

NTPC LIMITED

3x800 MW PATRATU STP

TECHNICAL SPECIFICATION

FOR

AGITATORS

SPECIFICATION NO.: PE-TS-434-571-18000-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PROJECT ENGINEERING INSTITUTE BUILDING
SECTOR-16A, PLOT NO.-25, NOIDA, INDIA**



3x800 MW PATRATU TPS

SPECIFICATION No: PE-TS-434-571- 8000-A

AGITATORS

TECHNICAL SPECIFICATION

SECTION

REV. 00

SHEET :

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PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATIONS FOR
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INTENT OF SPECIFICATION



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1.0 SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION

- 1.1 The specification covers Supply part, Services part and Mandatory spares comprising of design (i.e. Preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, fill of lubricants & consumables till handing over, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site, assembly AND services part covers supervision services for erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff covering all aspects of the Agitator- Operation & Maintenance, Troubleshooting etc., training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for Flue Gas Desulphurization (FGD) plant of 3x800 MW Patratu TPS, Ramgarh, Jharkhand of M/s Patratu Vidyut Utpadan Nigam Limited (PVUNL), a Joint Venture amongst Govt. of Jharkhand, JUVNL, JBVNL and NTPC Ltd. The following points may be noted.
- Agitators are envisaged in various tanks, details of which are given in Technical Information of Agitators.
 - Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
 - The Bidder shall offer only proven design which meets the Provenness /Pre-qualification requirement of NTPC. Necessary document evidences as per Attachment-3K for qualification shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, their offer will be rejected.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **Agitators** .
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment / system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the



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specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system for its safe, efficient, reliable and trouble free operation.

- 1.5 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.
- 1.6 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are hereby made part of the tender specifications. The equipment / material and works covered by this specification is subject to compliance to all the attachments referred in the specification. The tenderer shall be responsible for adherence to all requirements stipulated herein.
- 1.7 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Sec.-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Section -III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/it's customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification & requirements of different codes/standards and between respective clauses of sub-section C & sub-section D, more stringent clause as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/vendor and Customer/Purchaser/Employer will mean BHEL and/or Customer as interpreted by BHEL in the relevant context. Please refer GCC/SCC for better clarity.
- 1.12 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.



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- 1.13 BHEL's Customer's representative shall be given full access to the shop in which the equipment's are being manufactured or tested and all test records shall be made available to him.
- 1.14 Various codes and standards to be used shall be as indicated in various parts of the specification. In case bidder uses any standard other than those indicated in the specification, the onus of establishing equivalence of the same with the specified standards will rest with the bidder and acceptance of the same shall be sole prerogative of customer. The bidder will also arrange for BHEL a copy of the standards in ENGLISH language. The cost of such service will be deemed to have been included by the bidder in the total cost of the package. BHEL will not entertain any additional cost on account of the same.
- 1.15 All text/ numeric in the document / drawings to be generated by the successful bidder will be in English language only.
- 1.16 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

Note:

- a) Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.
- Internet explorer version – Minimum Internet Explorer 7.
 - Internet speed – 2 mbps (Minimum preferred).
 - Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
 - Vendor's internal proxy setting should not block DMS application's link (<http://dmsserver.bhelpem.com/Wrench%20Web%20Access/Login.aspx>).



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PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

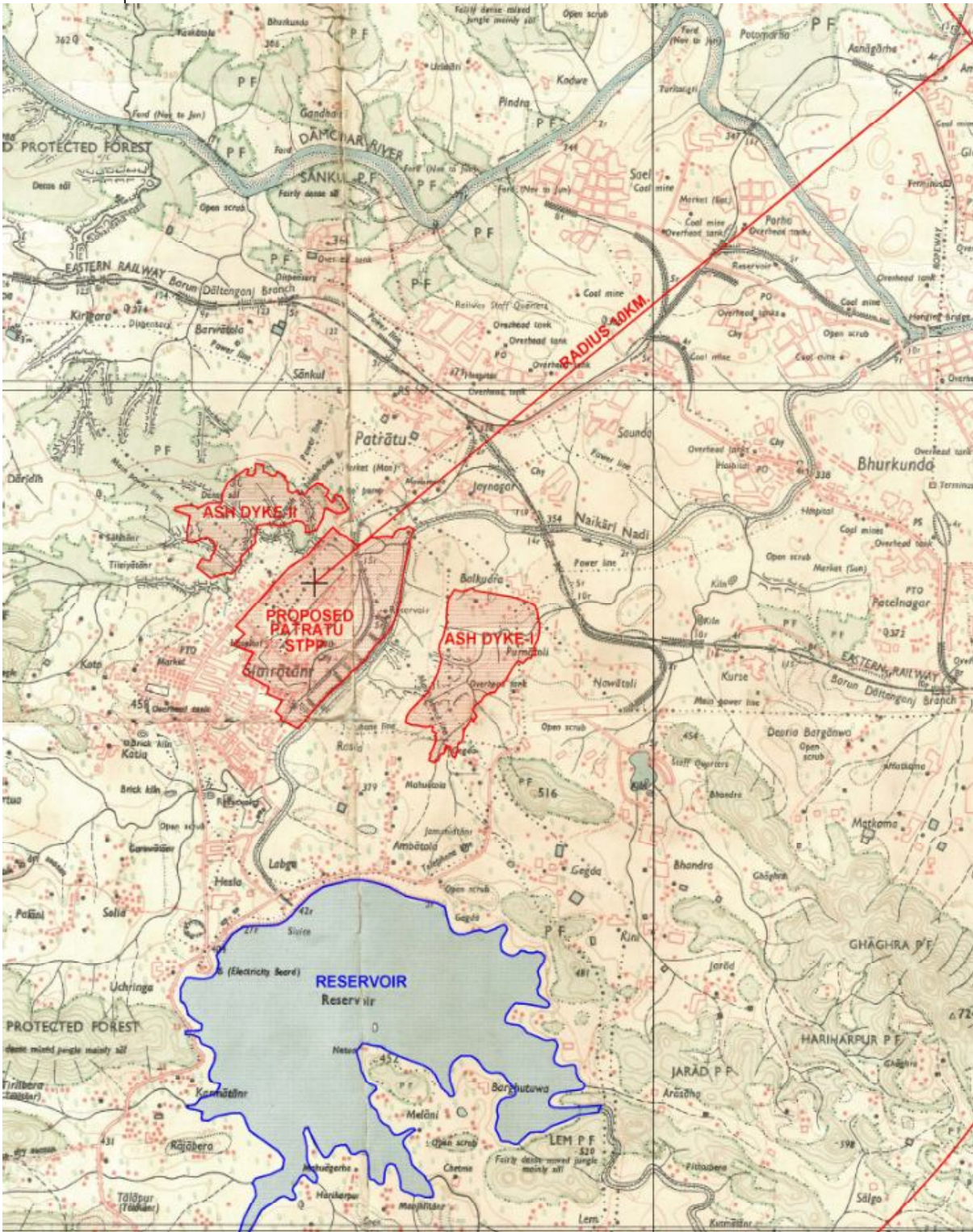
CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC															
	PATRATU STPS EXPANSION PHASE-I (3X800 MW)																		
1.00.00	BACKGROUND A Memorandum of Agreement (MOA) has been entered on 29.07.2015 amongst Govt. of Jharkhand (GoJ), Jharkhand Urja Vikash Nigam Limited (JUVNL), Jharkhand UrjaUtpadan Nigam Limited (JUUNL), Jharkhand BijliVitaran Nigam Limited (JBVNL) and NTPC Limited to form a Joint Venture Company of NTPC Limited& JBVNL for transfer of Patratu Thermal Power Station (PTPS) located in Ramgarh District of Jharkhand State to the proposed JV Company for Performance Improvement of existing capacity & 4000 MW Capacity expansion of PTPS. Further to signing of JV agreement on 29.07.2015, a Joint Venture Company namely Patratu Vidyut Utpadan Nigam Limited (PVUNL) has been incorporated amongst GoJ, JUVNL, JBVNL and NTPC Ltd. on 15.10.2015. The Performance Improvement of existing capacity and 4000 MW Capacity expansion of Patratu STPS will be implemented by the JV Company (JVC). The configuration of expansion of 4000 MW shall consist of 5 units of 800 MW to be implemented in two phases; Phase-I: 3x800 MW and Phase-II: 2x800 MW. The present proposal is for Patratu STPS Phase-I (3x800 MW). The project is envisaged to be commissioned during XIII Plan period.																		
2.00.00	CAPACITY Patratu STPS Phase-I: 3x800 MW - Present proposal																		
3.00.00	MODE OF OPERATION Base Load																		
4.00.00	LOCATION AND APPROACH																		
4.01.00	Patratu Thermal Power station (PTPS) is located just outside the coal belt of South Karanpura in Ramgarh District of Jharkhand State. The nearest Railway Station is Patratu which is at a distance of about 4 km on Barkakhana-Barwadih Railway line.																		
4.02.00	The latitudes and longitudes of the site are as follows: <table><tr><th>Corner name</th><th>Latitude</th><th>Longitude</th></tr><tr><td>Top Corner</td><td>23° 38 ' 60 '' N</td><td>85° 17' 51.5" E</td></tr><tr><td>Bottom Corner</td><td>23° 38 ' 12.5 '' N</td><td>85° 17' 27" E</td></tr><tr><td>Left Corner</td><td>23° 38 ' 22.5 '' N</td><td>85° 17' 10.6 '' E</td></tr><tr><td>Right Corner</td><td>23° 38 ' 40 '' N</td><td>85° 17' 57 '' E</td></tr></table>				Corner name	Latitude	Longitude	Top Corner	23° 38 ' 60 '' N	85° 17' 51.5" E	Bottom Corner	23° 38 ' 12.5 '' N	85° 17' 27" E	Left Corner	23° 38 ' 22.5 '' N	85° 17' 10.6 '' E	Right Corner	23° 38 ' 40 '' N	85° 17' 57 '' E
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Right Corner	23° 38 ' 40 '' N	85° 17' 57 '' E																	
4.03.00	Airport The nearest commercial airport is Ranchi at about 45 km by road.																		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION	PAGE 1 OF 15															

CLAUSE NO.	PROJECT INFORMATION		
5.00.00 6.00.00	A copy of Vicinity plan of the project site is placed at Annexure - I. LAND The total land to be transferred to JV Company is 1859 acres. Out of 1859 acre, about 1234 acres of land has been envisaged for Plant, Ash pond and Land on railway track of the for Phase-I (3x800 MW). The balance 625 acre of land shall be transferred during commencement of Phase-II (2x800 MW). WATER The make-up water for PSTPS is to be met from Patrattu Dam on Nalkari River (capacity 99 MCM i.e. 110 Cusecs). About 52.34 Cusecs of water will be available at 90% dependable monsoon flow after considering evaporation loss. GoJ/JUVNL owns and controls water of Patrattu Dam. GoJ/JUUNL supplies water to PTPS and to the other entities in the vicinity from this water reservoir. JUVNL had entered into agreements with these other entities for supply of water from water reservoir. JUVNL shall revisit these agreements to meet the requirement of water for expansion projects, if required. Make up water requirement of PSTPS, Phase-I (3x800 MW) would be about 27 Cusecs with "Air Cooled Condenser" based power plant. GoJ shall provide the required water from the existing reservoir to the JV Company. The JVC shall be responsible for the water supply arrangement starting at the downstream of intake chamber from where water supply commences for the Station. Ownership of the entire water supply system and related plant and equipment, including the water treatment plant, shall be that of the JVC and after the asset transfer, the JVC shall maintain, take care and use the same. The additional facility including addition of plant, equipment etc. for enhanced requirement (if any) and drawl of water shall be the responsibility of JVC and to be arranged by the JVC at their own cost.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION	PAGE 2 OF 15

CLAUSE NO.	PROJECT INFORMATION 		
7.00.00 7.01.00 7.02.00 7.03.00 7.04.00	COAL Coal Requirement, Availability and Linkage About 12 MTPA of coal will be required to meet coal requirement of the Phase-I (3x800 MW) of the project. The Banhardih captive coal block at a distance of about 155 km from plant is allocated to JUVNL for end use of Patratu expansion. The coal from Banhardih captive coal block shall be transferred to the JVC for the usage of PSTPS with the approval of Ministry of Coal, GOI. MOC (11.09.15) has accorded in-principle approval of the Central Govt. to assign Banhardih Coal Block allocated to JUVNL to the JV Company. Coal Transportation The envisaged mode of coal transportation from the coal mines to the power plant is by Indian Railways through BOBR / BOX- N wagons. Coal Quality The primary fuel for the main steam generator shall be coal. The domestic coal quality parameters are indicated in Annexure-IV-2 and imported coal parameters are indicated in Annexure-IV-4 are to be considered for steam generator design. Fuel Oil The fuel oils to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Heavy Fuel Oils having the characteristics given at Annexure-IV-3 and Light Diesel Oil having the characteristics given at Annexure-IV-1.		
8.00.00	NOT USED		
9.00.00	STEAM GENERATOR TECHNOLOGY The steam generators shall be super critical once through type, water tube, direct pulverized coal fired, top supported, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (Tower type) or two pass type.		
10.00.00	FLUE GAS DESULPHURIZATION SYSTEM (FGD) & SCR: The project is envisaged with Flue Gas Desulfurization (FGD) system and SCR meeting Ministry of Environment, Forest & Climate Change notification dated 07.12.2015. Limestone to be used for design of FGD system shall be as per the characteristic given at Annexure-IV-5.		
11.00.00	POWER EVACUATION SYSTEM 85% of power from the project is envisaged to be allocated to Jharkhand State subject to approval of Ministry of Power, while balance 15% would be as unallocated portion and Project is envisaged as regional project. Since major power (85%) is proposed to be absorbed by Jharkhand, the issue of Associated Transmission		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION	PAGE 3 OF 15

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	System for the project would be taken up with them for planning and execution of transmission system modalities as Inter-State System or ISTS System. Considering overall capacity of the project as 4000 MW, 765 kV step-up system has been envisaged. Two D/C 765 KV line, one each to New Ranchi (Bero) and Gaya has been envisaged. This would also form part of 765 kV transmission corridor connecting Ranchi to Gaya. These lines can be used to evacuate power to the Eastern Region ISTS as well as to Jharkhand State. In view of above, provision of four nos. of 765 kV outgoing Line bays has been kept in the new 765 kV generation switchyard. The issue of power evacuation of the proposed project shall be taken up with appropriate Transmission Utility (STU or CTU) as per regulatory provision, based on allocation of power.			
12.00.00	METEOROLOGICAL DATA			
	The meteorological data from nearest observatory is placed at Annexure-II .			
13.00.00	PLANT WATER SCHEME			
	The Plant water scheme is described below.			
13.01.00	Equipment Cooling Water (ECW) System (Unit Auxiliaries)			
	The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralized (DM) water in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from ACW system in a secondary circuit. The station auxiliaries such as Air compressors, Compressors of ash handling plant, compressor of mill reject system etc. shall also be cooled by Demineralized (DM) water in a closed circuit .The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system. It is proposed to provide independent primary cooling water circuit for Steam Generator & auxiliaries and TG & its auxiliaries.			
13.02.00	Not used			
13.03.00	Other Miscellaneous Water Systems			
	(a)The drinking water requirement of the plant shall be provided from water treatment plant.			
	(b) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water shall be provided from demineralizing plant.			
	(c) The quality of Raw Water & DM Water is enclosed with this sub-section as Annexure-III .			
	(d) Effluent from various areas in TG & SG system shall be collected in respective pits in their areas and pumped to a common terminal point as shown in plant water scheme.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION	PAGE 4 OF 15

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14.00.00	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in Part-B of this section.			
15.00.00	CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in Part-B of this section.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION	PAGE 5 OF 15

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	ANNEXURE-I			
				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION	PAGE 6 OF 15	

