas/equipment, not listed herein, the requirements of Technical Specification shall be followed. (a) Feed water heaters & deaerator. (b) Various pumps & Heat Exchangers. (c) Condenser water boxes (front & rear), vacuum pumps, CW butterfly valves, control fluid room etc. (d) Auxiliary cooling water pumps and DM cooling water pumps of ECW systems and Plate heat exchangers. (e) Central lube oil system room. (f) Any other equipment. The above requirement is indicative only; the requirement given in the respective chapter is to be adhered to.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3X800 MW)	TECHNICAL SPECIFICATIONS SECTION-VI PART-A BID DOC.NO. CS-9585-001-2	SUB SECTION- IIA-19 ELEVATORS CRANES AND HOIST	PAGE 2 OF 2	



GENERAL TECHNICAL REQUIREMENT OF ELEVATORS, CRANES AND HOISTS, WEIGH BRIDGE (CONT.)

EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION EXPANSION
PHASE I (3X 800MW)

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS:9585-001-2

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	SERVICE ELEVATORS CRANE HOIST & MONORAIL			
1.00.00	SERVICE ELEVATORS			
1.01.00	DESIGN CRITERIA AND OPERATIONAL SPECIFICATION			
1.01.01	Design Elevator shall be of conventional type for Service Building, TG building and of panoramic type with five glass panels on rear side for administrative building. The elevator shall meet the quality of international standard. The quality of glass panel on rear should be of highest grade from safety point of view and should meet the best standard.			
1.01.02	No. of floors to be served shall be as per the specification and tender drawing of the Employer. Bidders shall quote variation in price for addition/deletion of one landing level in the relevant schedule of Forms and Procedures. However, bidder shall quote for above indicated landing levels in his base offer. No of floors and landing elevations are tentative only. The final landing elevations for all buildings shall be subject to approval by the Employer after award.			
1.01.03	Elevators shall be designed based on following criteria:			
	i)	Design/construction/installation codes.	:	Latest edition of IS: 14665 (all parts)
	ii)	Load carrying capacity	:	a) 884 kgs. (equivalent to 13 persons) for passenger elevators for service building, TG building and administrative building. b) 1000 kgs. for Rack & pinion elevator. separate details attached for design criteria. c) 680 kgs (equivalent to 10 persons) for passenger elevator of ESP control room (If applicable).
	iii)	Rated speed	:	1.0 m/s.
	iv)	Position of machine room	:	Directly above the elevator shaft.
	v)	Machine room	:	Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder.
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW) TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC. NO.:CS-9585-001-2 SUB-SECTION-A-28 SERVICE ELEVATORS PAGE 1 OF 11				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.02.00	CONSTRUCTION			
	Construction of the elevators shall specifically meet all requirements of the codes indicated and shall have following additional features:			
	i)	Flooring of Cabin	:	Vitrified ceramic tiles of mat finish.
	ii)	Car enclosure & car panels	:	Stainless Steel
	iii)	Handrails on 3 sides	:	Mirror Stainless Steel
	iv)	False ceiling	:	Powder painted
	v)	Car opening & Hoist way opening	:	Protected by central opening sliding Stainless Steel door
	vi)	CABIN ACCESSORIES	:	The following accessories shall be provided : a) LED light fittings on car floor. b) Car control station c) Emergency stop switch. d) 5/15A, 3 pin plug socket with switch on top of lift car. e) Switches with Braille characters.
	1. AUTOMATIC RESCUE DEVICE (ARD) - (BATTERY DRIVE): Bidder to provide a modern Advanced electronic drive system of “RESCUING Passenger Trapped in a ELEVATOR”.			
	2. EMERGENCY SAFETY DEVICES: The lift shall be provided with safety Device attached to the lift car frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car.			
3. Elevator shall have Floor announcement system & Braille switches				
1.02.01	All steel embedment for fixing landing doors/indicators etc. to the Elevator well shaft and fascia plate shall be supplied by the Bidder.			
1.02.02	Guide rails complete with supporting brackets for the car and counter weights. Bidder to take care of granite tiles (approx 80 kg) to be provided for cabin flooring in selecting counter weights.			
1.02.03	Elevator drive machines complete with electric motor, reduction gear unit, suspension ropes, buffers for the cars and the counter weights and other drive and control mechanism. All			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-28 SERVICE ELEVATORS	PAGE 2 OF 11

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	foundation anchor bolts, sleeves, anchoring steel and any item required to complete the job satisfactorily shall be provided by the bidder. The bidder shall also provide for the grouting of anchor bolts, sleeves, anchoring steel, etc. and other anchorages			
1.02.04	Any other steel works as well as all other accessories/components not specified in the specification but necessary for making the Elevator complete.			
1.02.05	All building work including the supply of steel items, associated with installation of equipment in the machine room hoist way, hoist way door, frames and Elevator pit, shall form part of bidders scope of service, Bidder shall also provide the Elevator-well complete with foundation and brick walls around the lift-well together with overhead machine room. The machine room will be provided with R.C.C. floor slab with necessary pockets for anchor bolts and slots.			
1.03.00	OPERATION			
1.03.01	Elevator shall have provisions to meet following operational requirements :			
	a)	Selective Duplex collective, automatic operation with or without attendant through illuminated push button station located inside the lift car.		
	b)	Door operating shall be automatic door operation and electronic door protection system for opening/closing of car and landing doors.		
	c)	Bidder shall provide car operating panel with luminous buttons, car position indication in car (both visual and audio) combined with direction arrows, overload warning indicator, battery operated alarm bell and emergency light and fan & hands free speaker telephone set with suitable battery, charger & controls.		
	d)	Bidder shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio & visual)		
	e)	Bidder shall provide electronic door detector (Infra red curtain type).		
	f)	Two push buttons, one for upward movement and the other for downward movement at each intermediate landing and one push button at each terminal landing shall be provided in order to call the car. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the bidder.		
	g)	For facilitating the movement of visually & hearing impaired persons, hall lantern and car arrival chimes shall be provided.		
	h)	All fixtures shall be in stainless steel face plates.		
	i)	Push buttons shall be fixed in the car for holding the doors open for any length of the time required.		
	j)	All other safety/protection/operation interlocks as required by IS: 14665 (latest edition).		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC. NO.:CS-9585-001-2		SUB-SECTION-A-28 SERVICE ELEVATORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.04.00	Electrical Equipment:			
1.04.01	Driving Motors: The driving motors shall conform to IS 325 and suitable for the Variable Voltage Variable Frequency (VVVF) application. All motors shall be squirrel cage induction type, suitable for operation at 415V (+/- 10% variation) , 3 phase, 3 wire, 50HZ (+3% to -5% variation) supply. Motors shall be provided with thermal class 130 (B) or better insulation.			
1.04.02	Controls: The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation. Suitable control panel shall be provided in the machine room.			
1.04.03	Cables and Cables: All the cables except trailing cables shall be as per IS: 1554-1 or IS-7098-I. The PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties. a) Oxygen index of min. 29 (as per IS:10810 Part-58) b) Acid gas emission of max. 20% (as per IEC-754-I). c) Smoke density rating shall not be more than 60% (as per ASTM-D-2843). The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated) or IS-4289 Part-II (PVC insulated). The flat type trailing cables if offered shall be in accordance with IEC-60227-6. All wiring / cabling between the equipments in the lift machine room and that between the machine room and equipments in the lift well and at the landings shall be wired in HDP conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used.			
1.04.04	Earthing: The elevator structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
	DATA SHEET		
	i)	Type of services : Passenger	
	ii)	Load carrying capacity : As per specification	
	iv)	Rated speed : One (1) m/s	
	v)	Total Travel : TG hall- As per layout Service Building- As per layout ESP Control room (If applicable)- As per Layout Administrative Building-As per layout	
	vi)	No. of floor to be served : TG hall, Service Building, Administrative Building & ESP control room (If applicable): - To be decided during detailed engineering.	
	vii)	Method of control : Variable voltage variable frequency (VVVF)	
	viii)	Position of M/c room : Directly above lift shaft	
	ix)	Size of platform : As per IS14665 & manufacturer's standard latest.	
	x)	Size of lift well : -do-	
	xiii)	Specification code : As per IS: 14665 (5 parts) (Latest Edition).	
	xiv)	Design seismic co-efficient : According to the IS 1893-1977	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-28 SERVICE ELEVATORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	RACK & PINION ELEVATOR			
1.00.00	GENERAL			
	This specification is intended to cover design, engineering, supply, erection, testing and commissioning of the complete Rack & Pinion type Elevators as specified hereinafter complete in all respects and adequate for safe, efficient and trouble free operation of the elevator.			
1.01.00	CODES AND STANDARD			
	The design, manufacture, inspection and testing of Elevator shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Elevator shall conform to the latest edition of standards and codes. Other internationally acceptable standards/ codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Project Manager shall be final and binding.			
1.02.00	DESIGN AND CONSTRUCTION REQUIREMENTS			
1.02.01	GENERAL			
1.02.02	This section covers the design, engineering, fabrication, installation, commissioning and testing of the rack and pinion type vertical lift elevator including required enclosures, hoist, mast and guide rail, cab drive unit machinery buffers, power cable, control cable, mechanical and electrical equipment. The design of the elevator shall be in such a way that the elevator operation will be safe at all times.			
1.02.03	Elevator shall be located as indicated in the relevant tender drawings and shall be capable of operating from the ground floor to the top interior platform with intermediate stops at all interior platforms.			
1.02.04	All mechanical and electrical operating devices and Trailing cable shall be designed for outdoor operation with dusty and high humidity conditions and shall operate equally well in any ambient temperature as per project synopsis. Additionally, all mechanical and electrical components of the elevator shall be designed to withstand a temperature of 50°C ambient.			
1.02.05	ENCLOSURES			
	A three-sided enclosure with one access door shall be provided for ground landing. At each platform landing above ground level, a one sided enclosure with access door shall be provided. Enclosures shall be fabricated from tubular steel and/or other structural shapes expanded metal or wire mesh of suitable height and primer coated with one coat of the manufacturer's standard primer and finish paint. The ground landing shall be provided at a suitable height above the foundation slab to ensure a safety space underneath the cage. The space under the landing shall be surrounded by foundation enclosure. The staircase shall be provided for access to the cage. Enclosure access doors shall be electrically and mechanically interlocked			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	so that they remain closed and locked except when the cab is at a landing. Doors shall be bi-parting and swinging type.			
	Base of the three-sided enclosure shall be securely anchored to the ground level floor slab using expansion type anchors.			
1.02.06	Mast	Mast shall be provided in sections of suitable length, consisting of tubular sections and/or structural shapes welded together to form a framework to which the rack is bolted. Mast shall be securely anchored to the building structure.		
1.02.07	Cab			
1.02.08	Cab frame shall be fabricated from tubular steel and/or other structural shapes enclosed with expanded metal or wire mesh.			
1.02.09	Cab floor shall be of 6 mm thick Aluminum chequered plate or approved equivalent. Cab shall be attached to a framed structure and form an integral part with the drive mechanism located atop the cab.			
1.02.10	Framed structure shall include guide rollers and safety hooks to ensure positive engagement of the rack and pinion to prevent cab disengagement in case of roller failure.			
1.02.11	Cab roof shall be provided with an escape hatch electrically interlocked with the hoist control system. Tubular steel handrail shall enclose the cab roof for maintenance operations.			
1.02.12	Cab door and landing level enclosure doors shall be electrically and mechanically interlocked to prevent the cab from being operated unless the cab door and landing level enclosure doors are fully closed and to prevent the doors from being opened while the cab is in motion.			
1.02.13	One cabin fan and LED along with the fittings to be provided with one no. emergency light with battery & battery charger.			
1.03.00	Drive Unit & Safety Device			
1.03.01	Drive unit located on the cab shall be complete with AC squirrel cage induction motor, reduction gear, drive pinion and an over-speed governor. Drive unit shall incorporate an electric disc brake and an external manual brake release. The brake on the electric motor will be self adjusting type. In case of the power failure, the brake will be automatically applied & will stop the cab. A hand lever, which can be operated from the cage, is to be provided to enable the occupants to ease the brake and lower the cage to the bottom level. Motor shall be connected to a reduction gear, which drives the pinion.			
1.03.02	An over-speed governor must be incorporated to protect the cab against over speed during the cab downward motion. At a predetermined speed higher than normal, the brake, mechanism shall be actuated and stop the downward motion of the cab gradually. The brake should remain locked on following this action and has to be manually reset before normal elevator operation can be resumed.			
1.03.03	A remote control shall be provided for testing the safety device. The Contractor shall ensure that no individual is in cab during the test.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC. NO.:CS-9585-001-2		SUB-SECTION-A-28 SERVICE ELEVATORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.03.04	The drive system shall be designed so that it will be capable to operate smoothly without any tendency to rock or judder with all vertical, horizontal forces as well as the moments through the rack.			
1.03.05	Suitable arrangement shall be provided to bring the cage safely to the ground by gravity in the event of power failure.			
1.04.00	Buffers			
	Sufficient no. of buffers of spring loaded/hydraulic type shall be fitted below the cab. The buffer shall be capable of stopping the cab without permanent damage or deformation to themselves or any other part of the equipment. The no. of buffers shall be fixed as to ensure proper sharing of impact loads by all of them.			
1.05.00	Power Supply			
	Two incomers (3 phase 3 wire) (one from Bus-A and one from Bus-B of the MCC) for the power supply to each elevator shall be provided with castle key interlocks.			
1.06.00	Power and Control Cabinets			
	All electrical components furnished with the elevator shall be completely wired, energised and checked.			
	All electrical control devices shall be in enclosures. Equipment furnished shall also include the following:			
	(a.) Momentary contact push button for raise/lower control.			
	(b.) Reversing combination motor starter with a three phase thermal overload relay for motor protection. However, the control circuit in the elevator will have miniature circuit breakers.			
	(c.) Electric and mechanical interlocks on cab access door and landing level enclosure doors.			
	(d.) An ultimate three phase over travel limit switch which cuts off power and control supply in case of over travel. The switch can also be manually turned to off position.			
	Safety device as mentioned elsewhere in this specification			
	(e.) An alarm push button shall be provided in the cage. Alarm signal will be transferred to the auxiliary panel at elevator base.			
	The auxiliary panel at the base will have battery and battery charger for the alarm horn. Potential free contacts for remote alarm shall also be provided.			
	(f.) Reverse phase relay connected to prevent operation of the cab with improper phase rotation or failure in any phase in the power supply.			
	(g.) The cable shall be supported by brackets on the cage and guide rails. A cable trolley will keep it in tension and will be guided on the same rail as the cage. The trailing cable shall run through cable guides.			
	(h.) One auxiliary panel shall be furnished and mounted on the ground level enclosure. Panel shall be in enclosure equipped with a main "ON-OFF" switch, main Contractor,			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC. NO.:CS-9585-001-2		SUB-SECTION-A-28 SERVICE ELEVATORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.09.00	Trailing cables in the elevator shaft should be specially designed for the specific service and shall conform to IS. Trailing cables shall be EPR insulated for 1.1 kV and shall be neoprene jacketed flexible cord.			
	Conductor accessories including terminal materials like glands, lugs etc. markers, tying materials, and cable supports shall be furnished and installed.			
	Earthing			
	(a.) GENERAL			
	Complete earthing system shall be furnished for all equipments and accessories of the elevator as per relevant IS.			
	(b.) MATERIALS			
	The earthing of all electrical items being supplied by the Contractor shall be in his scope. For earthing the various equipment, conductor sizes shall be as listed below :			
	(1.) Motor above 5 kW upto 30 kW 25x6 mm2 GI flat			
	(2.) Motors upto 5 kW and misc. small item like conduits, junction boxes etc. 8 SWG GI wire			
	(3.) Cab earthing Additional core of trailing cable			
The earthing strip/wire shall be connected to the earthing mat by the Contractor. Clamps and other hardware of iron or steel used with the grounding system shall be hot-dip galvanised. Bolts, washers, and nuts shall be hot-dip galvanised steel.				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC. NO.:CS-9585-001-2		SUB-SECTION-A-28 SERVICE ELEVATORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET: RACK & PINION ELEVATOR 1.0.0 GENERAL 1.1.0 Type of Service Passenger-Cum-Goods 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Carrying capacity 1000 Kg 2.2.0 Rated speed Approx 25 - 40 m/min. 2.3.0 Total Travel Shall be as per actual dimension of the Building 2.4.0 No. of floors to be served As per requirement 2.5.0 Entrance As per requirement 2.6.0 Min. cab Floor size (inside) WxLxH 1.3m x 2.0m x 2.1 m 2.7.0 Various heights of landing floors to be served Suitable for working floors as indicated in the tender drawing. 2.8.0 Drive Motors (AC) One (1) No. 2.9.0 Cab Flooring 6 mm thk. Al. Chequered plate.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)	TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-28 SERVICE ELEVATORS PAGE 11 OF 11



SUB-SECTION VI

MANDATORY SPARES

**EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE-1 (3x800 MW)**

**TECHNICAL SPECIFICATION
SECTION-VI PART-A
BID DOC NO: CS-9585-001-2**

CLAUSE NO.	MANDATORY SPARES			
1.00.00	SPARES The Bidder shall include in his scope of supply all the necessary Mandatory spares, start up and commissioning spares and recommended spares and indicate these in the relevant schedules of the Bid Form and Price Schedules. The general requirements pertaining to the supply of these spares is given below:-			
1.01.00	MANDATORY SPARES (a) The list of mandatory spares considered essential by the Employer is indicated in Section VI, Part-F chapter. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms and Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item. (b) The Employer reserves the right to buy any or all the mandatory spares parts. (c) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes. (d) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments. (e) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise. (f) In case specified spares are not applicable to a particular design offered by the bidder, functionally equivalent applicable spares pertaining to the offered design shall be provided in quantities as per specified spares.			
1.02.00	RECOMMENDED SPARES (a) In addition to the spare parts mentioned above, the contractor shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Form and Price Schedules. This list shall take into consideration the mandatory spares specified in this Section-VI, part-F and should be independent of the list of the mandatory spares. The Employer reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATION SECTION-VI PART-A BID DOC. NO. CS-9585-001-2	SUB-SECTION-VI MANDATORY SPARES	PAGE 1 OF 3