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CLIMATOLOGICAL TABLE

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CLAUSE NO.	PROJECT INFORMATION																																																																										
	ANNEXURE-III RAW WATER ANALYSIS <table border="1"> <thead> <tr> <th>S.No</th><th>Constituent</th><th>As</th><th>mg/l</th></tr> </thead> <tbody> <tr><td>1</td><td>Calcium</td><td>CaCO₃</td><td>105</td></tr> <tr><td>2</td><td>Magnesium</td><td>CaCO₃</td><td>81</td></tr> <tr><td>3</td><td>Sodium</td><td>CaCO₃</td><td>70</td></tr> <tr><td>4</td><td>Potassium</td><td>CaCO₃</td><td>7</td></tr> <tr><td></td><td>Total cations</td><td>CaCO₃</td><td>263</td></tr> <tr><td>5</td><td>HCO₃</td><td>CaCO₃</td><td>180</td></tr> <tr><td>6</td><td>P- Alkalinity</td><td>CaCO₃</td><td>0</td></tr> <tr><td>7</td><td>Chloride</td><td>CaCO₃</td><td>60</td></tr> <tr><td>8</td><td>Sulphate</td><td>CaCO₃</td><td>23</td></tr> <tr><td></td><td>Total Anions</td><td>CaCO₃</td><td>263</td></tr> <tr><td>9</td><td>Silica, Reactive</td><td>Si</td><td>3</td></tr> <tr><td>10</td><td>Iron (Total)</td><td>Fe</td><td>0.6</td></tr> <tr><td>11</td><td>pH</td><td>-</td><td>7.0-7.8</td></tr> <tr><td>12</td><td>Turbidity</td><td>NTU</td><td>100</td></tr> <tr><td>13</td><td>Total dissolved solids</td><td></td><td>230-300</td></tr> <tr><td>14</td><td>Temperature</td><td>Deg C</td><td>20-35</td></tr> <tr><td>15.</td><td>Organics (KMnO₄)</td><td></td><td>2</td></tr> </tbody> </table>			S.No	Constituent	As	mg/l	1	Calcium	CaCO ₃	105	2	Magnesium	CaCO ₃	81	3	Sodium	CaCO ₃	70	4	Potassium	CaCO ₃	7		Total cations	CaCO ₃	263	5	HCO ₃	CaCO ₃	180	6	P- Alkalinity	CaCO ₃	0	7	Chloride	CaCO ₃	60	8	Sulphate	CaCO ₃	23		Total Anions	CaCO ₃	263	9	Silica, Reactive	Si	3	10	Iron (Total)	Fe	0.6	11	pH	-	7.0-7.8	12	Turbidity	NTU	100	13	Total dissolved solids		230-300	14	Temperature	Deg C	20-35	15.	Organics (KMnO ₄)		2
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	ANNEXURE-III			
	THE MINIMUM QUALITY OF DM WATER TO BE CONSIDERED FOR MAKE-UP WATER			
	Sl.No.	Characteristics	Value	
	1.	Silica (Max.)	0.02 ppm as Sio2	
	2.	Iron as Fe	Nil	
	3.	Total hardness	Nil	
	4.	pH value	6.8 -7.2	
	5.	Conductivity	Not more than 0.1micro mho/cm excluding the effects of free CO2	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02		SUB-SECTION-IB PROJECT INFORMATION
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CLAUSE NO.	PROJECT INFORMATION			एनडीपीसी NTPC																								
	ANNEXURE-IV-1																											
	LIGHT DIESEL OIL CHARACTERISTICS AS PER IS 15770-2008 <table><tr><th>Characteristics</th><th>LDO</th></tr><tr><td>1. Pour Point (max)</td><td>21 °C & 12°C for Summer and Winter respectively</td></tr><tr><td>2. Kinematic viscosity in centistokes at 40 deg.C</td><td>2.5 to 15.0</td></tr><tr><td>3. Sediment percent by mass (max)</td><td>0.10</td></tr><tr><td>4. Total sulphur percent by mass (max)</td><td>1.5</td></tr><tr><td>5. Ash percentage by mass (max)</td><td>0.02</td></tr><tr><td>6. Carbon residue (Rams bottom) percent by pass (max.)</td><td>1.50</td></tr><tr><td>7. Acidity inorganic</td><td>Nil</td></tr><tr><td>8. Flash point (Min.) - Pensky Martens</td><td>66 deg.C</td></tr><tr><td>9. Copper strip corrosion for 3 hours at 100°C</td><td>Not worse than No. 2</td></tr><tr><td>10. Water content, % by volume (max)</td><td>0.25</td></tr><tr><td>11. GCV(kcal/kg)</td><td>10,000</td></tr></table>				Characteristics	LDO	1. Pour Point (max)	21 °C & 12°C for Summer and Winter respectively	2. Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15.0	3. Sediment percent by mass (max)	0.10	4. Total sulphur percent by mass (max)	1.5	5. Ash percentage by mass (max)	0.02	6. Carbon residue (Rams bottom) percent by pass (max.)	1.50	7. Acidity inorganic	Nil	8. Flash point (Min.) - Pensky Martens	66 deg.C	9. Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2	10. Water content, % by volume (max)	0.25	11. GCV(kcal/kg)	10,000
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION	PAGE 11 OF 15																								

CLAUSE NO.	PROJECT INFORMATION					एनडीपीसी NTPC	
	ANNEXURE-IV-2						
	<u>DOMESTIC COAL CHARACTERISTICS</u>						
S No.	Characteristics (As received basis)	Range of 95% coal supplies			Range of 5% coal supplies		
		Column-1	Column-2	Column-3	Range of Adequacy coal		
1.0	PROXIMATE ANALYSIS	Design	Worst	Best	Worst	Best	
1.1	Total Moisture (%)	14	17	11	18	10	
1.2	Ash (%)	36	42	34	44	30	
1.3	Volatile matter (%)	23	19	24	19	28	
1.4	Fixed carbon (%)	27	22	31	19	32	
2.0	ULTIMATE ANALYSIS						
2.1	Carbon (%)	33.31	27.23	39.07	25.72	44.43	
2.2	Hydrogen (%)	3.49	3.05	3.53	2.93	3.72	
2.3	Sulphur (%)	0.6	0.9	0.5	0.95	0.35	
2.4	Nitrogen (%)	0.9	1.3	0.8	1.4	0.6	
2.5	Oxygen (%) (By difference)	11.7	8.52	11.1	7	10.9	
2.6	Total Moisture (%)	14	17	11	18	10	
2.7	Ash (%)	36	42	34	44	30	
2.8	GCV (kcal/kg)	3400	2900	3900	2800	4400	
2.9	Hard Grove index	55	50	60	45	65	
2.10	YGP Index (mg/kg)	75	80	70	85	65	
2.11	Carbonates	0.3	0.38	0.27	0.2	0.43	
2.12	Phosphorous	0.05	0.04	0.06	0.03	0.07	
2.13	Chloride	0.08	0.15	0.05	0.18	0.04	
2.14	Trace Elements (ppm)						
2.14.1	Arsenic	1	1.5	0.5	2.5	0.4	
2.14.2	Lead	35	75	25	150	10	
2.14.3	Mercury	0.1	0.5	0.08	0.6	0.06	
2.14.4	Selenium	0.8	1	0.6	1.5	0.5	
3.0	ASH ANALYSIS						
3.1	Silica (%)	59.25	63.4	56.92	63.56	54.2	
3.2	Alumina (%)	27.62	27.29	28.47	27.2	29.89	
3.3	Iron Oxide (%)	6.75	5.48	7	5.46	7.5	
3.4	Titania (%)	1.95	0.88	2.5	0.98	2.82	
3.5	P ₂ O ₅ (%)	0.24	0.3	0.11	0.35	0.1	
3.6	Lime (%)	0.9	0.7	1.5	0.6	1.6	
3.7	Magnesia (%)	0.2	0.3	0.15	0.35	0.1	
3.8	Sulphuric Anhydride (%)	1.2	0.5	1.4	0.4	1.7	
3.9	Sodium Oxide (%)	0.17	0.25	0.15	0.3	0.15	
3.10	Balance Alkalies (By Difference) (%)	1.72	0.9	1.8	0.8	1.94	
4.0	ASH FUSION RANGE (Under reducing atmosphere)						
4.1	Initial Deformation Temperature (°C)	1100	1100	1100	1100	1100	
4.2	Hemispherical temperature (°C)	1300	1250	1350	1250	1350	
4.3	Flow temperature (°C)	1400	1400	1400	1400	1400	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02		SUB-SECTION-IB PROJECT INFORMATION		PAGE 12 OF 15	

CLAUSE NO.	PROJECT INFORMATION				एन.टी.पी.सी. NTPC
	ANNEXURE-IV-3				
	FUEL OIL CHARACTERISTICS				
	Sl. No.	Characteristics	Heavy Furnace Oil grade HV (HFO) IS-1593-1982	Low Sulphur Heavy Stock (LSHS) IS-11489-1985	Heavy Petroleum stock (HPS) IS-11489-1985
	1.	Total sulphur content	4.5% Max.	1.0% Max.	4.5% Max.
	2.	Gross calorific value (KCal/kg)	of the order of 10,000	of the order of 10,000	of the order of 10,000
	3.	Flash Point (Min)	66 deg C	76 deg C	66 deg C
	4.	Water content by volume (Max)	1.0%	1.0%	1.0%
	5.	Sediment by weight (Max)		0.25%	0.25% 0.25%
	6.	Asphaltene content by weight (Max.)	2.5%	2.5%	2.5%
	7.	Kinematic viscosity in Centistokes	370 at 50deg C	100 at 100deg C	100 at 100deg C
	8.	Ash Content by weight (Max.)	0.1%	0.1%	0.1%
	9.	Acidity (inorganic)	Nil	Nil	Nil
	10.	Pour Point (Max.)	57 deg C	66 deg C	72 deg C
	11.	Sodium content	—	—	100 ppm
	12.	Vanadium content	25 ppm	25ppm	25 ppm
13.	Specific heat below pour point (KCal/Kg °C)		0.65		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02		SUB-SECTION-IB PROJECT INFORMATION	PAGE 13 OF 15

CLAUSE NO.	PROJECT INFORMATION	एनटीपीसी NTPC																																																																																																																																																									
	ANNEXURE-IV-4 TYPICAL IMPORTED COAL AND ASH CHARACTERISTICS <table> <tr> <th data-bbox="459 363 537 390">Sl.No.</th><th data-bbox="565 363 813 432">Characteristics (as received basis)</th><th colspan="2" data-bbox="998 363 1187 390">Imported Coal</th></tr> <tr> <td></td><td></td><th data-bbox="1052 432 1133 459">Worst</th><th data-bbox="1222 432 1284 459">Best</th></tr> <tr> <td>1.0</td><td>Proximate Analysis</td><td></td><td></td></tr> <tr> <td>1.1</td><td>Total Moisture (%)</td><td>20</td><td>16</td></tr> <tr> <td>1.2</td><td>Ash (%)</td><td>10</td><td>10</td></tr> <tr> <td>1.3</td><td>Volatile Matter (%)</td><td>30</td><td>45</td></tr> <tr> <td>1.4</td><td>Fixed Carbon (%)</td><td>40</td><td>29</td></tr> <tr> <td>1.5</td><td>Total (%)</td><td>100</td><td>100</td></tr> <tr> <td>2.0</td><td>Ultimate Analysis</td><td></td><td></td></tr> <tr> <td>2.1</td><td>Carbon (%)</td><td>56.4</td><td>62.4</td></tr> <tr> <td>2.2</td><td>Hydrogen (%)</td><td>4.5</td><td>4.9</td></tr> <tr> <td>2.3</td><td>Sulphur (%)</td><td>0.9</td><td>0.8</td></tr> <tr> <td>2.4</td><td>Nitrogen (%)</td><td>0.9</td><td>0.5</td></tr> <tr> <td>2.5</td><td>Oxygen (%) (By difference)</td><td>7.3</td><td>5.4</td></tr> <tr> <td>2.6</td><td>Carbonates (%)</td><td>0</td><td>0</td></tr> <tr> <td>2.7</td><td>Phosphorous (%)</td><td>0</td><td>0</td></tr> <tr> <td>2.8</td><td>Total Moisture (%)</td><td>20</td><td>16</td></tr> <tr> <td>2.9</td><td>Ash (%)</td><td>10</td><td>10</td></tr> <tr> <td></td><td>Total</td><td>100</td><td>100</td></tr> <tr> <td>2.10</td><td>GCV (Kcal/Kg)</td><td>5800</td><td>6500</td></tr> <tr> <td>2.11</td><td>Hard Grove Index</td><td>45</td><td>60</td></tr> <tr> <td>2.12</td><td>YGP (mg/kg)</td><td>100</td><td>70</td></tr> <tr> <td>3.0</td><td>Ash Analysis</td><td></td><td></td></tr> <tr> <td>3.1</td><td>Silica (SiO₂) (%)</td><td>32.74</td><td>34.94</td></tr> <tr> <td>3.2</td><td>Alumina(Al₂O₃) (%)</td><td>30.5</td><td>28.43</td></tr> <tr> <td>3.3</td><td>Iron Oxides(Fe₂O₃) (%)</td><td>18.2</td><td>15.2</td></tr> <tr> <td>3.4</td><td>Titania (TiO₂)</td><td>1.56</td><td>1.76</td></tr> <tr> <td>3.5</td><td>Phosphoric Anhydride(P₂O₅) (%)</td><td>0.44</td><td>0.54</td></tr> <tr> <td>3.6</td><td>Lime (CaO) (%)</td><td>6.12</td><td>7.62</td></tr> <tr> <td>3.7</td><td>Magnesia (MgO) (%)</td><td>1.83</td><td>1.93</td></tr> <tr> <td>3.8</td><td>Sulphuric Anhydride (%)</td><td>6.95</td><td>7.65</td></tr> <tr> <td>3.9</td><td>Sodium Oxide (Na₂O) (%)</td><td>0.3</td><td>0.4</td></tr> <tr> <td>3.10</td><td>Balance alkalies (by difference)</td><td>1.36</td><td>1.56</td></tr> <tr> <td></td><td>Total</td><td>100</td><td>100</td></tr> <tr> <td>4.0</td><td>Ash Fusion Temperature reducing temperature</td><td></td><td></td></tr> <tr> <td>4.1</td><td>Initial deformation Temp (°C)</td><td>1100</td><td>1250</td></tr> <tr> <td>4.2</td><td>Hemispherical Temp. (°C)</td><td>1300</td><td>1350</td></tr> <tr> <td>4.3</td><td>Flow Temp. (°C)</td><td>1400</td><td>1400</td></tr> </table>	Sl.No.	Characteristics (as received basis)	Imported Coal				Worst	Best	1.0	Proximate Analysis			1.1	Total Moisture (%)	20	16	1.2	Ash (%)	10	10	1.3	Volatile Matter (%)	30	45	1.4	Fixed Carbon (%)	40	29	1.5	Total (%)	100	100	2.0	Ultimate Analysis			2.1	Carbon (%)	56.4	62.4	2.2	Hydrogen (%)	4.5	4.9	2.3	Sulphur (%)	0.9	0.8	2.4	Nitrogen (%)	0.9	0.5	2.5	Oxygen (%) (By difference)	7.3	5.4	2.6	Carbonates (%)	0	0	2.7	Phosphorous (%)	0	0	2.8	Total Moisture (%)	20	16	2.9	Ash (%)	10	10		Total	100	100	2.10	GCV (Kcal/Kg)	5800	6500	2.11	Hard Grove Index	45	60	2.12	YGP (mg/kg)	100	70	3.0	Ash Analysis			3.1	Silica (SiO ₂) (%)	32.74	34.94	3.2	Alumina(Al ₂ O ₃) (%)	30.5	28.43	3.3	Iron Oxides(Fe ₂ O ₃) (%)	18.2	15.2	3.4	Titania (TiO ₂)	1.56	1.76	3.5	Phosphoric Anhydride(P ₂ O ₅) (%)	0.44	0.54	3.6	Lime (CaO) (%)	6.12	7.62	3.7	Magnesia (MgO) (%)	1.83	1.93	3.8	Sulphuric Anhydride (%)	6.95	7.65	3.9	Sodium Oxide (Na ₂ O) (%)	0.3	0.4	3.10	Balance alkalies (by difference)	1.36	1.56		Total	100	100	4.0	Ash Fusion Temperature reducing temperature			4.1	Initial deformation Temp (°C)	1100	1250	4.2	Hemispherical Temp. (°C)	1300	1350	4.3	Flow Temp. (°C)	1400	1400		
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CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC
	ANNEXURE-IV-5 LIMESTONE CHARACTERISTICS The details of Limestone data shall be furnished later.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION	PAGE 15 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS																	
	ANNEXURE- (d) CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures shall be designed for wind forces in accordance with IS 875 (Part-3) and as specified in this document. See Annexure – B for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than "5" and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovaling etc. should be examined and designed/detailed accordingly following the recommendations of IS 875(Part-3) and other relevant Indian standards. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a) Welded steel structures</td><td>: 1.0%</td></tr><tr><td>b) Bolted steel structures</td><td>: 2.0%</td></tr><tr><td>c) Reinforced concrete structures</td><td>: 1.6%</td></tr><tr><td>d) Steel stacks</td><td>: As per IS 6533 & CICIND Model Code whichever is more critical.</td></tr></table> SITE SPECIFIC DESIGN PARAMETERS The various design parameters, as defined in IS 875 (Part-3), to be adopted for the project site shall be as follows: <table><tr><td>a) The basic wind speed "V_b" at ten metre above the mean ground level:</td><td>39 metre/second</td></tr><tr><td>b) The risk coefficient "K_1"</td><td>: 1.06</td></tr><tr><td>c) Category of terrain</td><td>: Category-2</td></tr></table>				a) Welded steel structures	: 1.0%	b) Bolted steel structures	: 2.0%	c) Reinforced concrete structures	: 1.6%	d) Steel stacks	: As per IS 6533 & CICIND Model Code whichever is more critical.	a) The basic wind speed " V_b " at ten metre above the mean ground level:	39 metre/second	b) The risk coefficient " K_1 "	: 1.06	c) Category of terrain	: Category-2
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d) Steel stacks	: As per IS 6533 & CICIND Model Code whichever is more critical.																	
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b) The risk coefficient " K_1 "	: 1.06																	
c) Category of terrain	: Category-2																	
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-D-01 CIVIL WORKS	PAGE 333 OF 340														

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC												
	Annexure-(E) CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1):2002 and IS:1893 (Part 4):2005. Pending finalization of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures. A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Annexure-I. Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values. The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Annexure-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 and Part 4). Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>Steel structures</td><td></td><td>2 %</td></tr><tr><td>Reinforced structures</td><td>Concrete</td><td>5 %</td></tr><tr><td>Reinforced Stacks</td><td>Concrete</td><td>3 %</td></tr><tr><td>Steel stacks</td><td></td><td>2 %</td></tr></table>				Steel structures		2 %	Reinforced structures	Concrete	5 %	Reinforced Stacks	Concrete	3 %	Steel stacks		2 %
Steel structures		2 %														
Reinforced structures	Concrete	5 %														
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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-D-01 CIVIL WORKS	PAGE 334 OF 340												

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

- | | | | |
|----|--------------------------------|---|----|
| a) | Steel structures | : | 2% |
| b) | Reinforced Concrete structures | : | 5% |
| c) | Reinforced Concrete Stacks | : | 3% |
| d) | Steel stacks | : | 2% |

Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.