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CLAUSE NO.	MANDATORY SPARES			
	enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.			
7.00.00	All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.			
8.00.00	The contractor will provide the Employer with all the addresses and particulars of his sub suppliers while placing the order on vendors for items/components/equipments covered under the contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.			
9.00.00	The Contractor shall warrant that all spares supplied will be new and in accordance with the contract Documents and will be free from defects in design, material and workmanship.			
10.00.00	In addition to the recommended spares listed by the contractor, if the employer further identifies certain particular items of spares, the contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires.			
11.00.00	The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the contract. The Contractor shall guarantee that before going out of production of spares parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his sub contractors, Contractor will provide the Employers, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items.			
12.00.00	The bidder to provide datasheets/assembly drawings of the manufacturer/ any other relevant document showing Bill of Material(s), Make, Model Number, Part Number etc. through which the mandatory spares to be supplied can be uniquely identified. This would facilitate the Employer to assign a unique code to each of the mandatory spare as brought out in GCC. The bidder shall extend all necessary assistance in this regard.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATION SECTION-VI PART-A BID DOC. NO. CS-9585-001-2	SUB-SECTION-VI MANDATORY SPARES	PAGE 3 OF 3



SUB – SECTION – A-29

PRE-COMMISSIONING & COMMISSIONING ACTIVITIES

EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION EXPANSION
PHASE I (3X 800MW)