For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B .

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I.

Design/Detailing for Ductility for Structures

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

- | | | |
|----|---|----------|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.41 g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for ordinary moment resisting steel frames designed and detailed as per IS:800 | : 0.103 |
| b) | for braced steel frames designed and detailed as per IS:800 | : 0.077 |
| c) | For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.062 |
| d) | for RCC chimney | : 0.205 |
| e) | for liquid retaining tanks | : 0.123 |
| f) | for steel chimney | : 0.154 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below | : 0.103 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.205 |

Notes:

1. g = Acceleration due to gravity
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0	1.000	1.000	1.000
0.03	1.000	1.000	1.000
0.04	1.555	1.405	1.293
0.05	2.190	1.828	1.578
0.06	2.898	2.267	1.857
0.07	3.670	2.720	2.131
0.075	3.670	3.175	2.267
0.08	3.670	3.175	2.500
0.083	3.670	3.175	2.500
0.085	3.670	3.175	2.500
0.09	3.670	3.175	2.500
0.1	3.670	3.175	2.500
0.105	3.670	3.175	2.500
0.11	3.670	3.175	2.500
0.115	3.670	3.175	2.500
0.12	3.670	3.175	2.500
0.125	3.670	3.175	2.500
0.13	3.670	3.175	2.500
0.135	3.670	3.175	2.500
0.14	3.670	3.175	2.500
0.145	3.670	3.175	2.500
0.15	3.670	3.175	2.500
0.2	3.670	3.175	2.500
0.22	3.670	3.175	2.500
0.23	3.670	3.175	2.500
0.24	3.670	3.175	2.500
0.3	3.670	3.175	2.500
0.35	3.670	3.175	2.500
0.4	3.670	3.175	2.500
0.45	3.111	2.822	2.222
0.5	2.800	2.540	2.000
0.55	2.545	2.309	1.818
0.6	2.333	2.117	1.667
0.65	2.154	1.954	1.538
0.7	2.000	1.814	1.429
0.75	1.867	1.693	1.333
0.8	1.750	1.588	1.250
0.85	1.647	1.494	1.176
0.9	1.556	1.411	1.111
0.95	1.474	1.337	1.053
1	1.400	1.270	1.000

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
1.05	1.333	1.210	0.952
1.1	1.273	1.155	0.909
1.15	1.217	1.104	0.870
1.2	1.167	1.058	0.833
1.25	1.120	1.016	0.800
1.3	1.077	0.977	0.769
1.35	1.037	0.941	0.741
1.4	1.000	0.907	0.714
1.45	0.966	0.876	0.690
1.5	0.933	0.847	0.667
1.55	0.903	0.819	0.645
1.6	0.875	0.794	0.625
1.65	0.848	0.770	0.606
1.7	0.824	0.747	0.588
1.75	0.800	0.726	0.571
1.8	0.778	0.706	0.556
1.85	0.757	0.686	0.541
1.9	0.737	0.668	0.526
1.95	0.718	0.651	0.513
2	0.700	0.635	0.500
2.05	0.683	0.620	0.488
2.1	0.667	0.605	0.476
2.15	0.651	0.591	0.465
2.2	0.636	0.577	0.455
2.25	0.622	0.564	0.444
2.3	0.609	0.552	0.435
2.35	0.596	0.540	0.426
2.4	0.583	0.529	0.417
2.45	0.571	0.518	0.408
2.5	0.560	0.508	0.400
2.55	0.549	0.498	0.392
2.6	0.538	0.488	0.385
2.65	0.528	0.479	0.377
2.7	0.519	0.470	0.370
2.8	0.500	0.454	0.357
2.85	0.491	0.446	0.351
2.9	0.483	0.438	0.345
2.95	0.475	0.431	0.339
3	0.467	0.423	0.333
3.05	0.459	0.416	0.328
3.1	0.452	0.410	0.323
3.15	0.444	0.403	0.317

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
3.2	0.438	0.397	0.313
3.25	0.431	0.391	0.308
3.3	0.424	0.385	0.303
3.35	0.418	0.379	0.299
3.4	0.412	0.374	0.294
3.45	0.406	0.368	0.290
3.5	0.400	0.363	0.286



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SPECIFIC TECHNICAL REQUIREMENT – MECHANICAL



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1.0. APPLICABLE CODES & REGULATIONS

The design and materials shall conform to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the Agitator shall follow the latest applicable Indian/International (AISI / ASME/EN/Japanese) Standards.

Bidder shall supply the equipment in accordance with relevant regulations, codes and standards specified in the specification. If required by relevant regulations, codes and standards specified in the specification, Successful Bidder shall assist BHEL to obtain approval against the equipment, documents and drawings by Indian authorities.

2.0. PROVENNESS CRITERIA/Pre-QUALIFICATION REQUIREMENT

The Bidders are required to meet the Qualification Requirement (PQR) for Agitators as per Provenness Criteria & shall submit the credentials as called in the tender document. Only OEMs qualifying as per the Qualification requirement shall be considered for placement order.

3.0. MATERIAL OF CONSTRUCTION

	Material of construction	Horizontal agitators (side entry)	Vertical Agitators (Top entry)
i.	Impeller blade	Alloy 926 or better material	Alloy 926 or better material
ii.	Impeller Hub	Alloy 926 or better material	Alloy 926 or better material (or) Carbon steel with 6mm thick Bromo/Chloro Butyl Rubber Lining (as per Proven practice)
iii.	Shaft	Alloy 926 or better material	CS with Rubber Lining (min 6 mm thk Chloro/bromo butyl Rubber)
iv.	Fasteners in wetted parts	Alloy 926 or better material	Alloy 926 or better material
v.	Fasteners in Non Wetted	GI fastener (40 µ plated) / SS	GI fastener (40 µ plated) / SS
vi.	Mounting base	Alloy 926/SMO254 (Wetted parts)	Carbon Steel
vii.	Tank Nozzle (for inserting agitator) with Flange	Not applicable (in BHEL scope)	Not applicable (in BHEL scope)
viii.	Flush pipe for Start up with flange	Not applicable (in BHEL scope)	Not applicable (in BHEL scope)
ix.	Flush Pipe at the bottom of the mounting flange	Not applicable (in BHEL scope)	Not applicable (in BHEL scope)
x.	Lantern support with mounting flange and bolts	Carbon steel/MS	Carbon steel/MS
xi.	Tie rods	Bidder to select	Bidder to select



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xii	Seal type and shaft sleeve material	Bidder to select (as applicable)	Bidder to select (as applicable)
-----	-------------------------------------	----------------------------------	----------------------------------

Castings used for any part of the agitator assembly ordered under these specification shall be of sound and free of shrink or blow holes, scale, blisters and other similar casting defects.

3.1. POWER SUPPLY DETAILS:

1.	POWER SUPPLY	
	The following voltage levels shall apply:	
	3 phase, 3.3 kV AC ,50 Hz	Voltage for motors equal to / bigger than 200KW and for power distribution within the plant.
	3 phase, 415 V, AC , 50 Hz	Standard voltage for power supplies to electric power consumers and motors Above 0.2 KW and upto 200 kW.
	240V AC / 3 phase 415 V AC, 50 Hz	Standard voltage for power supplies to electric power consumers and motors Upto 0.2 kW.
	1. All equipments shall be suitable for rated frequency of 50 Hz with a variation of + 3% & -5%, and 10 % combined variation of voltage and frequency unless specifically brought out in the specification. 2. Bidder shall design and supply the equipment suitable for satisfactory operation under above mentioned power supply condition. 3. For further details refer electrical specification under Section-I, Sub-Section-C2	

4.0. SCOPE OF SUPPLY & SERVICES

The bidder shall assume sole responsibility for the design, fabrication, testing, surface preparation & painting, packing, transportation and performance of the specified equipment with accessories, and shall ensure that the equipment with accessories are in conformance with this specification, as well as other documents which form part of the Purchase Order/Contract.

Various inspections by the BHEL/NTPC shall not relieve the Bidder in any way of his obligation to maintain an adequate test, inspection, and documentation program of his own, and shall not relieve the Bidder of any other obligation under this specification. Furthermore, any inadvertent overlook of deviations from some requirements of this specification by the buyer shall not constitute a waiver of these requirements, or of the Bidder's obligation to correct the condition when it is discovered, or of any other obligation under this specification.

This specification only states the lowest technical requirement, neither specifying all technical details, nor referring the pertaining code and standard fully. It is the Bidder's responsibility to ensure that the complete delivery complies with all relevant codes, standards and specifications.

The Bidder is obliged to supply relevant drawings and documentation to the buyer. All to be in English language and metric system, if not otherwise agreed in writing.

Scope for the bidders shall include Design, Manufacturing, Supply, and Supervision of Erection & Commissioning

Design: broadly includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field quality plans, storage instructions, commissioning procedures, Erection & assembly Drawings, operation & maintenance



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manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from PVUNL.

Supply: the scope includes the following:

- Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting & packing.
- Mandatory spares as defined as Section-I, Sub-Section-D, Annexure-II.
- Recommended spare parts list to be furnished (is not part of scope of supply)
- Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units.
- Start-up & Commissioning Spares
- First fill of consumables

Services: Services to be provided by the bidder:

- Detailed Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL.
- Supervision for Erection & Commissioning, trial run at site
- Performance guarantee tests at site & handover in flawless condition of the package to the customer
- Training of customer/ client O&M staff covering all aspects of the GDS- Operation & Maintenance, Trouble-shooting etc. at site
- Training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding)
- Visits shall be planned by BHEL site team and prior intimation shall be sent to supplier for visit to site for supervision services. Bidder shall be informed at least 10 days in advance for the requirement of visit at site. Visiting team shall consist of one or two expert of bidder as deemed necessary by them.

The scope of supply for AGITATORS shall include but not limited to the following:

A) For Horizontal (Side Entry) Agitators:

Sl. No	Scope
1.	AGITATOR complete with
	i. AGITATOR Blades
	ii. AGITATOR Shafts
	iii. Coupling arrangement (Flexible)
	iv. Single Mechanical Seals
	v. Shaft Sleeve
	vi. Lanterns/ Stools (Bearing Housing), Safety Guard
	vii. Bearings
	viii. Agitator Mounting Flanges with gaskets and fasteners
	ix. Drive Motor(IE3) with gearbox arrangement
	x. Supporting arrangement including tie rods, gusset plates etc. of Side Entry Agitator on the tank Wall. Vessel Nozzle and mating flange for supporting on the tank wall , gaskets and fasteners.
	xi. Flushing system for start up consisting of : Pipe with Flange , Nozzle and mating flange,



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Sl. No	Scope
	Blind flange for plugging.
xii.	Foundation plate with foundation bolts, vessel nozzle
xiii.	Painting and Rust Prevention during shipment and construction
xiv.	Packing and transportation
xv.	Supervision of Erection & commissioning at site
xvi.	Special tools & tackles as applicable
xvii.	Start-up spares, Spare parts for commissioning & erection, Mandatory Spares: As per Project Specific Requirement
xviii.	Installation, operation and maintenance manuals
xix.	Any other items required for completeness of the equipment except the items covered in the exclusions.

B) For Vertical (Top Entry) Agitators :

Sl. No	Scope
2.	AGITATOR complete with
i.	AGITATOR Blades
ii.	AGITATOR Shafts
iii.	Coupling arrangement (Flexible)
iv.	Gland Packing, Seals, O Rings, Glands
v.	Shaft Sleeve
vi.	Lanterns/ Stools (Bearing Housing), Safety Guard
vii.	Bearings
viii.	AGITATOR Mounting Flanges with gaskets and fasteners
ix.	Drive Motor(IE3) with gearbox arrangement
x.	Mating Flange for Supporting on Slurry Tank Roof
xi.	Shims
xii.	Painting and Rust Prevention during shipment and construction
xiii.	Packing and transportation
xiv.	Supervision of Erection & commissioning at site
xv.	Special tools & tackles as applicable
xvi.	Start-up spares, Spare parts for commissioning & erection, Mandatory Spares: As per Project Specific Requirement
xvii.	Installation, operation and maintenance manuals
xviii.	Any other items required for completeness of the equipment except the items covered in the exclusions.

The quantity, location of the agitators have been included in the agitator schedule (Section-II, Annexure-8)



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4.1	TECHNICAL REQUIREMENTS
I	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the limestone slurry tank, Auxiliary Absorbent tank, and sumps etc.
II	All agitators shall be designed for continuous operation unless otherwise specified. The design of the agitators shall be of proven type.
III	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.
IV	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.
V	MOC of various agitator parts shall be as per Cl 3.0. This does not release the bidder of the responsibility for selecting the correct materials.
VI	Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the side mounted agitators without having to drain completely the slurry inside the tank.
VII	-VOID-
VIII	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.
IX	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.
X	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.
XI	All exposed moving parts shall be covered by guards.
XII	The shape of the impeller blades of side entry agitators/top entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s.
XIII	Belt drives (if applied for side entry agitators) shall be properly designed to provide a minimum lifetime of 2 years under design conditions
XIV	It shall be noted that all Agitators are meant for keeping the solid particles in suspended mode in liquid with "Full off-Bottom Suspension" of solid particles to 98% of liquid column to virtually "Uniform Solid Concentration". No chemical reaction will takes place.
XV	Maintaining a uniform concentration over the 95% of liquid column. Absolute sweeping of solid particle from tank bottom is a must for all Agitators. If speed is required to be increased to guarantee the above requirements; the same can be increased by vendor. Bidder's machines that consume less power will be in an advantageous position.