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS:9585-001-2

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	PRE-COMMISSIONING ACTIVITIES & COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
1.00.00	GENERAL			
1.01.00	The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.			
1.02.00	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.			
1.03.00	The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All pre-commissioning/commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance program as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.			
2.00.00	TESTING / COMMISSIONING PROCEDURES			
	The contractor shall submit his testing / commissioning check lists and procedures for various equipments / systems covered under the contract at least 18 months before the actual commissioning of the equipments / systems for review and approval of employer.			
	The testing / commissioning procedures are to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of commissioning check lists and procedures to be submitted and their content details shall be agreed upon during preaward discussions.			
	An indicative list of Testing / Commissioning procedures/schedules and Standard Checklists and the details regarding the contents of testing/commissioning are enclosed as annexure at the end of this sub-section of section-VI, Part B. The actual list of such equipments / systems shall depend on the equipments / systems being supplied by the contractor.			
	i) Annexure-I : Standard Checklist of items			
	ii) Annexure-II : Testing / Commissioning Procedure/schedules			
	iii) Annexure-III : Commissioning procedures requiring approval of Employer.			
	iv) Annexure – IV : Demonstration/Acceptance test procedures during Commissioning/Initial operation			
	v) Annexure – V : Brief write up on Contents of Testing / Commissioning Procedures			
	Procedure/schedules shall be approved by the employer.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO.: CS-9585-001-2	SUB-SECTION- A-29 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 1 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.00.00	PRECOMMISSIONING & COMMISSIONING ACTIVITIES			
3.01.00	General The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.			
3.02.00	PRE-COMMISSIONING ACTIVITIES/TESTS: Steam Generator			
3.02.01	Hydraulic Test of Pressure Parts On completion of installation of the Steam Generator pressure parts and high pressure boiler external piping & non boiler external piping a hydraulic test in accordance with the requirements of the Indian Boiler Regulations, shall be performed by the Contractor. However, making use of valves/control valves supplied by others and installed on the contractor's piping system during hydraulic testing shall be subjected to the acceptance of respective valve supplier otherwise hydraulic cap/blanking arrangement as required shall be used. The procedure adopted for hydraulic test and preservation shall have the prior approval of the Employer. The detailed schemes and procedure for carrying out hydraulic testing shall be prepared and furnished by the contractor and it shall be discussed and finalized during detailed engineering stage. The water for hydraulic test shall be made alkaline by addition of suitable chemicals. After the test, the Steam Generator and high pressure external piping shall be suitably drained and preserved. All blank flanges, removable plugs, temporary valves, pipes & fittings, spools, other accessories and services required for carrying out hydraulic testing of boiler external pipings & non boiler external pipings and boiler & its pressure parts shall be furnished by the Contractor. The pressurization equipment including water piping and any chemicals for preservation, needed for the above test shall also be furnished by the Contractor. Any defect noticed during the testing shall be rectified and the unit shall be retested by the Contractor. In the case of branch connections/ tap-off piping (in others scope) from contractor's scope of piping are not ready or not erected at the time of hydrostatic testing of piping in contractor's scope, then the contractor to supply/use necessary blanking arrangement as required at these tap-off /branch connections. The hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting authority as per the provision of the IBR and the Project Manager.			
3.02.02	Air & Gas Tightness Test After completion of installation of furnace tubes and/or inner skin casing wherever applicable ducts and airheaters, and before commencement of application of thermal insulation a test shall be performed on the Steam Generator by the contractor to prove or to establish the tightness of the erected equipments from the outlet of FD fan through Steam Generator to the stack. Such test shall be done, as far as possible, with all mountings like soot blowers etc. installed in position. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurising the section under test by running FD Fan / PA Fan / Temporary blower, as the case may be, is adopted. The contractor may adopt any other better method of testing.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO.: CS-9585-001-2	SUB-SECTION- A-29 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 2 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.03	All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor. The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their air/gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this manner. Any blanking etc. on the duct side required for testing of duct segments shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted without necessity of FD / PA fans. The above equipment shall be brought to site by the Contractor on temporary basis and shall be taken back after successful completion of air / gas tightness test.			
	Contractor shall perform thorough and efficient cleaning operations of all the internal parts of the boiler, like economiser, water wall / evaporator, separator, feed water line, piping, start-up recirculation lines and associated piping and all other pressure parts and associated high pressure piping covered under these specifications (except those portions which are to be steam blown).			
	The cleaning operation shall consist of De-mineralised (DM) water flushing, the chemical cleaning using acids like hydrofluoric acid or as recommended by the manufacturer, DM water rinsing, DM water flushing, nitrogen capping etc. Complete chemical cleaning procedure, the scheme and layout including parameters of the pumps, size of tanks, materials of construction, the rate of consumption and total requirements of steam and water for such cleaning process shall have the approval of the Employer.			
	The Contractor shall furnish all labour, materials such as the required chemicals and other consumables, all equipment such as acid/chemical transfer and acid/chemical circulating pumps complete with drive motors, acid storage and acid/chemical mixing tanks, all temporary piping, valves and specialities and local instruments for pressure, temperature and flow measurements and any other items needed to carry out the process. All equipment required for chemical cleaning of Steam Generator shall be supplied by the contractor.			
	The Contractor shall take care to dispose off the used chemicals and the effluents from the cleaning operations, after neutralisation, meeting all the statutory regulations and in a manner acceptable to the Project Manager and which would comply with the norms of the State Pollution Control Board. This includes construction of suitable neutralization pit, channels, disposal equipments etc.			
	The Contractor shall specifically make all necessary arrangements for prevention of any fire accidents, explosions etc. during the performance of the chemical cleaning operations. The Contractor shall ensure that during the cleaning process the procedure adopted shall be such as to consume minimum demineralized water.			
	The cleaning procedure shall include final flushing and draining of the boiler under a nitrogen gas cap and/or filling the boiler with inhibited water or any other proven procedure recommended by the manufacturer for the preservation of the boiler which is acceptable to the Employer. The Contractor shall furnish a detailed procedure for boiler preservation during detailed engineering for Employer's approval.			
All equipment needed for such preservation including the nitrogen cylinders, interconnecting piping and any regulating equipment for N2 cap and other preservatives shall be provided by the Contractor for the Steam Generator and the same shall also become the property of the Employer after completion of the chemical cleaning.				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO.: CS-9585-001-2	SUB-SECTION- A-29 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 3 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.04	The Contractor shall provide adequate safety and protective equipment for all his employees and ensure that they are worn at all times of danger. Specialized treatment equipment (such as required for first aid when using hydrofluoric acid/chemical) must be provided at the place of handling acid/chemical. An acid/chemical cleaning report and log of each cleaning must be provided by the Contractor to the Employer, immediately after the cleaning operation. S ☐☐☐☐ B ☐☐☐☐ Steam blowing of complete Superheaters, Reheaters and various boiler external piping and non boiler external piping shall be carried out by the Contractor as per requirements/scope of work (indicated in Part-A & Part-B, Section-VI) of this specification. Temporary materials as required for steam blowing of these piping systems shall be supplied by the contractor. Steam blowing of contractor's scope of piping systems shall be performed without valves/control valves supplied in steam blowing circuit otherwise valve supplier's acceptance to include these valves for steam blowing operation is to be submitted by the contractor. Based on the above the Contractor shall give recommended procedures, method of blowing and scheme for steam blowing indicating clearly additional system, if any, to be cleaned by steam blowing and furnish data/ write-up/ layouts/ drawings to that effect to the Employer for approval. The Contractor shall furnish his recommendations regarding use of various test equipments and instruments and termination/acceptance criteria for steam blowing, which in any case shall meet the steam turbine-generator requirements. The systems which should be ready and operational before steam blowing shall be made ready/operational by the Contractor by the scheduled date for starting of steam blowing. For equipments/components installed on high pressure external piping, such as various thermo-wells, flow meter, control valves, HP/LP Bypass valves etc., the Contractor shall comply with guidelines to be followed during steam blowing, with respect to removal / blanking / replacement of such items their internals etc. by spool pieces as given by the respective manufacturer/sub-contractor. Supply of all such spools (as above) and/or blanks, temporary piping and supports etc. as required, cutting / welding / edge preparation and rewelding required for blanking, temporary piping connection and/or for replacements by spool pieces shall be the responsibility of the Contractor. After steam blowing removal of spool pieces & temporary piping and reinstallation of various components, shall also be the responsibility of the Contractor. In the case of branch connections/ tap-off piping are not ready or not erected at the time of steam blowing operation then the contractor to supply/use necessary blanking arrangement as required at these tap-off / branch connections. It will be the responsibility of the Contractor to operate the Steam Generator and its accessories equipment to generate adequate steam at the parameter and quality in line with the requirements of steam blowing procedure. The Contractor shall make adequate provisions for temporary enhancement of fuel oil firing capacity of the steam generators by changing oil gun tips etc. as may be required so as to be able to conduct complete steam blowing operation by oil firing alone. All necessary precautions to avoid fires and cold end corrosion of Air preheater, during such oil firing at enhanced SG loads, shall be taken by the Contractor. The Contractor shall ensure successful and timely completion of steam blowing of all systems and will render all help/services as required including:			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO.: CS-9585-001-2	SUB-SECTION- A-29 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 4 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS 
3.02.05 3.02.06 3.02.07 3.02.07.01	(i) Services of test/operating personnel/supervisors. (ii) Extending all cooperation during erection, pre-commissioning of plant and equipment to be made ready and operational before starting steam blowing. (iii) Extending all cooperation for interface engineering of equipments/components of temporary system required for steam blowing operation. (iv) Contractor's engineers shall be available for all coordination meetings arranged by the Employer for finalizing the details of temporary system for steam blowing. For the steam blowing operation, steam conditions like pressure, temperature etc. at the Steam Generator outlet shall be so selected that a minimum cleaning ratio/ disturbance factor of more than 1.4 is achieved. A cycle of heating, cooling and blowing/ purging, is to be repeated to ensure thorough cleaning of the interior of the pipes/ tubes etc. The final indication of cleanliness shall be demonstrated by purging through target plates positioned at the discharge point. SCR SYSTEM Complete pre-commissioning work including tests of facilities such as pressure drop test of SCR system and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification. ESP Complete pre-commissioning work including tests of facilities such as air and gas tightness tests of ESP, pressure drop test of ESP, gas distribution test of ESPs etc. and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification. FGD SYSTEM Air and Gas Tightness Test After completion of installation of Booster fans (if required), ducts & absorber, and before commencement of application of thermal insulation a test shall be performed on the FGD system by the contractor to prove or to establish the tightness of the erected equipments. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurizing the section under test by running Temporary blower is adopted. The contractor may adopt any other better method of testing. All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor. The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this manner. Any blanking etc. on the duct side required for testing of duct segments shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted. The above equipment shall be brought to site by the Contractor on temporary basis and shall be taken back after successful completion of air / gas tightness test.