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XVI	It is to be noted that in continuous process any deposit at tank bottom is the loss of material which are not getting converted as per process. Hence, total loss of material by sedimentation is a loss to FGD Process & determines the “In efficiency of the Agitator”.
XVII	Vendor should ensure nil settlement; utilization of solid material shall be a guaranteed parameter and will be assessed in percentage (%) term to net wet of solid mass of inflow or out flow. This is one of the guarantee parameter.
XVIII	Agitator and its driver shall perform on the test stand at shop and on the Agitator’s permanent location at site within vibration limit the vibration of combined unit will be the responsibility of Agitator manufacturer. Agitator manufacturer is to ensure that Site performance of vibration is one of the “Acceptance Criteria” of the equipment. Please note vibration at test stand can only be taken as for information.
XIX	Every Tank will have a pump whose suction line shall be connected to tank. These pumps are to operate continuously at the lowest operating level which is decided by Process requirement. Hence, the minimum operating level of liquid in every tank for every Agitator is a must to assess the combined operation of Agitator as well as that of pump alone. The Tank water level is indicated as per “SECTION-II Annexure-8”.
XX	Agitator must have low-pitch propeller with low solidity ratio and Power Number of 0.3-0.35. The Maximum Input Power at motor terminal shall be considered as a guaranteed parameter under “Schedule of Guaranteed Parameters” in “SECTION-II Annexure-10-Schedule of Guarantees”- and the same shall be calculated for maximum liquid level in tank. A calculation of power specifying the hydraulic power of Agitator, Seal loss, Gear box and Motor internal loss must be submitted along with the offer. A characteristics curve showing power versus liquid level should be submitted from the lowest liquid level, required for Agitator to maximum liquid level in the tank. Motor should be selected based on the highest power demand with a 10% margin at maximum liquid level, taking into account frequency variation.
XI	The agitator shall be suitably designed for mounting and operation in purchaser’s tank whose drawings is annexed with the enquiry specification (SECTION-I, SUB-SECTION-D, Annexure-III). The bidder shall review and comment on the BHEL’s tank drawings for number and size of the baffles, sparger locations, mounting nozzle details etc.
XXII	Unless otherwise specified, for small diameter impeller, it shall be possible to remove complete agitator assembly without dismantling through the opening provided on the tank/sump, and for large diameter impeller, the blade shall be of removable construction for ease of removal. Bidder shall also provide the headroom required for taking out the agitator as above.
XXIII	Any instruments provided shall be Profibus Compatible.
XXIV	Bidder shall provide the design and arrangement of baffle plates in circular tanks. Baffle plates are in BHEL scope.
XXV	Bidder shall provide proper dowelling between motor and base plate, gear box and mounting tool/base plate, for ease of assembly of agitator unit. Tapered dowell shall be provided.
XXVI	Vendor shall provide suitable arrangement for supporting the agitator shaft with impellers during removal of gear-box for maintenance and details of such arrangements shall be furnished.
4.2	CONSTRUCTIONAL FEATURES
A)	BLADE AND HUB OF PROPELLER



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I)	The Blade design of the Agitator to be of most efficient design in order to offer least power consumption. The Agitator power consumption is part of the guarantee parameters.
II)	Although Agitator will have substantial low speed because of reduction Gear Box, hydraulic unbalance at impeller can cause severe vibration, hence it is mandatory that rotating assembly shall be dynamically balanced to its rated speed.
III)	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.
B)	SEAL
1	<u>Horizontal / Side Entry Agitators:</u>
I.	Agitators should be provided with Single Stage mechanical seal. the mechanical seal should be as per ISO-21049 / API 682
II.	The Mechanical Seals shall be so arranged that repacking or fitting of replacement seals can be carried out with the minimum of disruption to plant operation.
III.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with its own slurry.
IV.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.
V.	All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.
VI.	-VOID-
VII.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
VIII.	Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, it should have a provision of collecting / or discharging back to the tank.
IX.	Mechanical seals shall be fitted and installed in the Agitator before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping.
X	Intention of the specification is not to specify Type of Seal, Seal design, Spring configuration, Seal configuration, Balanced or Unbalance type etc. Agitator manufacturer to decide the same along with seal manufacturer, the best seal that is suitable for the offered Agitator
XI	Seal life has to be guaranteed, taking into consideration all its components for 25000 hrs. If the seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.
XII	The sub-vendor of the seal shall be approved by PVUNL during contract execution.
2	<u>Vertical Agitators for Other Slurry Tanks & Drain Pit Tanks</u>
I	Agitator shall be supplied with stuffing box or any proven equivalent or superior sealing type. Mechanical and hydraulic conditions in the seal chamber, required to maintain a stable film at seal face, including temperature, pressure and flow, shall be jointly established by Agitator manufacturer and seal manufacturer, and shall be noted in data sheet submitted in tender. If mechanical seal is offered by bidder, the mechanical seal should be as per ISO-21049 / API 682.



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C)	SHAFT
I.	Use of dissimilar material at flange joint shall be avoided to eliminate any crevice corrosion. Spacing of the shaft joint should not be more than 3.0 m for easy assembly if it is more than 40kg. If welding is used for joining two tubes, welding joint must be 100% radio graphed. If split shaft is proposed for larger tanks, shaft flange at the joining interface has to be rubber lined at manufacturer's works and necessary fasteners have to be provided.
II.	Shaft shall be capable of transmitting full rated torque as mentioned in the driver's nameplate.
III.	Shaft shall be capable for jamming conditions considering the impeller is jammed at a point 0.75 R from the center. Unless otherwise specified a safety factor of 1.5 shall be taken on the motor rating to work out pull out torque for calculating the stresses as per maximum shear strain energy theory. The maximum stress thus calculated shall be limited to yield stress of shaft material at tank design temperature.
IV.	Shaft runout shall be limited to a maximum value of 0.05mm at the face of the stuffing box/seal
V.	In assembled condition the maximum shaft runout at free end shall be limited to 1.0mm/ meter of overhung length of the shaft (measured from the nearest bearing/ seal face end)
VI.	There shall be a separation margin of minimum 20% between the critical speed and any operating speed.
D)	BEARING & BEARING HOUSING IN GEAR BOX
I	Bearing shall be of rolling type radial and thrust bearing (FAG/SKF/Timken make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition.
II	Thrust bearing shall provide full load capability if the Agitator's normal direction of rotation is reversed. Up-thrust and Down-thrust load must be taken into account in sizing bearing. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L10 of 25000 hr (minimum).
III	Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant-level sight-feed oiler of 100cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one(1) number G1/2" thread(ISO-228,Part-1)port is required for remote control of temperature of bearing housing oil bath RTD.
IV	If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.
V	Lubricating oil will be the responsibility of Gear Box manufacturer. Hence, manufacturer has to make arrangement of first fill of oil at installation and at commissioning stage. Quantity of oil and its grade is to be indicated in Drawing and Operation Manual.
E)	MATERIALS
I	Agitator components designated as "Full Compliance Material" shall meet the requirements of the industry specification as listed for the material in the table as well as in the specification in the respective section.
II	A detail quality plan is to be submitted along with offer for all items
III	Final acceptance of the quality plan will be approved by ultimate user (hereafter called PVUNL). Hence, it is expected that manufacturer to submit quality plan



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	(QAP) along with the offer. The same shall be followed at post order stage also. QAP should be as per the best practice followed internationally to avoid any conflict of interest.
F)	DRIVER (MOTOR)
I	Driver shall be sized to meet all specified operating conditions including bearing housing, seal, external gear box and coupling loss(if any).
II	Motor shall be able to accelerate to speed at reduced voltage and frequency as specified in "Site Power Supply Condition" as per Clause: 3.1.
III	It should meet the electrical specification (SECTION-C, SUBSECTION-C3).
G)	GEAR BOX
I.	Gear box should be vertical flange mounted solid shaft type (Vertical Agitators), reducing speed type, specially designed for the requirement of Slurry mixing and to be manufactured by the Agitator supplier. Complete up-thrust and down-thrust, developed by Agitator shall be taken by thrust bearing housing of Gear Box. An auxiliary slow drive provision shall be provided in the Gear Box so that slurry is always kept in dynamic condition to avoid settling of slurry at bottom, in the event of Agitator is not operating at its rated speed. Rating of at Gear box shall be at least 1.5 times the rated torque of Agitator.
II.	The reduction unit shall be procured from a reputed manufacturer and shall confirm to BS:721 (latest edition)/AGMA/Equivalent specification. The sub-vendor of the gear-box shall be approved by PVUNL during contract execution.
III.	Gear drives shall have splash type oil lubrication. If oil pumps are used, they shall be removable for maintenance without disturbing the motor or drive housing.
IV.	The gear reduction unit shall always be provided with an oil drain, a breather and oil level gauge. The lubrication to be designed keeping in view that the temperature within the bearing should not exceed 85 Deg.C.
V.	Drive housings shall be fabricated steel (fully stress relieved after welding) or of fine grain cast iron.
VI.	The bidder shall provide an easily accessible oil level gauge and a dipstick that will indicate oil level under standstill and operating conditions.
H)	COUPLING & COUPLING GUARD
I.	Coupling and coupling guard should be supplied between driver and driven equipment.
II.	Coupling should be designed taking into consideration adequate service factor.
III.	Design rating of the coupling (excluding service factor) should be indicated in data sheet.
IV.	Coupling must be having locking screw so that it does not slide over shaft in due course operation.
V.	Vertical Agitators - Coupling between Motor and Gear Box shall be Spacer-type flexible coupling, made of Cast Iron. Spacer length shall be of sufficient length so than Motor and



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	Gear Box shall be able to run independently at no-load condition by detaching the respective coupling.
VI.	It is desirable that for servicing of seal, coupling half should not be removed. Coupling should be dynamically balanced to Gr: G6.3, ISO-1940.
VII.	Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.
I)	PLATE AND FASTENING BOLTS
I.	Base plate shall be interpreted as the component of Agitator assembly through which the whole load will be transmitted to the Sole Plate/Nozzle over which the equipment will be mounted. The Base plate shall be fabricated with mild steel of structural quality (UTS=42N/sq mm minimum) with anti-corrosive paint of sufficient dry-film thickness.
II.	Base plate must have provision of leveling on its intended mounting place. Nozzle is not in the scope of supply of Agitator manufacturer. It should be noted that Nozzle will be rubber lined to prevent any leakage of corrosive gases
III.	Alignment between Gear Head Shaft and Agitator shaft shall be within the permissible limit of Gear Box. Similarly, misalignment between Motor shaft and Gear Box Shaft shall be within 0.050 micron (radial) and 2 degree (angular) or better as per requirement of Motor and Gear Box
IV.	Sole plate with desired number of hole shall be provided by the bidder, will be machined on one side. Sole Plate shall be welded to the structure after leveling, as recommended by Agitator manufacturer and rubber lining is completed before placing the equipment in its desired location.
J)	OTHER COMPONENTS
I	All fasteners used in wetted condition must be of Alloy 926 or better material so that even if it comes in contact with liquid by swelling of rubber, thread remains unaffected. Raw material of fastener must undergo Inter-granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test.
II	Wherever required, the bidder shall provide mounting stool for agitator unit. It shall house the shaft coupling, the bearing housing, the seal and the auxiliary coupling as applicable.
III	The lantern stool shall be designed to provide adequate accessibility for ease of erection and maintenance. The stool shall be either in standard ERW construction as per IS: 1978 or shall be fabricated from IS: 2062 Gr.B plate. Plugged holes shall be provided at proper locations to drain the oil which may get collected in the stool due to improper functioning of gear box, oil seal etc.
IV	Mounting flange dimensions shall be as per ASME B16.5 upto 600 Nb, ASME B 16.47 for more than 600 NB.
V	Rubber Lining (As Applicable) a) Rubber lined surfaces shall utilize 6 mm nominal thickness chlorobutyl rubber. b) Areas of high wear (e.g. leading edges on impeller blades) shall have an additional 6 mm of rubber for abrasion protection. c) No field-applied linings are permitted except for file patch kits.
	GENERAL REQUIREMENT OF SIDE ENTRY AGITATORS:
I.	All Agitators shall be designed for continuous operation.



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II.	The Material of Construction (MOC) of side entry Agitators shall be as per Cl 3.0
III.	It should be of Flange mounted type.
IV.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from side. Vendor to provide the nozzle and flange along with the agitator.
V.	The Bidder to consider Gypsum Sedimentation during stoppage of Agitator.
VI.	The following information to be provided along with the bid: a) Impeller Diameter b) Impeller Speed c) Agitator Pumping Capacity (m³/min) d) Volume per Agitator:
GENERAL REQUIREMENT OF TOP ENTRY AGITATORS IN OTHER SLURRY TANKS & DRAIN PITS:	
I.	All Agitators shall be designed for continuous operation.
II.	The Material of Construction (MOC) of Top Entry Agitators shall be as per Cl 3.0
III.	It should be roof mounted.
IV.	Agitators shall be vertical mounted type and shall be driven by motor with reducing speed gear box of rigid type, solid shaft coupling between gear box and agitator and flexible coupling of spacer type coupling between Motor and Gear Box. Both Gear Box and Motor should be vertically/horizontally flange mounted type with a common frame of the whole equipment. The entire thrust load of agitator should be transmitted to the thrust bearing of Gear box.
V.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from top.
VI.	Cable entry to the Motor terminal box should preferably be from top when motor is vertically mounted at its position and it should be easily accessible.
VII.	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.
VIII.	-VOID-
IX.	-VOID-
X.	-VOID-
XI.	-VOID-
4.3	MOTOR



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All AC motor shall be Squirrel cage induction motor and, shall be suitable for direct –on-line starting. Rating of the motor should of Type S1 (Continuously rated) as per ISO-60034, Part-1. Rating of motor must be selected with minimum margin(as per the below table) above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation:

Agitator Rated BKW	Motor Margin
<22KW	125% of Agitator Rated BKW
22KW-55KW	115% of Agitator Rated BKW
>55KW	110% of Agitator Rated BKW

It should meet the electrical specification (SECTION-I, SUBSECTION-C2).

5 GENERAL REQUIREMENTS

- | | |
|----|--|
| 1 | Metric unit shall be used in the drawings and in the any displays on the equipment's. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm ² G. For instance the pressure gauges should have dual unit's indication. |
| 2 | Descriptions in the drawings, in the documents, and in the displays shall be in English |
| 3 | All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. |
| 4 | The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate. |
| 5 | Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor. |
| 6 | The overall vibration level shall be as per ISO 10816. |
| 7 | Suitable drain connections shall be provided. |
| 8 | The equipment shall be suitable for stable operation continuously. |
| 9 | Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable Indian / International standard. |
| 10 | Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150 |
| 11 | Name plate: All equipment shall be provided with nameplates indicating the item number and service name. Name plates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided. |
| 12 | Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location. |



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13	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be minimum 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.
14	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
15	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
16	Bidder shall provide the necessary gaskets.
17	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.
18	Bidder to provide capacity of hoist required for material handling and the details of heaviest component to be handled. Bidder shall provide a typical arrangement/drawing of the handling arrangement.
19	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
20	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
21	Material of construction for all equipment/components shall be subject to PVUNL/ BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component (complying tender specifications), as per best engineering practice, global standard and global references, in case no MOC is available in specs.
22	Bidder to provide sub vendor list and Bidder shall strictly adhere to PVUNL approved vendor list (reference list is included in SUB-SECTION-C1F). In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by PVUNL/ BHEL before placing order and bidder shall submit relevant documents to take up with PVUNL for approval.
23	It shall be the complete responsibility of the successful bidder to obtain "Sub Vendor Approval" from BHEL / PVUNL for all equipment's & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of PVUNL/ BHEL, the same may be replaced with another PVUNL/BHEL approved sub-vendor only, without any price implications to BHEL.



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24	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the PVUNL and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments
25	During detail engineering, bidder to strictly adhere to BHEL/PVUNL drawing formats, document numbering, quality plan & FQP formats
26	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with reference Designation System for Power Plants - KKS system.
27	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/PVUNL during detail engineering
28	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/MS-Word /Excel format.
29	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/PVUNL should be addressed timely by the bidder.
30	Bidder to note above mentioned points not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.
31	Bidder shall provide design support to assist the Purchaser in efficiently integrating the furnished equipment. Design support specifically includes: • Bidder shall verify/ validate the number and location of agitators to keep material in suspension. • Static and dynamic loading information and requirements for agitator support design (applicable for top & side type)
6	PACKING AND FORWARDING
1	Proper packing to be ensured. Indigenous Supply: Agitator & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the Agitator internals during storage in the outer yard of power plant. Further the packing shall be done in line with requirements mentioned in point no. 2 to 20 of this section. Imported Supply: All imported supply should be packed as per Sea worthy packing standards as per Sub-Section C-1G. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.



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2	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
3	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
4	Crates and packing material used for shipping will become the property of owner.(PVUNL)
5	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.
6	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
7	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places f. Handling marks and the following delivery marking
8	Each package or shipping units shall be clearly marked or stenciled on at least two sides as per the dispatch instruction givens during the contract. In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.
9	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.
10	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.
11	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.



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12	Wherever necessary besides usual inscriptions the cases shall bear special indication such as “Top”, “Do not turn over”, “Care”, “Keep Dry” etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)
13	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for safe handling)
14	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.
15	The packing slip shall contain the following information: - Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of Agitator, BHEL item Code, Gross Weight and Net weight of Supplied items.
16	Prior to transport from manufacturer’s work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
17	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as “very severe” during final finishing/shipping.
18	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering.
19	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
20	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.
8	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING
1	The erection of Agitators will be done by owner as per Erection Manual and check List to be provided by the bidder during detail engineering. However, the bidder shall make visit as per enquiry/PO for the supervision of erection, pre-commissioning & post-commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply & Services.