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW) TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO.: CS-9585-001-2 SUB-SECTION- A-29 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES PAGE 5 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.07.02	All pre-commissioning tests & activities as indicated in Annexure-I, II & III and elsewhere in the technical specification shall be performed by the Contractor.			
3.02.08	Any other pre-commissioning activity such as floating of safety valves etc. as considered essential for readiness of facilities for commencement of commissioning activities shall also be undertaken by the Contractor.			
3.03.00	D o u r i n g t e s t s / A l l t e s t s t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e b i d d e r m a y b e d e m o n s t r a t e d d u r i n g c o m m i s s i o n i n g f o r w h i c h t h e			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.03.03	Thermal Aspects			
	(i)	H.P./L.P. Bypass Control The HP & LP Bypass system should satisfy the following functional requirements under automatic interlock action. It should come into operation automatically under the following conditions: (a) Generator circuit breaker opening. (b) HP - IP stop valves closing due to turbine tripping. (c) Sudden reduction in demand to house load. Under all these conditions, while passing the required steam flows as per the relevant heat balances, the condenser should be able to swallow the entire steam without increasing the exhaust hood temperature and condenser pressure beyond the maximum permissible value indicated by the BIDDER in his offer and accepted by the EMPLOYER. The same shall be demonstrated.		
	(ii)	Steam Condenser Performance (a) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads. (b) Oxygen content in condensate, at condensate collection tank outlet, shall not exceed 0.015 CC per litre over the entire load range and shall be determined according to calorimetric Indigo - Carmine method. (c) Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system. (e) The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17 deg.C below the temperature corresponding to absolute suction pressure shall not be less than as specified elsewhere. Correction curves for establishing the capacity at site conditions shall also be furnished. (f) The air and vapour mixture from air cooling zone of condenser shall be 4.17 deg.C below the saturation temperature corresponding to 25.4 mm Hg (abs) suction pressure. Correction curves for establishing the same at site conditions shall also be furnished.		
(iii)	Feed Water Heater & Deaerator (a) TTD's and DCA's of feed water heaters in line with 800 MW heat rate guarantee heat balance shall be demonstrated. (b) Dissolved O2 content in Deaerator effluent at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 CC/ litre determined as per D5543-09 Indigo Carmine method. (c) Difference between saturation temperature of steam entering the deaerator and temperature of feed water leaving deaerator.			
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CLAUSE NO.	TECHNICAL REuirements	
	(iv) Centrifugal Export Pumps (a) Each CEP set shall be capable of delivering flow & total dynamic head corresponding to runout point as specified. (b) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated. (v) Drip Pumps (Condensate) (a) Each drip pump shall be capable of delivering flow & total dynamic head corresponding to design point as specified. (b) The vibration and noise level shall be demonstrated. (vi) Boiler Feed Pumps (a) Each boiler feed pump set shall be capable to deliver flow and total dynamic head corresponding to runout point as specified elsewhere. (b) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated as per specification requirements. (c) Cold start up / hot start up of the unit using TDBFP with motive steam from auxiliary steam header.	
3.03.04	Boiler Pumps, Blowers, Fans, Compressors and Rotating Equipment a) The vibration, noise level and parallel operation, wherever applicable, of the pumps, blowers, fans, compressors and rotating equipment shall be demonstrated. b) Pumps, blowers, fans, compressors and rotating equipment shall be capable of delivering flow and head corresponding to design point as specified.	
3.03.05	Boiler Air Cooled/Precipitator Contractor shall balance the primary air as well as coal flows in the pulverised fuel pipes such that the minimum PF and PA flow imbalance in the PF pipes from each coal pulveriser does not exceed 5% of average flows. The above balancing shall be checked by the Contractor by carrying out both clean air test and dirty air test (using dirty pitot tubes).	
3.03.06	Dust Collector Refer Sub section-A-02 and A-03 ,Part-B(Mechanical), Section VI of Technical Specification..	
3.03.07	Steam Temperature The Contractor shall demonstrate that at SH and RH outlets (in case of more than one outlet) the temperature imbalance between the outlets does not exceed 10 deg C under all loads including transients.	
3.03.08	Nozzle Contractor shall demonstrate that oil support for flame stabilization shall not be required beyond 40% of BMCR load when firing the coals from the range identified. The Contractor	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.03.09	shall demonstrate that with any combination of mills/ adjacent mills in service (to Employer's choice) the Steam Generator does not require any oil firing for stable and efficient boiler operation at and above 40% BMCR loads. Completion of drives After completion of installation of drives, contractor shall demonstrate the capability of all drives as specified elsewhere in Section VI Part B of Technical Specifications.			
3.03.10	Margin on Fans After completion of installation of fan drives, Fans, inlet and outlet ducting, measuring equipments etc. contractor shall demonstrate the margin on seal air fans, primary fans, Forced draft fans and induced draft fans as specified elsewhere in Section VI Part B of Technical Specifications.			
3.03.11	Cold Air Velocity Test (CAVT) A CAVT shall be conducted on each Steam Generator during commissioning before its initial operation to establish the average cold air velocity and the velocity distribution at minimum three predetermined sections (Employer's Choice) of steam generator. The data obtained from the CAVT will be used to compute the actual flue gas velocities as well as their distribution at the test sections during actual operation by correlating the CAVT data with the test/computed data from Thermal Performance Test as per Clauses 1.03.04 (iii) sub section-IV, Section-VI- Part-A. Should the CAVT results after this correlation with TPT data indicate actual localized high flue gas velocity zones/ mal-distribution of gas flow and/or flue gas laming, suitably designed stainless steel screens at required SG cross sections shall be provided by the Contractor to bring the deviation of the localized gas velocity within $\pm 20\%$ of average gas velocity specified. Through this test the Contractor shall also demonstrate the compliance with the specification requirements regarding the maximum allowable flue gas velocities at various sections of the Steam Generator, refer sub-section-A-03, Part-B of Technical Specifications. The detailed CAVT procedure shall be to Employer's approved. The Contractor shall submit a detailed CAVT report and the computations of actual velocities after correlating CAVT data with TPT data to the Employer for approval.			
3.03.12	Continuous operation at 30% TMCR Contractor shall demonstrate the capability of Steam generator and its auxiliaries to operate at rated parameters safely and on sustained basis at TMCR load while firing range of Indian coal(s) as specified in Table-1(A), Annexure-IV-2 ,sub section-IB ,Part-A of Section-VI blended with imported coal up to 30% by weight specified in Table-4, Annexure-IV-4, sub section-IB ,Part-A, Section-VI. Such demonstration shall be for 72 hours of continuous operation			
3.03.12 a)	Performance characteristic of fans (PA/FD/ID fan capacity, head developed, etc.)			
3.03.13	Passenger & good elevators for steam generator – overload tests, travel and hoist speed checks.			
3.03.14	Auxiliary Boiler Rating Contractor shall demonstrate the rated parameters of Auxiliary Boiler, its steam generating capacity as per Clause 1.05.20 of Sub-section A-02.			
3.03.15	ESP Air in Leakage			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.03.16	Contractor shall demonstrate that ESP air in leakage shall be limited to 1% of the total gas flow under guarantee point condition. Pressure Drop Across ESP			
3.03.17	Contractor shall demonstrate that the maximum flue gas pressure drop across the ESP under specified guarantee point condition shall not exceed 20 mmwc. FGD System (i) Performance characteristics of fans (capacity, head developed, etc.) and margins on fans in case Booster Fan, as specified in Part-B of technical specification, is provided by the Contractor. (ii) Capabilities of all drives (Refer Part B of Technical Specifications) (iii) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building: Over load tests, travel and hoist speed checks.			
3.03.17	Hydrogen Generation Plant a) Parallel operation of two streams shall be demonstrated at site. Purity level and moisture contents of Hydrogen shall also be demonstrated at site. b) Hydrogen Generation Plant capacity of each stream shall be demonstrated at site.			
3.04.00	Pressure Testing & Commissioning of Piping System: (a) Hydraulic Test for STG integral piping, heat exchangers, condenser tubes & condenser, equipment cooling water system pipes and associated equipment etc. shall be done. The hydraulic test of other piping system as per statutory requirement and specified elsewhere shall also be carried out. All equipment needed for the tests shall be furnished by the Contractor. (b) Oil flushing of lube oil system, control & jacking oil system, etc. for turbines shall be done. Entire flushing oil requirement & refilling with fresh oil and other consumables along with flushing equipment shall be met by the Contractor. (c) High Pressure/Low Pressure (HP/LP) bypass tests, vacuum tightness test as per approved procedures shall be done by the Contractor after arranging & lining up of all the necessary equipment by him. (d) Steam blowing & chemical cleaning, as applicable of integral piping of the turbo-generator, Low pressure piping, Power cycle piping & other piping in the scope of the Contractor shall be done by the Contractor. (e) Steam blowing & chemical cleaning, as applicable of integral piping of CEP sets & other piping in the scope of the Contractor shall be done by the Contractor. (f) All tests and activities pertaining to the CEP and its drive as per manufacturer's recommendations and as given in the chapter and covered in the specification. (g) Steam blowing & chemical cleaning, as applicable of integral piping of Drip Pump sets & other piping (if applicable) shall be done by the Contractor.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	(h) All tests and activities pertaining to the Drip Pump and its drive (if applicable) as per manufacturer's recommendations and as given in the chapter and covered in the specification.			
	(i) Steam blowing & chemical cleaning, as applicable of integral piping of the Heaters & other components shall be done by the Contractor.			
	(j) All tests and activities pertaining to the Heater as per manufacturer's recommendations and as given in the chapter and covered in the specification.			
	(k) Oil flushing of lube oil system, control & jacking oil system, for BFP sets shall be done. Entire flushing oil requirement & refilling with fresh oil and other consumables along with flushing equipment shall be met by the Contractor.			
	(l) Steam blowing & chemical cleaning, as applicable of integral piping of BFP sets & other piping shall be done by the Contractor.			
	(m) All tests and activities pertaining to the BFP and its drive as per manufacturer's recommendations and as given in the chapter and covered in the specification.			
	(n) Hydraulic Test for all low and high pressure piping, equipment cooling water system pipes and associated equipment etc. shall be done as per statutory requirement and specified elsewhere shall be carried out. All equipment needed for the tests shall be furnished by the Contractor.			
	(o) All tests and activities pertaining to the Generator and Excitation as per manufacturer's recommendations and covered in the specification.			
	(p) All tests and activities pertaining to the Generator Auxiliaries viz Primary water system, Seal oil system, Gas system etc., as per manufacturer's recommendations and covered in the specification.			
	(q) Any other pre-commissioning checks/ tests and activities as described below and also those mutually agreed between the Contractor & the Employer shall be undertaken.			
3.05.00	COMMISSIONING OF FACILITIES G			
Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities. Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence. The Contractor shall finalize the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	5. Standard commissioning tests and procedures as per Contractor's practice for steam turbine generator and other equipment / auxiliaries within the Contractor's scope of work. 6. Checks on operation of all individual control loops in the turbine generator control system. 7. Checks on correct functioning of the Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT). 8. Standard commissioning tests and procedures as per Contractor's practice for CEP and other equipment / auxiliaries within the Contractor's scope of work. 9. Checks on operation of all individual control loops in the CEP control system. 10. Standard commissioning tests and procedures as per Contractor's practice for Drip Pump (if applicable) and other equipment / auxiliaries within the Contractor's scope of work. 11. Checks on operation of all individual control loops in the Drip Pump control (if applicable) system. 12. Feed water heater operational test for establishing correct cascaded flow, heater water levels and checking of all parameters as per approved heat balance diagram. 13. standard commissioning tests and procedures as per contractor's practice for heaters and de-aerator and other equipment/auxiliaries within the contractor's scope of work. 14. Checks on operation of all individual control loops in the heater and deaerator control system. 15. Test for operation of governing control system for BFP turbines. 16. Standard commissioning tests and procedures as per Contractor's practice for BFP and other equipment / auxiliaries within the Contractor's scope of work. 17. Checks on operation of all individual control loops in the BFP control system. 18. Checks on correct functioning of the BFP Turbine for Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT). 19. Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications. 20. Checks on operation of all rotating equipments to ascertain level of noise and vibration 21. Checks on operation of all static equipments to ascertain level of noise and vibration 22. Standard commissioning tests and procedures as per manufacturer's practice for Generator, Excitation and its auxiliaries within the Contractor's scope of work.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.06.00	B प्री-कमिशनिंग टेस्ट्स & गतिविधियाँ All pre-commissioning tests &activities as required for successful running of the equipment or as mentioned in the technical specification elsewhere shall be performed by the contractor.			
4.00.00	INITIAL OPERATION Upon completion of system checking/tests and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.			
5.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).			
6.00.00	The Contractor shall conduct the comprehensive guarantee tests on the Steam Generator in co-ordination with the Steam Generator to establish the functional guarantee values at stipulated conditions as per Sub-section-IV, Part-A, Section-VI.			
7.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).			
8.00.00	COMMISSIONING SPARES			
8.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.			
8.02.00	These spare will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	ANNEXURE-I			
	STANDARD CHECKLIST This is an indicative list of items. The actual list shall depend on the Equipment / System being supplied by the contractor. MECHANICAL VALVES 1. Manually Operated Valve 2. Electrically Operated Valve 3. Pneumatically Actuated Valve 4. Hydraulically Actuated Valve 5. Safety Valve 6. Electromatic Relief Valve 7. Steam Trap 8. Non Return Valve (including Hydraulic/ Pneumatic QCNRVS) 9. Control Valve 10. Relief Valve 11. Differential Pressure Regulating Valve 12. Butterfly valve (Electrically Operated) 13. Butterfly valve (Manually Operated) 14. Butterfly valve (Fourway -Electrical) 15. One spare EOTV for steam blowing TANKS & PRESSURE VESSELS 1. Tanks (metal) up to 20 M³ 2. Tanks (Large Storage) 3. Pressure Vessel (Below 17 bars) 4. Air Receiver 5. Pressure Vessel – Access Door PUMPS 1. Pump-Low Pressure Centrifugal (Motor driven) 2. Pump-Up to 350HP 3. Pump-Sump installation 4. Gear Pump/Screw pump 5. Slurry Pumps 6. Vacuum Pumps PIPE WORK SYSTEM 1. Steam services			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	2. Water services 3. Slurry Services 4. Oil / Fire Resistant fluid system 5. Air services (Compressor) 6. High pressure services 7. Constant load support 8. Spring supports 9. PF Coal 10. Hangers and other Supports <u>STRAINER AND FILTER</u> 1. Strainer / Filter Basket Type 2. Strainer Rotary (Low Pressure) 3. Filter & Strainers Centrifugal Separators 4. Filter & Strainer Y-Type 5. Filter & Strainer (Plate Type) 6. Purifier 7. Filter – Compressed Air Line <u>HEAT EXCHANGER</u> 1. Heat Exchanger (General) 2. Heat Exchanger – Oil / Water 3. Rotary Air Heater <u>FANS & COMPRESSORS</u> 1. Fans –Non-Pressure Lubricated 2. Fans – Axial Flow pressure Lubricated 3. Compressors-General including H2 gas compressor 4. Blowers <u>DAMPERS & GATES</u> 1. Manually Operated Damper 2. Pneumatically Operated Damper 3. Electrically Operated Damper 4. Manually Operated Gates 5. Pneumatically Operated Gate 6. Electrically Operated Gate <u>DUCT WORK</u> 1. Air & Flue Gas Ducting 2. Expansion Joints 3. Observation & Access Door		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	CRANES AND ELEVATORS 1. Auxiliary Overhead Crane 2. Travel Support Structure for Crane 3. Long Travel & Cross Traverse Motion of Crane 4. Main Aux. Hoist Motion (Crane) 5. Crane Electric Hoist 6. Passenger cum goods elevator POWER TRANSMISSION 1. Power Transmission Gear Box 2. Bearings 3. Fluid Couplings BOILER & AUX.SYSTEM 1. Soot Blower Long Retractable 2. Wall Deslagger/Soot Blower 3. Bottom Ash Hopper 4. Fly Ash Hopper 5. Lubricator –Compressed Air Lines 6. Wind Box Assembly 7. Mixer / Stirrer 8. Compressed Air Breathing Apparatus 9. Oil Burner 10. Ignitors 11. Scanner 12. Manual Lubricators 13. Air Motor 14. Driers-Non Regenerative /Regenerative 15. Coal Bunker FGD & AUX.SYSTEM 1. Agitators 2. Air Motor 3. Process trestle 4. Limestone feeder 5. Vacuum belt filter			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO CS-9585-001-2	ANNEXURE-I OF SUB-SECTION- A-29 PRE-COMM. & COMM. ACTIVITIES	PAGE 3 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	6. Limestone ball mill 7. Limestone Hydrocyclones 8. Primary Hydrocyclones 9. Secondary Hydrocyclones 10. Absorber internals 11. Absorber Auxiliaries ELELCTRICAL 1. D.C. Motor 2. HV Squirrel Cage Induction Motor 3. 415 V Squirrel Cage Induction Motor 4. Motor Operated Actuators 5. Soot Blower (Deslagger) 6. Soot Blower (Long Retractable) 7. Soot Blower (Air Heater) 8. Aux. Control and Relay Panel Desk 9. LT SWITCHGEARS/MCC a) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM B) PT CARRIAGE AND CUBICLES C) CABLE/BUS DUCT/BUS BARS D) CONTRACTOR MODULE E) SWITCH FUSE MODULE F) MASTER PANEL OF LUBE OIL PANEL G) FEEDER PANEL OF LUBE OIL PANEL H) SPACE HEATER AND CABLE MODULE I) HT CIRCUIT BREAKER J) 415 V CIRCUIT BREAKER K) POWER CABLE L) AUXILIARY CABLE M) D.C. CABLE N) EXPLOSION PROOF ELECTRICAL EQUIPMENT O) JUNCTION BOX P) CONTROL TRANSFORMER MODULE Q) BRUSH GEAR ASSEMBLY R) AUX. CONTROL AND RELAY PANEL DESK S) INDICATING INSTRUMENT T) RECORDING INSTRUMENT u) INTEGRATING INSTRUMENT CONTROL & INSTRUMENTATION 1. Conductivity Measuring Equipment Including Test Procedures 2. pH Analyser Including Test procedure			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO CS-9585-001-2	ANNEXURE-I OF SUB-SECTION- A-29 PRE-COMM. & COMM. ACTIVITIES	PAGE 4 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	3. Silica Analyser 4. Level Switch (Float Actuated) 5. Level Switch (Electrode Type) 6. Level Switch (Displacer Actuated) 7. Transmitter (Float Operated Pneumatic Output including Testing procedures) 8. Level indicator (Float/Pulley Type) 9. Local Temperature Indicator Including Test Procedure 10. Resistance Thermometer Element Including Test procedure 11. Thermocouple Element and Connecting Cable 12. Thermocouple and Resistance Thermometer Convertor/Transmitter Including Test Procedures 13. Temperature Switch Including Test Procedure 14. Cold Junction Boxes 15. O₂Analyser 16. O₂ in Hydrogen including Test procedures 17. Pressure and Vacuum Gauge 18. Pressure and Vacuum Switch Including Test procedures 19. Differential Pressure Transmitter including Test Procedures 20. Differential pressure switch including Test procedures 21. Flow indicator (Variable Area) 22. Orifice plate 23. Flow Switch 24. Nozzle 25. Flow Integrator (pneumatic input) including test procedure 26. Flow indicator (Float Operated) Including Test Procedure 27. Venturi (Fluid) 28. Flow Switch (Magnetic Type) 29. Limit Switches 30. Turbine Supervisory Measuring System 31. Position Measurement & Indication Including Test procedures 32. Vibration Measurement 33. Digital Indicator 34. Moving Coil Indicator Including Test Procedures 35. Recorder Including Test procedure 36. Flame Scanner 37. Electrical Auto Manual Control Station 38. Push Button Module			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI/PART-B BID DOC NO CS-9585-001-2	ANNEXURE-I OF SUB-SECTION- A-29 PRE-COMM. & COMM. ACTIVITIES	PAGE 5 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	39. Test Procedure for Electronic Modules of DDCMIS 40. Alarm Annunciator Equipment Including Test Procedure 41. Test procedure for Adjustment of Modulating Controller-PID Term 42. Test Procedure Indicating Controller-Electrical Input & Pneumatic Output			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO CS-9585-001-2	ANNEXURE-I OF SUB-SECTION- A-29 PRE-COMM. & COMM. ACTIVITIES	PAGE 6 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																										
	ANNEXURE-II TESTING / COMMISSIONING PROCEDURES Following is an indicative list of equipments / systems for which Testing / Commissioning procedures are to be submitted. The actual list will depend on the equipment / system being supplied by the Contractor. <table><tr><th>S. No</th><th>DESCRIPTION</th></tr><tr><td colspan="2">Bidding</td></tr><tr><td>1.</td><td>ID Fan</td></tr><tr><td>2.</td><td>FD Fan</td></tr><tr><td>3.</td><td>PA Fan</td></tr><tr><td>4.</td><td>Air Heater</td></tr><tr><td>5.</td><td>Scanner Air Fans</td></tr><tr><td>6.</td><td>Fuel Firing System</td></tr><tr><td>7.</td><td>Milling System</td></tr><tr><td>8.</td><td>Soot Blower System</td></tr><tr><td>9.</td><td>Aux. Steam System</td></tr><tr><td>10.</td><td>Mill Reject Handling System</td></tr><tr><td>11.</td><td>HP Bypass System</td></tr><tr><td>12.</td><td>S.A.D.C. and its control</td></tr><tr><td>13.</td><td>Boiler Chemical Analysis Equipment</td></tr><tr><td>14.</td><td>SH / RH Spray system</td></tr><tr><td>15.</td><td>Chemical Dosing System</td></tr><tr><td>16.</td><td>Boiler Air and Gas System -Interlock Operation</td></tr><tr><td>17.</td><td>Boiler Start-up Re-Circulation Pump</td></tr><tr><td>18.</td><td>Coal Feeders</td></tr><tr><td>19.</td><td>Electrostatic Precipitator</td></tr></table>				S. No	DESCRIPTION	Bidding		1.	ID Fan	2.	FD Fan	3.	PA Fan	4.	Air Heater	5.	Scanner Air Fans	6.	Fuel Firing System	7.	Milling System	8.	Soot Blower System	9.	Aux. Steam System	10.	Mill Reject Handling System	11.	HP Bypass System	12.	S.A.D.C. and its control	13.	Boiler Chemical Analysis Equipment	14.	SH / RH Spray system	15.	Chemical Dosing System	16.	Boiler Air and Gas System -Interlock Operation	17.	Boiler Start-up Re-Circulation Pump	18.	Coal Feeders	19.	Electrostatic Precipitator
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	20.	Dosing System		
	21.	Seal Air Fans		
	22.	Boiler Safety Valves		
	FGD SYSTEM			
	1.	Booster Fan (if provided)		
	2.	Absorber System		
	3.	Limestone grinding system		
	4.	Absorber system		
	5.	Gypsum dewatering system		
	LIST OF TEST / ACTIVITIES TO BE PERFORMED ON TG & AUXILIARY (BUT NOT LIMITED TO THE FOLLOWING)			
	A) TESTING SCHEDULES			
	1.	TURBINE ON BARRING GEAR		
	2.	BEARING AND JACKING OIL INITIAL CIRCULATION		
	3.	HP BYPASS SYSTEM		
	4.	LP BYPASS SYSTEM		
5.	GOVERNOR OIL CONTROL SYSTEM			
6.	VACUUM RAISING PLANT			
7.	CENTRAL OIL PURIFICATION PLANT			
.	HYDRAULIC TEST PROCEDURE FOR			
A)	LUB OIL SYSTEM			
B)	CONTROL OIL & JACKING OIL SYSTEM			
C)	GENERATOR SEAL OIL SYSTEM			
D)	GENERATOR STATOR WATER SYSTEM			
E)	GENERATOR GAS SYSTEM (Alternatively, pneumatic test with suitable leak detection method shall also be acceptable subject to owner's approval)			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO CS-9585-001-2	ANNEXURE-II SUB-SECTION- A-29 PRE-COMM. & COMM. ACTIVITIES	PAGE 2 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	F) HEATERS 9. OIL FLUSHING OF LUB OIL SYSTEM 10. OIL FLUSHING OF CONTROL & JACKING OIL SYSTEM 11. OIL FLUSHING OF GENERATOR SEAL OIL SYSTEM 12. ALKALI FLUSHING FOR CONDENSATE SYSTEM 13. HP/ LP BYPASS SYSTEM 14. CONDENSER VACUUM TIGHTNESS TEST 15. STEAM BLOWING OF GLAND SEAL PIPE LINES, AUX. STEAM PIPELINE 16. CEP 17. Drip Pump (if applicable) 18. HEATER 19. DEAERATOR 20. BFP 21. BEARING AND JACKING OIL INITIAL CIRCULATION 22. GOVERNOR OIL CONTROL SYSTEM 23. HYDRAULIC TEST PROCEDURE FOR A) LUB OIL SYSTEM B) CONTROL OIL & JACKING OIL SYSTEM C) WATER SYSTEM D) HEAT EXCHANGERS 24. OIL FLUSHING OF LUB OIL SYSTEM 25. OIL FLUSHING OF CONTROL & JACKING OIL SYSTEM 26. STEAM BLOWING OF GLAND SEAL PIPE LINES, AUX. STEAM PIPELINE 27. HT MOTORS B) COMMISSIONING SCHEDULE 1. Turbine Gland sealing system for Main Turbine 2. HP-LP Bypass system 3. Turbine Initial Run up for Main Turbine			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO CS-9585-001-2	ANNEXURE-II SUB-SECTION- A-29 PRE-COMM. & COMM. ACTIVITIES	PAGE 3 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC													
	4. Lube Oil / Governing Oil System for Main Turbine 5. LP HEATERS 6. HP HEATERS 7. DEAERATOR STEAM OPERATION 8. Turbine Gland sealing system for BFP turbine 9. Turbine Initial Run up for BFP turbine 10. Lube Oil / Governing Oil System for BFP turbine 11. Generator and excitation system 12. Generator seal oil system 13. Generator stator water system 14. Generator gas system <table><tr><th colspan="2">Other Systems</th></tr><tr><td>1.</td><td>Compressed Air System</td></tr><tr><td>2.</td><td>Hydrogen Generation/ Bottling Plant</td></tr><tr><td>3.</td><td>Fire Protection & Detection System</td></tr><tr><td>4.</td><td>Air Conditioning and Ventilation System</td></tr><tr><td>5.</td><td> Ash Handling System - Bottom Ash System - Coarse Ash System(Economiser Ash) - Fly Ash System (ESP and APH) - Ash Slurry Disposal System - Ash water System </td></tr><tr><td>6.</td><td>Fuel Oil Pressurizing System</td></tr></table>			Other Systems		1.	Compressed Air System	2.	Hydrogen Generation/ Bottling Plant	3.	Fire Protection & Detection System	4.	Air Conditioning and Ventilation System	5.	Ash Handling System - Bottom Ash System - Coarse Ash System(Economiser Ash) - Fly Ash System (ESP and APH) - Ash Slurry Disposal System - Ash water System	6.	Fuel Oil Pressurizing System
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CLAUSE NO.	TECHNICAL REQUIREMENTS			NTPC																																																
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	ANNEXURE-IV दस्तावेज/आवश्यकता दर्शाते हैं चौकिसी/लोकल ऑफिस The following tests shall be demonstrated during commissioning for which the bidder has to furnish the procedure and get the approval of the employer: 1. Start-up, Loading, Unloading and Shutdown Capabilities (For Turbine Generator) 2. Turbine Generator Set Capability 3. Turbine Auxiliaries 4. Balance Pumps, Blowers, Fans, Compressors and rotating equipment. 5. Balancing of Coal/Primary air flow 6. Demonstration of boiler operation, rate of change of load and sudden load change withstand capability 7. Steam Temperature Imbalance 8. No fuel oil support shall be required above 40% BMCR 9. Capability of all drives 10. Margin on Fans 11. Cold Air Velocity Test (CAVT)			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO CS-9585-001-2	ANNEXURE-IV SUB-SECTION- A-29 PRE-COMM. & COMM. ACTIVITIES	PAGE 1 OF 1