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2	The bidder will be informed well in advance for the visit.
3	-VOID-
4	Price comparison for evaluating the lowest bid will be considered all main supply, supervision of E&C charges and mandatory spares price all together.
5	Scope of Supervision for Erection & commissioning: Tentatively following visits shall be planned by site team which shall be as follows:- • Three visits (for all agitators) of 20 days each for supervision for erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply & Services. • Two visits of 10 days each (for all agitators) for performance demonstrations and handing over of system. • Any additional visit as per requirement of BHEL site office during erection of equipment.
6	Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system shall be in bidders scope.
9	EXCLUSION
	The following work associated with the Agitators will be by others: - Access, Walkways, platforms and ladders - Handling equipment (hoist) along with the handling arrangement. However, bidder shall provide the details of the same to BHEL. - Baffle plates - Agitator mounts/supports except as specifically identified above - Foundations - Receiving, unloading, and storage at the project site - Installation, however, supervision of erection and commissioning shall be in bidder's scope - Support steel structure for top entering agitators
10	INSPECTION AND TESTING
1	The General inspection requirements to be considered are as below:
2	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used on the Agitators for review by BHEL/PVUNL prior to manufacture.
3	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/PVUNL.
4	Since there is no standard for "Acceptance Test Procedure" for Agitator, Agitator manufacturer is to submit a test procedure and Quality Plan, clearly indicating that equipment will meet the desired parameter.
5	Power consumption at motor terminal and vibration of equipment will be conducted at site. Vendor to indicate other material tests that are to be conducted as per their practice in their Quality plan.



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6	No liquid should enter the tube through any flange joint. "O"-ring used in the flange joint will deteriorate at a highly chlorinated and acidic environment of medium at a maximum operating temperature unless right quality of rubber is used. Hydrostatic testing of tube assembly is required at a pressure of twice that of maximum liquid column in any tank or 30m whichever is higher. The hydro test duration will be for a minimum of 1 hr to check sweating at any flange. Hydrostatic test is meant in part for a check of equipment joint at new condition only. It cannot be considered as a guarantee of functional objective of rubber used.
7	Mechanical Run Test (in air) Each Agitator unit shall be given a 4-hour mechanical run test in air at vendor's shop. Agitator unit shall be mounted in the same manner as it will operate in the field. During this test the record shall be made of: a) Shaft run out at free end. b) Dynamic shaft deflection adjacent to the mechanical seal/packing/vapour seal. c) Gearbox oil temperature and temperature of bearing housing in stool. The temperature of the gear box oil shall not exceed ambient plus 40 Deg.C and that of bearing housing shall not exceed from room temperature plus 20 Deg.C after temperatures have stabilized. d) Bearing Housing vibration checks shall be carried out. maximum acceptable vibration velocity shall be 6 mm/sec. e) Noise level shall be checked and shall be within the specified limits mentioned in the specification. f) Agitator shaft RPM and motor RPM. g) Check of satisfactory operation of shut off and retracting arrangement.
8	-VOID-
9	Acceptance Test (at Site) After the agitator has been installed at site and is ready for test, vendor shall depute his representative to supervise the site acceptance test
10	DYNAMICS
10.1	CRITICAL SPEED
10.1.1	Operation speed of the Agitator motor shall be at least 25% below the first critical speed
10.1.2	Additional to the requirement of the critical speed of Agitator, as specified above. Agitator manufacturer is to analyze the torsional critical speed of combined system of Agitator, Gear Box and Motor to establish there is a separation margin of minimum 20% between the torsional critical speed (dry/wet) and any operating speed.
10.2	VIBRATION SEVERITY
10.2.1	During performance test, unfiltered vibration measurements shall be made with running of Agitator in Air. Measurement shall be taken on the Gear Box thrust bearing housings as well in motor top.
10.2.2	Guaranteed Site vibration of the equipment on its own pedestal, at commissioning with normal level of liquid and with maximum liquid at respective tank, Vibration limit at site will be as per ISO-10816, and 1.5-2.3mm/sec even if Motor rating falls below 15kw.



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TECHNICAL SPECIFICATIONS FOR
AGITATORS

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I, SUB-SECTION-C1

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10.2.3	Vibration measurements of bearing housing shall be made in root mean square (RMS) velocity.
10.2.4	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
11	For surfaces with rubber lining Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.
12	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.
13	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
14	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air packets (or) surface without adherence.
15	For surfaces with rubber lining, Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.
16	Out of all Agitators One Number of each type will be inspected at the Bidder's works before dispatch or where the test facilities are available.
17	The Bidder shall conduct performance test for the remaining Agitators and submit the reports.
18	Contract shaft mechanical seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition, if applicable.
19	Agitators shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
20	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
21	Bidder to arrange all calibrated gauges, Instruments during inspection.
22	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same / higher rating for the shop test and inspection.
11	PAINTING
	Please refer painting specification (SECTION-C, SUB-SECTION-C2C)
12	SPARES,TOOLS & TACKLES
	Bidder shall supply a set of special tools and tackles required either for erection or operation or maintenance of the agitator units. A list of such tools shall be submitted by bidder along with the offer.



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	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools (SECTION-II Annexure-7).
12.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the Agitators. Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares required for successful operation till commissioning of Agitator shall come under this category. Bidder shall provide an adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipment's are energized. The List of such spares to be provided during bidding stage (SECTION-II Annexure-9).
12.2	RECOMMENDED SPARES
	Bidders shall also furnish the recommended spares list along with the offer required for 3 years of normal operation of the plant and should be independent of the list of the mandatory spares. Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment.
12.3	MANDATORY SPARES:
	Bidder to quote for the mandatory spares as per the Mandatory Spare list given for a specific project (SECTION-I, SUB-SECTION-D Annexure-II). Bidder shall quote for the "Mandatory Spares Part List", and it will be considered for L1 evaluation. Mandatory spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written "S" mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipment's. Each item shall be labelled in English and be packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years' storage in a dry weatherproof building. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the mandatory spares shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan. Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.



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12.4	FIRST FILL OF CONSUMABLES
I	Bidder's scope shall include supply and filling of all chemicals, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.
II	Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. (as applicable) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.
III	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the PVUNL/BHEL's approval herein shall be furnished within 2 months of placement of Order. On completion of erection, complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.
14	PERFORMANCE GUARANTEE
	All performance tests for Agitators shall be carried out in accordance with any latest international codes/standards. Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Agitators and its accessories The Bidder shall ensure a design of the equipment to achieve an average target availability of 98% for 120 days and average target availability of 95% for 1 year. Noise level ≤ 85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions. Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ PVUNL approval. In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.
14	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial Offer. Vendors are requested to comply with above in all respect. List of such documents have been indicated in (SECTION-II Annexure-1).
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	The Successful bidder shall submit necessary data, documents and drawings for review, approval as specified in this specification. Drawings that are reviewed by the PVUNL/ BHEL will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must



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	be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a “hold” on those items or areas of design. PVUNL/ BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by PVUNL must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. All documents in hard and soft form are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per PVUNL requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. The list of such drawing/documents have been indicated in (SECTION-I,SUB-SECTION-D Annexure-IV).
15	LIST OF REFERENCE DRAWINGS BY BHEL
I	The drawings specified in in Annexure-III, Sub-Section-D of Section-I are being provided along with the tender specification for estimation and calculation purpose of the bidder.
16	BID EVALUATION CRITERIA FOR POWER CONSUMPTION
I	Bidder is required to quote GPC in the price schedule issued along with tender.



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CUSTOMER SPECIFICATION



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SECTION-I, SUB-SECTION-C2A

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CUSTOMER SPECIFICATION: TECHNICAL REQUIREMENT

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
9.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal.		
9.04.00	The pump shall deliver the rated flow at rated head with margins as specified in the respective clauses. The pump shall be capable of pumping of filtrate water with solid concentration upto 10% & particle lumps of 6-7mm. Sump pumps handling slurry shall be designed with a maximum concentration of 30% solid by weight.		
9.05.00	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.		
9.06.00	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.		
10.00.00	SLURRY & PROCESS WATER TANKS		
10.01.00	All the slurry tanks (Slurry Tanks, Filtrate Tank, Secondary hydro cyclone feed tank, vacuum receiver tank, Waste water Tank, Lime Neutralization tanks etc.) & Process water tanks (Process water Storage tanks, Clarified water Storage tanks, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replacable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. Coarse-screen(s) at suction-side of these pumps shall be provided.		
11.00.00	AGITATORS		
11.01.00	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, limestone mill recycle tanks, limestone slurry tank, Auxiliary Absorbent tank, and sumps etc.		
11.02.00	All agitators shall be designed for continuous operation unless otherwise specified. Horizontal agitators shall be used for all big tanks and vessels (especially, absorber bottom and emergency drain tank).In other vessels and tanks vertical agitators are also acceptable if they are of proven make and the Bidders standard practice which can be proven by means of suitable references. The design of the agitators shall be of proven type.		
11.03.00	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal, impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.		
11.04.00	All agitator parts and accessories in contact with the stirred fluid shall be constructed		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-9585-001-2	SUB-SECTION-A-05 (FGD)
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.			
11.05.00	The material for the shaft and agitator blades of the Absorber Agitators and for Agitators in other tanks shall be in accordance with Alloy 926 or better. This does not release the Contractor of the responsibility for selecting the correct materials.			
11.06.00	Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the Agitators of the absorber vessel without having to drain completely the absorber.			
11.07.00	To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.			
11.08.00	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.			
11.09.00	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.			
11.10.00	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.			
11.11.00	All exposed moving parts shall be covered by guards.			
11.12.00	Side entry agitator shall be flange mounted.			
11.13.00	The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s.			
11.14.00	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions			
12.00.00	SLURRY LINES AND VALVES			
12.01.00	Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor may provide a recirculation line with motorized isolation valve for the above purpose.			
12.02.00	All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes of size lower than 3" made up of abrasion resistant FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same.			
12.03.00	The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.			
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CUSTOMER SPECIFICATION : PROJECT SPECIFIC GENERAL REQUIREMENTS



TITLE:

**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
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CUSTOMER SPECIFICATION : GENERAL TECHNICAL REQUIREMENTS

PART - C

GENERAL TECHNICAL REQUIREMENTS

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

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

GENERAL TECHNICAL REQUIREMENTS

PART - C

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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
1.00.00	INTRODUCTION This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.	
2.00.00	BRAND NAME Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.	
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.	
4.00.00	COMPLETENESS OF FACILITIES	
4.01.00	Bidders may note that this is a turnkey contract. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.	
4.02.00	All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All same standard components/ parts of same equipment provided, shall be interchangeable with one another.	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
4.03.00	For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.	
5.00.00	CODES & STANDARDS	
5.01.00	In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following : a) Indian Electricity Act b) Indian Electricity Rules c) Indian Explosives Act d) Indian Factories Act and State Factories Act e) Indian Boiler Regulations (IBR) f) Regulations of the Central Pollution Control Board, India g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India h) Pollution Control Regulations of Department of Environment, Government of India i) State Pollution Control Board. (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC). (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (m.) Explosive Rules, 1983 (n.) Petroleum Act, 1984 (o.) Petroleum Rules, 1976, (p.) Gas Cylinder Rules, 1981	
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5.02.00	(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981			
	(r.) Workmen's Compensation Act, 1923			
	(s.) Workmen's Compensation Rules, 1924			
	(t.) NTPC Safety Rules for Construction and Erection			
	(u.) NTPC Safety Policy			
	(v.) Any other statutory codes / standards / regulations, as may be applicable.			
	Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply :			
	a) Bureau of Indian standards (BIS)			
	b) Japanese Industrial Standards (JIS)			
	c) American National Standards Institute (ANSI)			
	d) American Society of Testing and Materials (ASTM)			
	e) American Society of Mechanical Engineers (ASME)			
	f) American Petroleum Institute (API)			
	g) Standards of the Hydraulic Institute , U.S.A.			
	h) International Organization for Standardization (ISO)			
	i) Tubular Exchanger Manufacturer's Association (TEMA)			
	j) American Welding Society (AWS)			
	k) National Electrical Manufacturers Association (NEMA)			
	l) National Fire Protection Association (NFPA)			
	m) International Electro-Technical Commission (IEC)			
	n) Expansion Joint Manufacturers Association (EJMA)			
	o) Heat Exchange Institute (HEI)			
p) IEEE standard				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
5.03.00 5.04.00 5.05.00 5.06.00 5.07.00 5.08.00 6.00.00 6.01.00	q) JEC standard Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English. As regards highly standardised equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered. In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern. Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award. In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect. A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification. EQUIPMENT FUNCTIONAL GUARANTEE The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 4 OF 111	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.			
7.00.00	DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS			
7.01.00	DESIGN OF FACILITIES All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best coordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.			
7.02.00	MAINTENANCE AND AVILABILITY CONSIDERATIONS Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list. Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.			
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8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR	
8.01.00	Bidders may note that this is a turnkey contract. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works. The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification. A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.	
8.02.00	The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in Annexure-VI to this Part-C, Section-VI of the Technical Specification.	
8.03.00	The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:	
8.03.01	A) BASIC ENGINEERING DOCUMENTATION Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum: i) System description of all the mechanical, electrical, control & instrumentation & civil systems. ii) Technology scan for each system / sub-system & equipment. iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options. iv) Optimisation studies including thermal cycle optimisation. v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.	
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	vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups. vii) Water Balance diagram. viii) Operation Philosophy and the control philosophy of the Main Plant and other plants. ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope. x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area, transformer yard, switchyard and other areas included in the scope of the bidder. xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer. B) DETAILED ENGINEERING DOCUMENTS i) General layout plan of the station. ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant. iii) Flow diagram, process and instrumentation diagrams along with write up and system description. iv) Start up curves for boiler and both turbines and boiler combined together as a unit for various start ups, viz. cold, warm and hot start up. v) Piping isometric, composite layout and fabrication drawings. vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.			
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	vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors. viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans, BFPs, CEPs, Heaters/ Deaerators, Condensers, vacuum pumps etc. ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier. x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.. xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.). xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters. xiii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc. xiv) Power supply single line diagram, block logics, control schematics, electrical schematics, etc. xv) Protection system diagrams and relay settings. xvi) Cables schedules and interconnection diagrams. xvii) Cable routing plan. xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.			
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8.03.02	xx) Sequence and protection interlock schemes. xxi) Type test reports, insulation co-ordination study report and power system stability study report. xxii) Control system configuration diagrams and card circuit diagrams and maintenance details. - xxiii) Detailed DDCMIS system manuals. xxiv) Detailed flow chart for digital control system. xv) Mimic diagram layout, Assignment for other application engg. xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results. - xxvii) Underground facilities, levelling ,sanitary, land scaping drawings. - xxviii) Geotechnical investigation and site survey reports (if and as applicable). xxix) Model study reports wherever applicable. xxx) Functional & guarantee test procedures and test reports. xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification. The Contractor's while sumitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made. INSTRUCTION MANUALS The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV. The Contract shall not be considered to be completed		
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	for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. A) ERECTION MANUALS The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. a) Erection strategy. b) Sequence of erection. c) Erection instructions. d) Critical checks and permissible deviation/tolerances. e) List of tool, tackles, heavy equipments like cranes, dozers, etc. f) Bill of Materials g) Procedure for erection and General Safety procedures to followed during erection/installation. h) Procedure for initial checking after erection. i) Procedure for testing and acceptance norms. j) Procedure / Check list for pre-commissioning activities. k) Procedure / Check list for commissioning of the system. l) Safety precautions to be followed in electrical supply distribution during erection. B) OPERATION & MAINTENANCE MANUALS a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the		
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	manufacturers shall be typewritten with a margin on the left hand side. b) The arrangement and contents of O & M manuals shall be as follows : 1) <u>Chapter 1 - Plant Description</u> : To contain the following sections specific to the equipment/system supplied (a) Description of operating principle of equipment / system with schematic drawing / layouts. (b) Functional description of associated accessories / controls. Control interlock protection write up. (c) Integrated operation of the equipment alongwith the intended system. (The is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers). (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries. (e) Design data against which the plant performance will be compared. (f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets. (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system). (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume). 2) <u>Chapter 2.0 - Plant Operation</u>: To contain the following sections specific to the equipment supplied (a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc. (b) Limiting values of all protection settings. (c) Various settings of annunciation/interlocks provided.			
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	(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode. (e) Do's and Don'ts related to operation of the equipment. (f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions. (g) Parameters to be monitored with normal value and limiting values. (h) Equipment isolating procedures. (i) Trouble shooting with causes and remedial measures. (j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing. (k) Routine Operational Checks, Recommended Logs and Records (l) Change over schedule if more than one auxiliary for the same purpose is given. (m) Preservation procedure on long shut down. (n) System/plant commissioning procedure. 3) <u>Chapter 3.0 - Plant Maintenance</u>- To contain the following sections specific to the equipment supplied. (a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population. (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment. (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc. (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.			
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8.03.03	(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out. (f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done. (g) Long term maintenance schedules (h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling. (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.. (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC. (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied. After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer. If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by			
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	ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-VI of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC. Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site. The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats. iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per Annexure-VI of Part-C. iv) Contractor shall prepare the model of all the facilities located in Main Power Block area, covering Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area and any other facility located in Main Plant Block area in an integrated & intelligent 3D software solution using rule based, data centric 3D design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer. After the completion of engineering of respective area i.e. TG building/ Boiler/ ESP etc., the corresponding complete 3D review model shall be handed over to the employer for its reference.			
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	b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable. c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract. The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature. f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project . The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or			
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	approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this turnkey package. Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability. j) As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per Annexure VI. k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout			
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8.04.00	completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule. m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing. ENGINEERING INFORMATION SUBMISSION SCHEDULE Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts. i) Information that shall be submitted for the approval to the Employer before proceeding further, and ii) Information that would be submitted for Employer's information only. The Master Drawing List(MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL. The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.			
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8.05.00	Engineering Co-ordination Procedure	
8.05.01	The following principal coordinators will be identified by respective organizations at time of award of contract : NTPC Engineering Coordinator (NTPC EC) : Name : _____ Designation : _____ Address : _____ a) Postal : _____ b) Telegraphic / e-Mail : _____ c) FAX : _____ TELEPHONE : _____ Contractor's/ Vendor's Engineering Coordinator (VENDOR EC): Name : _____ Designation : _____ Address : _____ a) Postal : _____ b) Telegraphic / e-Mail : _____ c) FAX : _____ TELEPHONE : _____	
8.05.02	All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.	
8.05.03	Contractor's/Vendor's Drawing Submission and Approval Procedure : a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings". b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.	
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	c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance. d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor, thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number. e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories : CATEGORY- I: Approved CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments. CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted. CATEGORY -IV For information and records.		
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	h) Contractor shall resubmit the drawings approved under Category II, III & IV within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents. i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work. j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule. k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing. l) These comments will be taken care by the contractor while submitting the revised drawing. The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.			
8.06.00	ENGINEERING PROGRESS AND EXCEPTION REPORT			
8.06.01	The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission b) Drawings which were not submitted as per agreed schedule.			
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8.06.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.	
9.00.00	TECHNICAL CO-ORDINATION MEETING	
9.01.00	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.	
9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.	
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.	
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.	
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.	
10.00.00	DESIGN IMPROVEMENTS The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change.	
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11.00.00	Following such agreement, the provision thereof, shall be deemed to have been amended accordingly. EQUIPMENT BASES A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.			
12.00.00	PROTECTIVE GUARDS Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.			
13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS			
13.01.00	All the first fill and one year's topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids, gases (excluding H₂, CO₂ and N₂ for generator) and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion of facilities shall be supplied by the contractor. Suitable standard lubricants as available in india are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder scope shall also include supply of H₂, CO₂ and N₂ as applicable for the generator till successful commissioning of generator. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.			
13.02.00	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.			
14.00.00	LUBRICATION			
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14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.	
15.00.00	MATERIAL OF CONSTRUCTION	
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.	
16.00.00	RATING PLATES, NAME PLATES & LABELS	
16.01.00	Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.	
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.	
16.03.00	Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.	
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.	
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support.	
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire.	
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification.	
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	b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm² (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.			
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.			
17.00.00	TOOLS AND TACKLES The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.			
18.00.00	WELDING			
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES			
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19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.	
20.00.00	PROTECTION AND PRESERVATIVE SHOP COATING	
20.01.00	PROTECTION	
	All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.	
20.02.00	PRESERVATIVE SHOP COATING	
	All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.	
20.03.00	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.	
20.04.00	All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.	
20.05.00	All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.	
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20.06.00	Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.		
21.00.00	QUALITY ASSURANCE PROGRAMME		
21.01.00	To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following: a) His organisation structure for the management and implementation of the proposed quality assurance programme b) Quality System Manual c) Design Control System d) Documentation Control System e) Qualification data for Bidder's key Personnel. f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. h) Control of non-conforming items and system for corrective actions. i) Inspection and test procedure both for manufacture and field activities. j) Control of calibration and testing of measuring testing equipments. k) System for Quality Audits. l) System for indication and appraisal of inspection status. m) System for authorising release of manufactured product to the Employer.		
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	n) System for handling storage and delivery. o) System for maintenance of records, and p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as Annexure-I and Annexure-II respectively.			
22.00.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE			
22.01.00	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.			
22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)			
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).			
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the			
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	Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.	
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V . The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.	
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.	
22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).	
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details	
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.	
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.	
22.11.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified	
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	as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer..			
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping shall be as per relevant code. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding			
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.			
22.14.00	No welding shall be carried out on cast iron components for repair.			
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.			
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of correlation of the test report with the job.			
22.17.00	In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested.. The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at Annexure-IV . Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.			
22.18.00	For components/equipment procured by the contractors for the purpose of the			
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	contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.			
22.19.00	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.			
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.			
22.21.00	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.			
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.			
22.23.00	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.			
22.24.00	Environmental Stress Screening All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the			
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	contractor / sub – contractor should meet the following. 1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization. Or In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure. <u>Elevated Temperature Test Cycle</u> During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service. During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C. In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement. 2) <u>Burn in Test Cycle</u> The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test. The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time. During the above tests, the process I/O and other load on the system shall	
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22.25.00	be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable. During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature. The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.			
23.00.00	QUALITY ASSURANCE DOCUMENTS			
23.01.00	The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓)mark.			
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.			
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.			
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23.05.00	TRANSMISSION OF QA DOCUMENTATION On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.	
24.00.00	PROJECT MANAGER'S SUPERVISION	
24.01.00	To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.	
24.02.00	The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following: (a.) Interpretation of all the terms and conditions of these documents and specifications: (b.) Review and interpretation of all the Contractor's drawing, engineering data, etc: (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract : (d.) Inspect, accept or reject any equipment, material and work under the contract : (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 35 OF 111