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	ANNEXURE-V BRIEF WRITE UP ON THE CONTENTS OF TESTING / COMMISSIONING PROCEDURE Testing / Commissioning Procedure is required to be of a standard format in order to maintain consistency of presentation, content and reporting. These should contain the following sections to make the document a self contained one. 1. Plant Details / Design data 2. Objective 3. Proposal 4. Services Required 5. Safety Precautions 6. Emergency Procedures 7. State of the Plant (Status in respect of erection completion of Mech, Elect and C&I items) 8. Method 9. Completion / Acceptance Criteria 10. Appendix • Result • Log sheet • Drawing etc.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI PART-B BID DOC NO CS-9585-001-2	ANNEXURE-V SUB-SECTION- A-29 PRE-COMM. & COMM. ACTIVITIES	PAGE 1 OF 1

e-Learning Package For Effluent Treatment Plant

e-Learning Package:

e-learning packages shall be supplied for the equipment / system for the complete Pre Treatment Plant along with associated electrical and C&I system.

1. The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified above is to facilitate the employees to have first hand information / requirement with respect to above activities for the supplied equipment / system .
2. The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied as above.
 - a. The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure etc.
 - b. The commissioning course(s) should include instructions on pre-commissioning, commissioning, initial operation etc.
 - c. The operation course(s) should include instructions on the permissive, interlocks, physical check ups, start up, shutdown and protections etc.
 - d. The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling.

Depth of coverage of above courses shall be as specified for “**Instruction Manuals**” in General Technical Requirement Part-C, Section-VI of technical specification. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system.

3. The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of EIC or representative before acceptance by NTPC. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site. The respective module for operation & maintenance shall be delivered and successfully test run at least three months before scheduled first synchronization of first unit.

4. e-Learning course broad requirements:

- a. The courses shall be web based and mobile based Application type. It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc.
- b. The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices.
- c. Course content text shall be in English language and be associated with a voiceover in English language with Indian accent.
- d. Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI.
- e. Each course shall have every physical and functional detail of the equipment / system supplied.
- f. Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules.
- g. There shall be option for self-assessment test after every course. In case the user doesn't opt for self assessment test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz.
- h. If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same.
- i. Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window.
- j. The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course.
- k. The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.

- l. The system shall provide the user with the ability to select the information with a Cursor.
- m. The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function.
- n. Every course shall contain the 3D design/drawing/exploded view/360° turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable), animation and audio.
- o. The users shall be able to control audio sound level associated with the courses.
- p. Drawings / text in the courses shall be scalable (Zoom In/ Out).
- q. The user shall have the capability to record a **bookmark** to mark displayed information for later recall, whenever he accesses the same course next time.

Notes:

- 1. e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system.
- 2. e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system.
- 3. The vendor shall get the approval of one sample course from EIC before proceeding for further courses.

File Formats Supported by SPPID, SPI, SPEL & SP3D

July 16, 2014

PREPARED BY- NEHA BANSAL

BHEL-PEM/ IPDS

SMARTPLANT P&ID (SPPID)

The data import and export facilities of SmartPlant P&ID allow users to populate the system with relevant plant data, such as process data from process simulation databases based on Aspen Basic Engineering from Aspen Technologies, Inc. or equipment and line lists. The user can use to import a spreadsheet in a recognized format to either update data on existing items in the plant database or to create new items in the SmartPlant P&ID Stockpile to use for designing the P&ID.

Aspen Basic Engineering spreadsheets in either Microsoft Excel or XML format are supported. These spreadsheets include the Vessel Equipment List, Pump Equipment List, and Heat Exchanger equipment. During the import process, you can assign the stream and its associated engineering data to the pipe run.

For SmartPlant P&ID Engineering, importing from SmartSketch is not allowed.

Users can save drawings in different formats, including .pid for SmartPlant P&ID, .dwg and .dxf for AutoCAD, .dgn for MicroStation, and .pdf format. SPPID items reports can be saved in Excel worksheet format.

SMARTPLANT INSTRUMENTATION (SPI)

The SPI Import Utility provides inherent support of the following database platforms and database file formats:

- ❖ Oracle (only if you have selected Oracle as your current database platform during Setup)
- ❖ SQL Server (only if you have selected SQL Server as your current database platform during Setup)
- ❖ Sybase Adaptive Server Anywhere (only if you have selected Sybase Adaptive Server Anywhere as your current database platform during Setup)
- ❖ Microsoft Access
- ❖ .dbf files
- ❖ ASCII delimited files
- ❖ Excel worksheets
- ❖ Text files

For text files, the Import Utility uses Microsoft Text drivers (.txt and .csv files).

SmartPlant Instrumentation provides a PowerSoft Report (.psr) file viewer that enables user to retrieve, view, and manage files saved in the .psr format. Reports or specifications can be saved in .psr file format using Save As command.

SmartPlant Instrumentation also enables the users to import/export process datasheets for lines or instruments in .ipd (SmartPlant Instrumentation process data) format for use with the Process Data Editor. In this way, it allows an external party to modify the process data outside of SmartPlant Instrumentation. The .ipd format allows to include multiple tags in a single file.

SmartPlant Instrumentation supports saving specification datasheets in the following formats:

- ❖ .isf (only specs whose item type is Instrument)
 - ❖ .psr (any single-tag spec, multi- tag spec, or a non-instrument spec)
 - ❖ .xls (only specs whose item type is Instrument)
- External Editor (supplied with the SmartPlant Instrumentation software package)- Supports working with spec data saved in .isf format, allows to convert .psr files to .isf format, and import data from .isf files to SmartPlant Instrumentation.
 - InfoMaker- Supports working with spec data saved in .psr format, does not allow to import data from .psr files. First need to convert .psr files to .isf format in External Editor.
 - Excel- Supports working with spec data saved in .xls format, does not allow to import data from Excel files back to SmartPlant Instrumentation.