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25.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES	
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.	
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.	
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.	
25.04.00	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.	
25.05.00	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.	
25.06.00	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise	
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	specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.	
25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.	
25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.	
25.09.00	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.	
25.10.00	Associated document for Quality Assurance programme	
25.10.01	Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at Annexure-I.	
25.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II.	
25.10.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).	
25.10.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV.	
25.10.05	Field Welding Schedule Format enclosed at Annexure-V.	
25.11.00	TESTING OF MAJOR DESIGN FEATURES: The major design features of the system shall be demonstrated by the Contractor at the Contractor's works or any other place mutually agreed within Six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like	
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	configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following. a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B. b) Loop reaction time for sample loops/ logics. c) SOE functionality tests. d) Server changeover. e) Various response times, having serious implication on operation & maintenance philosophy. f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load. g) Unified HMI for DDCMIS. The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer. If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report. 25.12.00 DEMONSTRATION OF APPLICATION ENGINEERING 25.12.01 Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI.	
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	i) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA. ii) Regulating drain valves in which case it shall be limited to 90 dBA-115 dBA. iii) Mill noise which will be limited to 85-90 dBA. iv) TG unit in which case it shall not exceed 90 dBA. v) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 90 dBA. vi) For BFP Motor Noise level shall be with in the limit of 90 dBA.				
31.00.00	PACKAGING AND TRANSPORTATION All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.				
32.00.00	ELECTRICAL EQUIPMENTS/ENCLOSURES				
32.01.00	All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.				
33.00.00	INSTRUMENTATION AND CONTROL				
33.01.00	All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications. All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		<table border="1"> <tr> <td data-bbox="630 1892 983 2011"> TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2 </td><td data-bbox="986 1892 1262 2011"> GENERAL TECHNICAL REQUIREMENTS </td><td data-bbox="1265 1892 1410 2011"> PAGE 45 OF 111 </td></tr> </table>	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 45 OF 111
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	All scales and charts shall be calibrated and printed in Metric Units as follows: 1. Temperature 2. Pressure 3. Draught 4. Vacuum 5. Flow (Gas) 6. Flow (Steam) 7. Flow (Liquid) 8. Flow base 9. Density - Degree centigrade (deg C) - Kilograms per square centimetre (Kg/cm²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure. - Millimetres of water column (mm wc). - Millimeters of mercury gauge (mm Hg) or water column (mm Wcl). - Tonnes/ hour - Tonnes/ hour - Tonnes / hour - 760 mm Hg. 15 deg.C - Grams per cubic centimetre.		
33.02.00	All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.		
33.03.00	All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.		
34.00.00	ELECTRICAL NOISE CONTROL The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).		
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35.00.00	SURGE PROTECTION FOR SOLID STATE EQUIPMENT All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.				
36.00.00	INSTRUMENT AIR SYSTEM The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.				
37.00.00	TAPPING POINTS FOR MEASUREMENTS Tapping points shall include probes, wherever applicable, for analytical measurements and sampling. For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted. The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor. i) Temperature test pockets with stub and thermowell ii) Pressure test pockets				
38.00.00	SYSTEM DOCUMENTATION The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		<table border="1"> <tr> <td data-bbox="630 1895 983 2004"> TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2 </td><td data-bbox="986 1895 1265 2004"> GENERAL TECHNICAL REQUIREMENTS </td><td data-bbox="1268 1895 1402 2004"> PAGE 47 OF 111 </td></tr> </table>	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 47 OF 111
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	LIST OF CODES AND STANDARDS			
	Indian Standards	Title	International and Internationally recognised standards	
	IS:277	Galvanised steel sheets (plain or corrugated)		
	IS:655	Specification for metal air duct		
	IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952	
	IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev	
	IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1	
IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958)		
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	(ISO/R-65-1958) (BS 1387 : 1957) IS:1239 Part-II Mild steel tubulars and other wrought steel pipe fittings BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965 IS:2825 Code for unfired vessels IS:1520 Horizontal centrifugal pumps for clear cold and fresh water IS:1600 Code for practice for performance of constant speed IC Engines for general purpose IS:1601 Specification for performance of constant speed IC Engines for general Purpose IS:1893 Criteria for earthquake resistant design of structures IS:1978-1971 Line Pipe April 1969. API Standards 5L IS:2254-1970 Dimensions of vertical shaft motor for pumps IEC Pub 72-1 part I NEMA Pub MG 1 1954 IS:2266 Steel wire ropes for general engineering purposes BS :302 : 1968 IS:2312 Propellant type Ventilation fans IS:2365 Steel wire suspension ropes for lifts and hoists BS : 1957 IS:3346 Method for the determination of thermal DIN 52612 (Deutscher Normenausschuss)			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
		conductivity of thermal insulation materials (two slab guarded hot plate method) IS:3354 Outline dimensions for electric lifts. IS:3401 Silica gel IS:3588 Specification for electrical axial flow fans IS:3589 Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre) IS:3677 Unbonded rock and slag wool for thermal insulation IS:3815 Point hook with shank for general engineering purposes IS:3895 Specification for monocry-stallines semiconductor rectifier cells and stacks IS:3963 Roof extractor unit IS:3975 Mild steel wires, strips and tapes for armouring cables IS:4503 Shell and tube type heat Exchanger IS:4540 Specification for monory-stallines rectifire assembly	ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963 BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	equipment IS:4671 Expanded polystyrene for thermal insulation purpose IS:4736 Hot dip zinc coating on steel tubes IS:4894 Centrifugal fans IS:5456 Code of practice for testing of positive displacement type air compressors and exhausters (For Test Tolerance Only) IS:5749 Forged ramshorn hooks Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958 IS:6392 Steel pipe flanges BS 4504 : 1969 IS:6524 Part-I Code of practice for design of tower cranes Static and rail mounted BS 2799 : 1956 IS:7098 Cross linked Polyethylene insulated PVC sheathed cables Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524 IS:7373 Specification for wrought aluminium and aluminium sheet and strips IS:7938 Air receivers for compressed air installation ISO:1217 Displacement compressor-Acceptance test ASHRAE-33 Methods of testing for rating of forced circulation air cooling and air heating coils. ASHRAE-52-76 Air cleaning device used in general ventilation for removing particle matter.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
	ASHRAE-22-72 Method of testing for rating of water cooled refrigerant condensers. ASHRAE 23-67 Methods of testing for rating of positive displacement refrigerant compressors. ARI-450-6 Standard for water cooled refrigerant condensers. ARI-550 Standard for centrifugal water chilling packages. ARI-410 Standard for forced circulation air cooling and air heating coils ARI-430/435 Central station AHU/Application of Central Station AHU BS:848 Fans (Part-1,2) BS:400 Low carbon steel cylinders for the storage & transport of permanent gases. BS:401 Low carbon steel cylinders for the storage & transport of liquified gases. CTI Code Acceptance test code for Water Cooling Tower. ACT-105 ANSI-31.5 Refrigerant piping ASME-PTC- Atmospheric Water Cooling Equipment 23-1958 AMCA A-21C Test Code for air moving devices API:618 Reciprocating Compressor for general refinery services. HYDRAULIC INSTITUTE STANDARDS. HYDRANT SYSTEM MANUALS OF TAC. TAC MANUALS OF SPRAY SYSTEM NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS. INDIAN EXPLOSIVES ACT. INDIAN FACTORIES ACT. STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.	
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	CODE AND STANDARD FOR CIVIL WORKS Some of the applicable Standards, Codes and references are as follows: Excavation & Filling IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc. IS: 4701 Code of practice for earth work on canals. IS: 9758 Guide lines for Dewatering during construction. IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade. Properties, Storage and Handling of Common Building Materials IS: 269 Specification for ordinary Portland cement, 33 grade. IS: 383 Specification for coarse and fine aggregates from natural sources for concrete. IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. IS: 455 Specification for Portland slag cement. IS: 702 Specification for Industrial bitumen. IS: 712 Specification for building limes. IS: 808 Rolled steel Beam channel and angle sections. IS: 1077 Specification for common burnt clay building bricks. IS: 1161 Specification of steel tubes for structural purposes. IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C. IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B. IS: 1367 Technical supply conditions for Threaded fasteners. IS: 1489 Specification for Portland-pozzolana cement: (Part-I) Fly ash based.			
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	(Part-II) Calcined clay based. IS: 1542 Specification for sand for plaster. IS: 1566 Specification for hard-drawn steel wire fabric for concrete reinforcement. IS: 1786 Specification for high strength deformed bars for concrete reinforcement. IS: 2062 Specification for steel for general structural purposes. IS: 2116 Specification for sand for masonry mortars. IS: 2386 (Parts-I to VIII) Testing of aggregates for concrete. IS: 3150 Hexagonal wire netting for general purpose. IS: 3495 (Parts-I to IV) Methods of tests of burnt clay building bricks. IS: 3812 Specification for fly ash, for use as pozzolana and admixture. IS: 4031 Methods of physical tests for hydraulic cement. IS: 4032 Methods of chemical analysis of hydraulic cement. IS: 4082 Recommendations on stacking and storage of construction materials at site. IS: 8112 Specification for 43 grade ordinary portland cement. IS: 8500 Medium and high strength structural steel. IS: 12269 53 grade ordinary portland cement. IS: 12894 Specification for Fly ash lime bricks. Cast-In-Situ Concrete and Allied Works IS: 280 Specification for mild steel wire for general engineering purposes. IS: 456 Code of practice for plain and reinforced concrete.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS: 457 IS: 516 IS: 650 IS: 1199 IS: 1791 IS: 1838 (Part-I) IS: 2204 IS: 2210 IS: 2438 IS: 2502 IS: 2505 IS: 2506 IS: 2514 IS: 2645 IS: 2722 IS: 2750 IS: 2751 IS: 3025 IS: 3366 IS: 3370	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures. Method of test for strength of concrete. Specification for standard sand for testing of cement. Methods of sampling and analysis of concrete. General requirements for batch type concrete mixers. Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type). Code of practice for construction of reinforced concrete shell roof. Criteria for the design of reinforced concrete shell structures and folded plates. Specification for roller pan mixer. Code of practice for bending and fixing of bars for concrete reinforcement. General requirements for concrete vibrators, immersion type. General requirements for concrete vibrators, screed board type. Specification for concrete vibrating tables. Specification for Integral cement water proofing compounds. Specification for portable swing weigh batches for concrete. (single and double bucket type) Specification for Steel scaffolding. Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction. Methods of sampling and test waste water. Specification for Pan vibrators. Code of practice for concrete structures for the storage of		
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	(Part I to IV)	liquids. IS: 3414 Code of practice for design and installation of joints in buildings. IS: 3550 Methods of test for routine control for water used in industry. IS: 3558 Code of practice for use of immersion vibrators for consolidating concrete. IS: 4014 Code of practice for steel tubular scaffolding. (Parts I & II) IS: 4326 Code of practice for earthquake resistant design and construction of buildings. IS: 4461 Code of practice for joints in surface hydro-electric power stations. IS: 4656 Specification for form vibrators for concrete. IS: 4925 Specification for batching and mixing plant. IS: 4990 Specification for plywood for concrete shuttering work. IS: 4995 Criteria for design of reinforced concrete bins for the storage of granular and powdery materials. (Parts I & II) IS: 5256 Code or practice for sealing joints in concrete lining on canals. IS: 5525 Recommendations for detailing of reinforcement in reinforced concrete work. IS: 5624 Specification for foundation bolts. IS: 6461 Glossary of terms relating to cement concrete. IS: 6494 Code of practice for water proofing of underground water reservoirs and swimming pools. IS: 6509 Code of practice for installation of joints in concrete pavements. IS: 7861 Code of practice for extreme weather concreting. (Parts I & II) IS: 9012 Recommended practice for shot concreting. IS: 9103 Specification for admixtures for concrete.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 57 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
		IS: 9417 Recommendations for welding cold worked steel bars for reinforced concrete construction. IS: 10262 Recommended guidelines for concrete mix design. IS: 11384 Code of practice for composite construction in structural steel and concrete. IS: 11504 Criteria for structural design of reinforced concrete natural draught cooling towers. IS: 12118 Specification for two-parts poly sulphide. IS: 12200 Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams. IS: 13311 Method of non-destructive testing of concrete. Part-1 Ultrasonic pulse velocity. Part-2 Rebound hammer. SP:23 Handbook of concrete mixes SP: 24 Explanatory Handbook on IS: 456-1978 SP: 34 Handbook on concrete reinforcement and detailing. Precast Concrete Works SP: 7(PartVI/ National Building Code- Structural design of prefabrication and Sec.7) systems building. IS: 10297 Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units. IS: 10505 Code of practice for construction of floors and roofs using pre-cast reinforced concrete units. Masonry and Allied Works IS: 1905 Code of Practice for Structural Safety of Buildings-Masonry walls. IS: 2212 Code of Practice for Brickwork.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 58 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
	IS: 2250 Code of Practice for Preparation and use of Masonry Mortar. SP: 20 Explanatory hand book on masonry code. Sheeting Works IS:277 Galvanised steel sheets (plain or corrugated). IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets. IS: 513 Cold-rolled carbon steel sheets. IS: 730 Specification for fixing accessories for corrugated sheet roofing. IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings. IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage. IS: 3007 Code of practice for laying of asbestos cement sheets. IS: 5913 Methods of test for asbestos cement products. IS: 7178 Technical supply conditions for tapping screw. IS: 8183 Bonded mineral wool. IS: 8869 Washers for corrugated sheet roofing. IS: 12093 Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets. IS: 12866 Plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced). IS: 14246 Specification for continuously pre-painted galvanised steel sheets and coils. Fabrication and Erection of Structural Steel Work IS: 2016 Specification for plain washers.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 59 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS: 814 IS: 1852 IS: 3502 IS: 6911 IS: 3757 IS: 6623 IS: 6649 IS: 800 IS: 816 IS: 4000 IS: 9595 IS: 817 IS: 1811 IS: 9178 IS: 9006 IS: 7215 IS: 12843 IS: 4353 SP: 6 (Part 1 to 7)	Specification for covered Electrodes for Metal Arc Welding for weld steel. Specification for Rolling and Cutting Tolerances for Hot rolled steel products. Specifications for chequered plate. Specification for stainless steel plate, sheet and strip. Specification for high strength structural bolts Specification for high strength structural nuts. High Tensile friction grip washers. Code of practice for use of structural steel in general building construction. Code of practice for use of Metal Arc Welding for General Construction. Code of practice for assembly of structural joints using high tensile friction grip fasteners. Code of procedure of Manual Metal Arc Welding of Mild Steel. Code of practice for Training and Testing of Metal Arc Welders. Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes). Criteria for Design of steel bins for storage of Bulk Materials. Recommended Practice for Welding of Clad Steel. Tolerances for fabrication steel structures. Tolerance for erection of structural steel. Recommendations for submerged arc welding of mild steel and low alloy steels. ISI Hand book for structural Engineers.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 60 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS: 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.		
	IS: 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube		
	IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.		
	IS : 2595	Code of Practice for Radio graphic testing.		
	IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.		
	IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.		
	IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.		
	IS : 3658	Code of practice for Liquid penetrant Flaw Detection.		
	IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.		
	Plastering and Allied Works			
	IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.		
	IS : 1661	Application of cement and cement lime plaster finishes.		
	IS : 2333	Plaster-of-paris.		
	IS : 2402	Code of practice for external rendered finishes.		
	IS : 2547	Gypsum building plaster.		
	IS : 3150	Hexagonal wire netting for general purpose.		
	Acid and Alkali Resistant Lining			
	IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.		
	IS : 412	Specification for expanded metal steel sheets for general purpose.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 61 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
		IS : 4441 Code of practice for use of silicate type chemical resistant mortars. IS : 4443 Code of practice for use of resin type chemical resistant mortars. IS : 4456 Method of test for chemical resistant tiles. (Part I & II) IS : 4457 Specification for ceramic unglazed vitreous acid resistant tiles. IS : 4832 Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type IS : 4860 Specification for acid resistant bricks. IS : 9510 Specification for bitumasitc, Acid resisting grade. Water Supply, Drainage and Sanitation IS : 458 Specification for concrete pipes. IS : 554 Dimensions for pipe threads, where pressure tight joints are made on thread. IS : 651 Specification for salt glazed stoneware pipes. IS : 774 Flushing cisterns for water closets and urinals. IS : 775 Cast iron brackets and supports for wash basins and sinks. IS : 778 Copper alloy gate, globe and check valves for water works purposes. IS : 781 Cast copper alloy screw down bib taps and stop valves for water services. IS : 782 Caulking lead. IS : 783 Code of practice for laying of concrete pipes.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS PAGE 62 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS : 1172 IS : 1230 IS : 1239 IS : 1536 IS : 1537 IS : 1538 IS : 1703 IS : 1726 IS : 1729 IS : 1742 IS : 1795 IS : 1879 IS : 2064 IS : 2065 IS : 2326 IS : 2470 (Part-I & II) IS : 2501 IS : 2548 IS : 2556 (Part 1 to 15) IS : 2963	Basic requirements for water supply, drainage and sanitation. Cast iron rain water pipes and fittings. Mild steel tubes, tubulars and other wrought steel fittings. Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage. Vertically cast iron pressure pipes for water, gas and sewage. Cast iron fittings for pressure pipe for water, gas and sewage. Ball valves (horizontal plunger type) including float for water supply purposes. Cast iron manhole covers and frames. Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories. Code of practice for building drainage. Pillar taps for water supply purposes. Malleable cast iron pipe fittings. Code of practice for selection, installation and maintenance of sanitary appliances. Code of practice for water supply in building. Automatic flushing cisterns for urinals. Code of practice for installation of septic tanks. Copper tubes for general engineering purposes. Plastic seat and cover for water-closets. Vitreous sanitary appliances (vitreous china). Non-ferrous waste fittings for wash basins and sinks.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS
		PAGE 63 OF 111		