SMARTPLANT ELECTRICAL (SPEL)

The SPEL Import Manager allows to import data to SmartPlant Electrical from external data files and various database platforms, such as

- ❖ Microsoft Access
- ❖ Microsoft SQL Server
- ❖ Oracle
- ❖ Excel worksheets

Import Manager provides the import of electrical data, association data, select list items, and lookup table values.

SmartPlant Electrical supports the major commercial databases and outputs drawings in common CAD formats including SmartSketch, and generates reports in Microsoft Excel format (For creating a report in Excel, file format of the blank template is XLSM for Office 2007 and Office 2010, for Office 2003, the file format is XLS.) SmartPlant Schematics can be imported and exported to an AutoCAD or MicroStation document.

The ETAP- SmartPlant Electrical interface allows to import ETAP data to SmartPlant Electrical and export data to ETAP. When exporting data to ETAP user can publish single electrical analysis SLDs or a complete set of all the existing electrical analysis SLDs in one set. When retrieving ETAP data, user can retrieve a particular ETAP one-line diagram or publish all project data to SmartPlant Electrical.

SMARTPLANT 3D (SP3D)

External reference 3D models for importing in SP3D can be of the following nature:

- ❖ Smart 3D models published in ZVF and XML format.
- ❖ PDMS models published to RVM and ATT format.
- ❖ PDS model data
- ❖ Plain graphic file formats from other tools such as .dgn files.

User can import 3D model data in SP3D from XML files. The files are created in two ways—XML files generated using the PDS Model Data Exporter, or XML files that are written in XMpLant format. PDS Model Data Exporter exports PDS data into XML files in Intergraph Schema. XMpLant is an industry standard (ISO15926), neutral format that is used to import third-party software data.

PDS Model Data Exporter

-  Creates XML data that is compatible with the Intergraph (Ingr) schema.
-  Mapping files for Intergraph schema XMLs are written in Excel workbooks.
-  The PDS Model Data Exporter utility is delivered separately from SmartPlant 3D.

XMpLant-formatted XML

-  This XML corresponds with XMpLant schema.
-  Mapping files for XMpLant schema XMLs are written in XML format.
-  Also added XMPlant to bring PDMS data into SmartPlant 3D

SmartPlant 3D Model Data can be exported to SmartPlant Review files (ZVF, VUE and XML files) or CAD (SAT) files.

The file types for each SP3D drawing type are described in the following table.

Drawing Type	Target File Types
MicroStation	MicroStation (*.dgn)
Piping Isometric Drawings	Shape2DServer (*.sha) PCF file (*.pcf)
NOTES - For Piping Isometric Drawings, the name of the drawing document becomes the prefix for all of the files. For example, if the drawing document name is <i>My_Pipeline</i>, the saved file names become: <i>My_Pipeline.sha</i>, <i>My_Pipeline.pcf</i>, and so on. - For Piping Isometric Drawings, a file is created for each sheet in the drawing with [<i>drawing name</i>][<i>sheet name</i>] as the filename. For example, if the drawing <i>My_Pipeline</i> contains Sheet1 and Sheet2, two files will be saved with the names <i>My_Pipeline_Sheet1</i> and <i>My_Pipeline_Sheet2</i>.	Both (*.sha & *.pcf) All Files (*.*) - Includes all .sha and .pcf files, as well as all enabled supplementary files. MicroStation (*.dgn) AutoCAD (*.dxf) AutoCAD (*.dwg)
Spreadsheet Reports	Worksheets (*.xls)
Composed Drawings, Volume Drawings, and Orthographic Drawings by Query	Shape2DServer (*.sha) MicroStation (*.dgn) AutoCAD (*.dxf) AutoCAD (*.dwg)

SmartPlant Interop Publisher

SmartPlant Interop Publisher provides the ability to work with a wide range of datasets from Intergraph and non-Intergraph formats such as PDMS and XMpLant.

Different data sources can be:

- ❖ PDS
- ❖ PDMS
- ❖ Tekla
- ❖ AutoCAD
- ❖ MicroStation

Company Formats

Company Formats				
Application	Graphic File	Data File	SmartPlant Interop Publisher License	Notes
Intergraph				
Smart 3D v2009.1 and above in an integrated environment	ZVF	XML	No	A license of SmartPlant Interop Publisher is not needed to reference this format in Smart 3D
Smart 3D v2009.1 and above in a non-integrated environment	VUE	XML	No	
Smart 3D Pre v2009.1	VUE	XML	No	
Smart 3D using SmartPlant Review Direct	VUE	MDB2	Yes	
PDS, FrameWorks® Plus	DRI, DGN	DRV, TAG	Yes	
ISOGEN® (IDF, PCF, POD)	IDF, PCF, POD	IDF, PCF	Yes	

CADWorx Equipment, CADWorx Plant, CADWorx Plant Professional	DWG	DRV	Yes	
AVEVA				
PDMS	RVM	ATT, DRV	Yes	
Autodesk				
AutoCAD v2011 and earlier	DXF, DWG	DRV	Yes	AutoCAD proxy-enabled objects are supported.
Bentley				
MicroStation J MicroStation V8 MicroStation V8i MicroStation XM AutoPlant PlantSpace i-model	DGN, PRP, DTM	DRV	Yes	Data limited to MicroStation level and tag information. Requires MicroStation. SmartPlant Interop Publisher supports data files containing smartsolids that were created or reformatted in MicroStation V8.
Industry-Standard Formats				
Open Standards				
Industry Foundation Classes (IFC)	IFC	DRV	Yes	
XMpLant	XML	DRV	Yes	

CIS/2 (design model data from products such as SP3D, SDS/2, StruCAD, Tekla Structures, and ProSteel, among others)	STP	DRV	Yes	
Mechanical Applications				
Products exporting ACIS (such as SolidEdge, SolidWorks, Pro/Engineer)	SAT	N/A	Yes	Graphics only
Products exporting IGES; Smart 3D using SmartPlant Review Direct	IGES, IGS	N/A	Yes	Graphics only
Generic Formats				
System	Format		Notes	
BOCAD	CIS/2		SDNF exports can be converted into CIS/2 FrameWorks Plus.	
SACS	CIS/2 or ACIS (SAT)		SDNF to CIS/2 Conversion via FrameWorks Plus. Export SAT directly from SACS	
AutoPLANT, PlantSpace	AutoCAD, ISOGEN			
ANSYS Workbench	ACIS (SAT)			
SolidEdge, SolidWorks, AutoCAD Inventor, CREO Parametric (formerly Pro/Engineer), Siemens, Catia	ACIS (SAT)			

SmartPlant Spoolgen, SmartPlant Isometrics	ISOGEN	
JT Open	SAT	JT Open to SAT conversion by Theorem
Speedikon, Tribon M2 / M3	MicroStation	
ShipConstructor	AutoCAD	Graphics only

Notes:

- ❖ Smart 3D applications require a license of SmartPlant Interop Publisher for conversion and reference of all formats.
- ❖ Laser scanning applications require the SmartPlant Review Point Cloud module to support the display of laser data inside SmartPlant Review.
- ❖ For ACIS and IGES files, the DRV and MDB2 files generated by SmartPlant Interop Publisher during translation are created with empty label data. This can also apply to MicroStation V7 DGN files that do not have tag data.
- ❖ Smart 3D applications require a license of SmartPlant Interop Publisher for translation and reference of all foreign or third-party formats.
- ❖ Both SmartPlant Review and Smart 3D applications require licenses from Leica, Z+F or Quantapoint to display laser data.



TITLE:
3 X 800 MW PATRATU STPP STAGE - I

SPECIFICATION NO. PE-TS-434-164-A001

**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT**

REV. NO. 00

DATE : 29/05/2019

SECTION – IIB

GENERAL TECHNICAL REQUIREMENTS – ELECTRICAL

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 28.01.10
		SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
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1.0 INTENT OF SPECIFICATION

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 of rotating electrical machines
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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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 fro three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable fro 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: 4691and 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.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	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.	
4.7	Terminals and Terminal Boxes	
4.7.1	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".	
4.7.2	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.	
4.7.3	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 V W & V respectively.	
4.7.4	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.	
4.7.5	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.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	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.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	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.	
4.8	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.	

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4.9

General

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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	TITLE	SPECIFICATION NO.
		VOLUME II B
		SECTION D
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		SHEET 1 OF 2

S. No.	Description		Data to be filled by successful bidder
A.	General		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	Design and Performance Data		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB)		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
		VOLUME II B
		SECTION D
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S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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:

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

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

please refer below examples:

- i) 3C x 120 sq. mm. (1.1kV) PVC FRLS, Unarmoured Aluminium cable, the voltage code shall be D03G120
- ii) 3C x 2.5 sq. mm. (1.1kV) PVC FRLS, Unarmoured Copper cable, the voltage code shall be D03C2.5
- iii) 3.5C x 120 sq. mm. (1.1kV) PVC non-FRLS, Armoured Aluminium cable, the voltage code shall be D3HF120

(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)
- 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
- C = unarmoured FRLS
- B = Armoured Non-FRLS
- D = Unarmoured Non-FRLS