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS : 3114 IS : 3311 IS : 3438 IS : 3486 IS : 3589 IS : 3989 IS : 4111 (Part I to IV) IS : 4127 IS : 4764 IS : 4827 IS : 5329 IS : 5382 IS : 5822 IS : 5961 IS : 7740 IS : 8931 IS : 8934 IS : 9762 IS : 10446	Code of practice for laying of cast iron pipes. Waste plug and its accessories for sinks and wash basins. Silvered glass mirrors for general purposes. Cast iron spigot and socket drain pipes. Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter). Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories. Code of practice for ancillary structure in sewerage system. Code of practice for laying of glazed stone-ware pipes. Tolerance limits for sewage effluents discharged into inland-surface waters. Electro plated coating of nickel and chromium on copper and copper alloys. Code of practice for sanitary pipe work above ground for buildings. Rubber sealing rings for gas mains, water mains and sewers. Code of practice for laying of welded steel pipes for water supply. Cast iron grating for drainage purpose. Code of practice for road gullies. Cast copper alloy fancy bib taps and stop valves for water services. Cast copper alloy fancy pillar taps for water services. Polyethylene floats for ball valves. Glossary of terms for water supply and sanitation.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 64 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS : 10592	Industrial emergency showers, eye and face fountains and combination units.		
	IS : 12592	Specification for precast concrete manhole covers and frames.		
	IS : 12701	Rotational moulded polyethylene water storage tanks.		
	SP: 35	Hand book on water supply and drainage.		
	-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.		
	Doors, Windows and Allied Works			
	IS : 204	Tower Bolts		
	Part-I	Ferrous metals.		
	Part-II	Nonferrous metals.		
	IS : 208	Door Handles.		
	IS : 281	Mild steel sliding door bolts for use with padlocks.		
	IS : 362	Parliament Hinges.		
	IS : 420	Specification for putty, for use on metal frames.		
	IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.		
	IS : 1038	Steel doors, windows and ventilators.		
	IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.		
	IS : 1341	Steel butt hinges.		
	IS : 1361	Steel windows for industrial buildings.		
	IS : 1823	Floor door stoppers.		
	IS : 1868	Anodic coatings on Aluminium and its alloys.		
	IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 65 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
	IS:2209 Mortice locks (vertical type). IS:2553 Safety glass IS:2835 Flat transparent sheet glass. IS:3548 Code of practice for glazing in buildings. IS:3564 Door closers (Hydraulically regulated). IS : 3614 Fire check doors; plate, metal covered and rolling type. IS:4351 Steel door frames. IS:5187 Flush bolts. IS:5437 Wired and figured glass IS:6248 Metal rolling shutters and rolling grills. IS:6315 Floor springs (hydraulically regulated) for heavy doors. IS:7196 Hold fasts. IS:7452 Hot rolled steel sections for doors, windows and ventilators. IS:10019 Mild steel stays and fasteners. IS:10451 Steel sliding shutters (top hung type). IS:10521 Collapsible gates. R oof Water Proofing and AlliedWorks IS:1203 Methods of testing tar and bitumen. IS:1322 Specification for bitumen felts for water proofing and damp proofing. IS:1346 Code of practice for water proofing of roofs with bitumen felts. IS:1580 Specification for bituminous compound for water proofing and caulking purposes.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 66 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.		
	IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.		
	Floor Finishes and Allied Works			
	IS:1237	Specification for cement concrete flooring tiles.		
	IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.		
	IS:2114	Code of practice for laying in-situ terrazzo floor finish.		
	IS:2571	Code of practice for laying in-situ cement concrete flooring.		
	IS:3462	Specification for unbacked flexible PVC flooring.		
	IS:4971	Recommendations for selection of industrial floor finishes.		
	IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.		
	IS:8042	Specification for white portland cement.		
	IS:13801	Specification for chequered cement concrete flooring tiles.		
	Painting and Allied Works			
	IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.		
	IS:1477	Code of practice for painting of ferrous metals in buildings.		
	Part-I	Pretreatment.		
	Part-II	Painting.		
	IS:1650	Specification for colours for building and decorative finishes.		
	IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.		
	IS:2338	Code of practice for finishing of wood and wood based materials.		
	Part-I	Operations and workmanship		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 67 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	Part-II IS:2395 Part-I Part-II IS:2524 Part-I Part-II IS:2932 IS:2933 IS:4759 IS:5410 IS:5411 (Part-I) IS:6278 IS:10403 Piling and Foundation IS:1080 IS:1904 IS:2911 IS:2950 IS:2974 (Part-I TO V) IS:6403	Schedules Code of practice for painting concrete, masonry and plaster surfaces. Operations and workmanship. Schedule. Code of practice for painting of nonferrous metals in buildings. Pretreatment. Painting. Specification of synthetic enamel paint, exterior, under-coating and finishing. Specification enamel paint, under coating and finishing. Code of practice for hot dip zinc coating on structural steel and other allied products. Specification for cement paint Specification for plastic emulsion paint-for exterior use Code of practices for white washing and colour washing. Glossary of terms relating to building finishes. Code of practice for design and construction of simple spread foundations. Code of practice for design and construction of foundations in Soils; General Requirements. Code of practice for designs and construction of Pile foundations (Relevant Parts). Code of practice for designs and construction of Raft (Part-I) foundation. Code of practice for design and construction of machine foundations. Code of practice for determination of Allowable Bearing pressure on Shallow foundation.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 68 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	IS:8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.	
	Part-I	Shallow foundations.	
	Part-II	Deep foundations.	
	IS:12070	Code of practice for design and construction of shallow foundations on rocks.	
	DIN:4024	Flexible supporting structures for machines with rotating machines.	
	VDI:2056	Criteria for assessing mechanical vibrations of machines.	
	VDI:2060	Criteria for assessing rotating imbalances in machines.	
	Stop Log and Trash Rack		
	IS:4622	Recommendations for fixed - wheel gates structural design.	
	IS:5620	Recommendations for structural design criteria for low head slide gates.	
	IS:11388	Recommendations for design of trash rack for intakes.	
	IS:11855	General requirements for rubber seals for hydraulic gates.	
	Roads		
	IRC:5	Standard specifications and Code of practice for road bridges, section-I general Features of Design.	
	IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.	
	IRC:16	Specification for priming of base course with bituminous primers.	
	IRC:19	Standard specifications and code of practice for water bound macadam.	
	IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).	
	IRC:34	Recommendations for road construction in waterlogged areas.	
	IRC:36	Recommended practice for the construction of earth embankments for road works.	
	IRC:37	Guidelines for the Design of flexible pavements.	
	IRC:56	Recommended practice for treatment of embankment slopes for erosion control.	
	IRC:73	Geometric design standards for rural (non-urban) highways.	
	IRC:86	Geometric Design standards for urban roads in plains.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IRC:SP:13 Guidelines for the design of small bridges & culverts. IRC - Public- Ministry of Surface Transport (Roads Wing), Specifications ation for road and bridge works. IS:73 Specification for paving bitumen Loadings IS:875 Code of practice for design loads other than earthquake) for (Pt. I to V) buildings and structures. IS:1893 Criteria for earthquake resistant design of structures. IS:4091 Code of Practice for design and construction of foundation for transmission line towers & poles. IRC:6 Standard specifications & code of practice for road bridges, Section-II Loads and stresses. M.O.T. Deptt. of railways Bridge Rules. Safety IS:3696 Safety code for scaffolds and ladders. (Part I & II) IS:3764 Safety code for excavation work. IS:4081 Safety code for blasting and related drilling operations. IS:4130 Safety code for demolition of buildings. IS:5121 Safety code for piling and other deep foundations. IS:5916 Safety code for construction involving use of hot bituminous materials. IS:7205 Safety code for erection on structural steelwork. IS:7293 Safety code for working with construction machinery. IS:7969 Safety code for handling and storage of building materials IS:11769 Guidelines for safe use of products containing asbestos. - Indian Explosives Act. 1940 as updated. Architectural design of buildings SP:7 National Building Code of India SP:41 Hand book on functional requirements of buildings (other than industrial buildings)		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 70 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
	Miscellaneous IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers. IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. IS:10430 Criteria for design of lined canals and liner for selection of type of lining. IS:11592 Code of practice for selection and design of belt conveyors. IS:12867 PVC handrails covers. CIRIA Design and construction of buried thin-wall pipes. Publication REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents. Temperature Measurements 1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). 2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. 3. Temperature measurement by electrical Resistance thermometers - IS:2806. 4. Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements 1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). b) Electronic transmitters BS:6447. 2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. 3. Process operated switch devices (Pr. Switch) BS-6134.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 71 OF 111

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT :				
			ITEM :		QP NO.:		PACKAGE :		CONTRACT NO. :		
			SUB-SYSTEM:		REV. NO.:		MAIN-SUPPLIER:		DATE:		
					PAGE: OF						

SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9. D*	10.

MANUFACTURER/ SUB-SUPPLIER	SIGNATURE	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)		DOC. NO.:		REV.	
				REVIEWED BY	APPROVED BY	APPROVAL SEAL	
FORMAT NO.: QS-01-QAL-P-09/F2-R1				1/1			

ENGG. DIV./QA&I

PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.: CS-9585-001-2	GENERAL TECHNICAL REQUIREMENT	PAGE 79 OF 111
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ANNEXURE-III

		Project Package Supplier Contractor No.	Stage ::	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL							DOC. NO.:	
				SUB-SYSTEM :							REV. NO.:	
											DATE :	
											PAGE : OF	
S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks		

LEGENDS

SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list alongwith the condition of approval, if any.

DR – For these items “Detailed required” for NTPC review. To be identified with letter “DR” in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with “NOTED.”

QP/INSPN CATEGORY:

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

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

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

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

FORMAT NO.: QS-01-QAI-P-1/F3-R0

1/1

Engg. Div. / QA&I

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ANNEXURE-IV

		Project :		Stage ::		STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL					DOC. NO.:	
		Package :									REV. NO.:	
		Contractor :									DATE :	
		Contractor No. :									PAGE : OF	
S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks	
FORMAT												

Engg. Div. / QA&I

1/1

ANNEXURE-V

 DRG No. for Weld Location and Identification mark		Project :		Stage :		FIELD WELDING SCHEDULE (To be raised by the contractor)				DOC. NO.:				
		Contractor :				Welding Code:				REV. NO.:				
		Contractor No. :								DATE :				
		System :								PAGE : OF				
Sl. No.	Description of parts to welded	Matl. Spec.	Dimensions	Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment Temp.	Holding time	NDT method/ Quantum	REF Spec. No.	ACC Norm Ref.	Remarks
NOTES:														
SIGNATURE														
FORMAT														
Engg. Div. / QA&I														

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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			एनटीपीसी NTPC																																																								
	<table><tr><th>S.No</th><th>Description of Drgs/Docs</th><th>No of Prints</th><th>No of CD ROMs/DVDs/Portable Hard Disk</th></tr><tr><td rowspan="8">1</td><td>Drawings, Data sheets, Design calculations, Purchase specifications and other documents</td><td></td><td></td></tr><tr><td>First submission and submission with major changes</td><td></td><td></td></tr><tr><td>▪ Layout (A0&A1 sizes)</td><td>4</td><td>-</td></tr><tr><td>▪ Other Drawings/Documents (A0&A1 sizes)</td><td>2</td><td>-</td></tr><tr><td>▪ P&ID (All sizes)</td><td>4</td><td>-</td></tr><tr><td>a) Final drawings/documents (Directly to site)</td><td>6</td><td>2</td></tr><tr><td>b) "As Built" Drawing/Documents (Directly to site)</td><td>6</td><td>2</td></tr><tr><td>c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.</td><td>2</td><td>2</td></tr><tr><td>2</td><td>Erection Manual (Directly to site)</td><td>4 sets</td><td>2</td></tr><tr><td rowspan="2">3</td><td>Operation & Maintenance manual</td><td rowspan="2">1 set</td><td rowspan="2">--</td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td></tr><tr><td rowspan="2">4</td><td>Plant Hand Book</td><td rowspan="2">1</td><td rowspan="2">1</td></tr><tr><td>i) First Submission</td></tr><tr><td rowspan="2">5</td><td>Commissioning and Performance Test Procedure manual</td><td rowspan="2">1 set</td><td rowspan="2">--</td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td></tr></table>	S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk	1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents			First submission and submission with major changes			▪ Layout (A0&A1 sizes)	4	-	▪ Other Drawings/Documents (A0&A1 sizes)	2	-	▪ P&ID (All sizes)	4	-	a) Final drawings/documents (Directly to site)	6	2	b) "As Built" Drawing/Documents (Directly to site)	6	2	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2	2	Erection Manual (Directly to site)	4 sets	2	3	Operation & Maintenance manual	1 set	--	i) First Submission		ii) Final Submission (Directly to site)	4 sets	2	4	Plant Hand Book	1	1	i) First Submission	5	Commissioning and Performance Test Procedure manual	1 set	--	i) First Submission		ii) Final Submission (Directly to site)	4 sets	2			
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 83 OF 111																																																								

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)				
	S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk	
	6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	—	
		ii) Approved Copies (Direct to Site)	4 sets	2	
	7	Project Completion Report (Directly to site)	6 sets	2	
	8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	—	
	9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	—	
	10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc			
		i) For review/comment	1	—	
		ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2	
	11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals			
		i) For review/comment	1 set	—	
		ii) Approved copies (Direct to Site)	4 sets	2	
	12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2	
	13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 84 OF 111



TITLE:
PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-434-(-)-A001

SECTION-I, SUB-SECTION-C2B

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING: QUALITY ASSURANCE

CLAUSE NO.	QUALITY ASSURANCE	
1.08.00 1.08.01 1.08.02 1.08.03 1.08.04	STRUCTURES , DUCTS, HOPPERS: All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested. Visual inspection of all welds shall be performed in accordance with AWS D1.1. NDT requirements of structural steel welds shall be as under: i) 100% RT/UT on butt-welds of plate thickness ≥ 32mm. ii) For plates of $25\text{mm} \leq \text{thickness} < 32\text{mm}$ - 10% RT and 100% MPI. iii) For plates of thickness $< 25\text{mm}$ - 10% MPI/LPI. Edge for shop and field weld shall be examined by MPI for plate thickness ≥ 32 mm.	
1.09.00 1.09.01 1.09.02 1.09.03 1.09.04 1.09.05	VACUUM BELT FILTER SYSTEM: Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested. UT on shaft (if greater or equal to 40mm) and impeller shall be carried out. All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc. Filter cloths and belts shall be tested for physical properties as per relevant standard Hydro cyclones shall be checked by visual, dimensional etc.	
1.10.00 1.10.01 1.10.02	SPRAY NOZZLES: Spray nozzles shall be tested for physical properties Spray nozzles also shall be subjected to performance test.	
1.11.00 1.11.01 1.11.02 1.11.03	AGITATORS: Rubber lining shall be tested for hardness and spark test Impellers shall be tested for dimensional and balancing check Gear Boxes shall be tested for run test as per standard practice	
1.12.00 1.12.01 1.12.02	FANS: Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining. Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.	
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 – E-04 FGD SYSTEM Page 3 of 4

CLAUSE NO.	QUALITY ASSURANCE		
1.12.03 1.12.04 1.12.05 1.13.00 1.14.00 1.14.01	All rotating components and assemblies of fan shall be balanced dynamically Performance test shall be carried out on fans as per Technical specification/ Relevant standard Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard Thermal Insulation, Lagging & Cladding: (a) Lightly resin bonded mineral wool: LRB mattresses/sections of Rockwool/ Glasswool shall conform to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in respective Sub-Section of Technical Requirements of Steam Generator & Auxiliaries. (b) Lagging & Cladding: All insulation shall be protected by means of an outer covering of Aluminium sheeting confirming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet. OTHER CRITICAL EQUIPMENTS: Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.		
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 – E-04 FGD SYSTEM	Page 4 of 4

CLAUSE NO.	QUALITY ASSURANCE			एनटीपीसी NTPC
	(b.) Longitudinal butt weld on bellow shall be subjected to suitable NDT examination before forming, and after forming MPE / DP test shall be carried out. (c.) All welds shall be subjected to 100% magnetic particle/dye pentrant check and butt welds shall be subjected to 100% radiographic testing. (d.) All the bellows subjected to vacuum service shall be subjected to vacuum test. (e.) The bellows shall be subjected to movement test to establish suitability to perform satisfactorily in site conditions. During this test spring rate shall also be measured. (f.) The testing of MEJ shall be as per Expansion joint Manufacturer Association (EJMA) standard.			
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-E-06 POWER CYCLE PIPING	Page 5 of 5

QUALITY ASSURANCE

QUALITY ASSURANCE										
10. Atmospheric Storage Tanks/ Pressure Vessels	Y ^a	Y	Y ^b	Y	Y	Y ⁸	Y	Y ^c	Y ⁷	
Tests/Check		WPS/PQR/Welder Qualification						Test as per relevant Std/ Appd.		
Items / Components	Material Test	DPT/MPi	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Data Sheets	Other Tests	Remarks
11. Rubber lining	Y ^a			Y				Y	Y ⁹	Y ⁷ Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall also be stress relieved as per the requirement of code.
12.Butterfly valves(HP)	Y ^a		Y	Y		Y	Y			Y ⁸ RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT.
13.Ball valves(HP)	Y ^a		Y	Y		Y	Y			Y ⁹ Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted.
12. Resins / Activated Carbon Filter	Y ^a	Y	Y ^b	Y				Y	Y ¹⁰	Y ¹⁰ Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted.
14. Agitators /Flash Mixer/ Flocculator	Y ^a	Y	Y ^b	Y			Y	Y	Y ¹⁰	Y ¹¹ One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured.
15. Pipes (Fabricated)	Y ^a	Y	Y	Y	Y	Y	Y ¹¹	Y		Y ¹² Dry cycle test on valve spring for 1, 00,000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring.
16. Ventilation/Exhaust Fan	Y ^a		Y ^b	Y				Y	Y ^{dc}	
After erection, the complete Piping system along with valves & fittings shall be hydraulically tested at 1.5 times design pressure or 2 times working pressure 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 E-28 CONDENSATE POLISHING PLANT	PAGE 2 OF 2
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SUB-SECTION–E-51

MOTORS

**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**

MOTOR

TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y			Y		
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes, for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y						
Complete Motor	Y	Y	Y						
Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW. 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard 3. Makes of major bought out items for HT motors will be subject to NTPC approval. Y1 = for HT Motor / Machines only.									

CLAUSE NO.		QUALITY ASSURANCE							एनटीपीसी NTPC	
MOTOR										
TESTS/CHECKS ITEMS/ COMPONENTS	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034/IEC 60079-1	vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.										
Shaft										
Magnetic Material	Y		Y							
Rotor										
Copper/Aluminium										
Stator copper			Y							
SC Ring										
Insulating Material			Y							
Tubes for Cooler		Y								
Sleeve Bearing		Y								
Stator/Rotor, Exciter Coils										
Castings, stator frame, terminal box and bearing housing etc.										
Fabrication & machining of stator, rotor, terminal box										
Wound stator										
Wound Exciter										
Rotor complete				Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly										
Accessories, RTD, BTD,CT, , Space heater, antifriction bearing, gaskets etc.										
Complete Motor						Y	Y	Y	Y1	Y
Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW. 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard 3. Makes of major bought out items for HT motors will be subject to NTPC approval. Y1 = for HT Motor / Machines only.										
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-E-51 MOTORS			Page 2 of 2	



TITLE:

**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-C, SUB-SECTION-C1D

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

CUSTOMER SPECIFICATION : FUNCTIONAL GUARANTEES

SUB-SECTION-IV

FUNCTIONAL GUARANTEES

**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.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS The term "Performance Guarantees" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)". The term “BMCR” (Boiler Maximum Continuous Rating) appearing in the Technical Specification shall mean the maximum continuous steam output of Steam Generator (as defined Cl. No. 1.02.00 Sub-section A-02, Part-B) at super heater outlet at rated parameters. The term “TMCR” (Turbine maximum continuous rating) appearing in the technical specification shall mean 800 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this sub-section) under rated steam parameters, 0% cycle make-up and 160 mmHg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure and /or a different throttle steam pressure.			
1.00.00	PERFORMANCE GUARANTEES			
1.00.01	General Requirements a) The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications. b) The guaranteed performance parameters furnished by the bidder in his offer, shall be without any tolerance values whatsoever and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures. c) The Contractor shall conduct performance test and demonstrate all the guarantees covered herein, during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance test are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually. d) All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation, shall be included in the bid price. e) It is the responsibility of the contractor to perform the Performance			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 1 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
	Guarantee/Acceptance test as specified in this subsection. The performance tests will be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall only be used for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits. f) The Contractor shall make the plant ready for the performance guarantee tests. g) All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation required for performance tests shall be supplied by the contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subjected to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes. h) Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost. i) The Performance / Acceptance test shall be carried out as per the agreed procedure. The PG test procedure including demonstration tests shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award. After the conductance of Performance test, the contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one months from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run. The P&G test procedures shall be submitted for equipments/ system & subsystem under Contractor's scope for all Guarantees under category I, II & III as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees. j) The contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following:			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 2 OF 98	

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
	a) Object of the test. b) Various guaranteed parameters & tests as per contract. c) Method of conductance of test and test code. d) Duration of test, frequency of readings & number of test runs. e) Method of calculation. f) Correction curves. g) Instrument list consisting of range, accuracy, least count, and location of instruments. h) Scheme showing measurement points. i) Sample calculation. j) Acceptance criteria. k) Any other information required for conducting the test. k) In case during performance guarantee tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. However if the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit specified at clause 1.01.02 of this subsection, Employer will accept the equipment/system/plant after levying liquidated damages as per clause 1.01.02 of this sub-section. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following: i) For Category-I Guarantees Reject the equipment/system/plant and recover from the Contractor the payments already made OR			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 3 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
1.01.00 1.01.01	Accept the equipment/system/plant after levying Liquidated Damages as specified hereunder. The liquidated damages, for shortfall in performance indicated in clause 1.01.02 for this sub-section are on per unit basis and shall be levied separately for each unit, except for the rate indicated for auxiliary power consumption for station auxiliaries which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category - I' Guarantees. ii) For Category-II Guarantees Reject the equipment/plant/system and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category - II ' Guarantees. Conformance to the performance requirements under Category -II is mandatory. iii) For Category-III Guarantees Reject the equipment / system/plant & recover from the Contractor the payments already made. OR Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the EMPLOYER. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s) replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters/capacities shall be termed as category - III, guarantees.	GUARANTEES UNDER CATEGORY - I		
	The performance guarantees which attract liquidated damages (LD) are as follows: i) Unit Heat Rate a) Unit Heat rate in kcal/kWhr under rated steam conditions at 160 mm Hg (abs) condenser pressure with zero (0%) make up at 800 MW unit load (i.e. 100% of rated load). b) Unit Heat rate in kcal/kWhr under turbine throttle main steam pressure of 210 Kg/cm² (abs) and turbine throttle main steam temperature / reheat steam temp. at turbine inlet of 600 deg C / 600 deg C at 160 mm Hg (abs) condenser pressure with zero make up at 600 MW unit load (i.e. 75% of rated load) .			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 4 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	Unit Heat rate shall be computed as per clause 1.01.03. ii) TG Output Continuous TG output of 840 MW unit load (i.e. 105% of rated load) under rated steam conditions at 160 mm Hg (abs) condenser pressure with 0% make-up. iii) Condenser Pressure in mm Hg (abs) measured at 300mm downstream of low pressure turbine last stage bottom blade tip at 840 MW output under rated steam conditions, 3% make up and ambient temperature of 38°C. Note: The condenser pressure measurement while conducting the guarantee tests from (i) to (iii) above shall be measured at 300 mm downstream of low pressure turbine last stage bottom blade tip. iv) Steam Generating Capacity Steam generating capacity in T/hr of steam at rated steam parameters at superheater outlet & rated steam temperature at reheater outlet (with any combination of mills working as per Employer's discretion) with the coal being fired from within the range specified in the table at Annexure-IV-2, Sub section I-B (Project information), Part A, Section VI. v) Coal Pulveriser Wear Parts Warranty Life of coal pulveriser wear parts, in hours of operation, for the entire range of coal characteristics specified. (To be demonstrated as per clause 1.01.04 of this sub-section). vi) SCR/ Hybrid (SCR+SNCR) Efficiency for Control of NOx emission Contractor shall guarantee and demonstrate that at the end of 16000 hrs of operation and with the originally installed catalyst (i.e. without the use of future layer of catalyst) the SCR/ Hybrid (SCR+SNCR) efficiency for control of NOx emission (from thermal as well as fuel) shall not be less than 80% at 6% oxygen (O₂) content in flue gas on dry gas basis and ammonia slip not exceeding 3ppm at 100% TMCR load condition, when firing any coal from the range of coal(s) specified. The SCR/ Hybrid (SCR+SNCR) efficiency test for control of NOx emission shall be conducted at the end of 16000 hrs of operation or as and when SCR/ Hybrid (SCR+SNCR) efficiency for control of NOx emission based on online measurements available in the control room reaches to the level of 70%, whichever is earlier. The catalyst will be deemed to have exhausted its life as and when SCR/ Hybrid (SCR+SNCR) efficiency for control of NOx emission reaches to the level of 70%.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 5 OF 98

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	vii) Catalyst Life Contractor shall guarantee and demonstrate minimum SCR catalyst life of 16000hrs. The catalyst shall be deemed to have exhausted its life as and when SCR/ Hybrid (SCR+SNCR) efficiency for control of NOx emission reaches to a level of 70%, with ammonia slip not exceeding 3ppm at 6% oxygen (O₂) content in flue gas on dry gas basis. viii) Ammonia Consumption Rate (applicable in case of SCR system alone) Guaranteed Ammonia consumption rate (in Kg/hr/unit, 99.5 wt %) at 100% TMCR for firing coal from the range of coal(s) specified shall be demonstrated. The ammonia consumption rate shall be measured during the test for SCR efficiency for control of NOx emission. ix) Urea consumption rate (Applicable in case of Hybrid (SCR+SNCR) system) Guaranteed solid Urea consumption rate (in Kg/hr/unit) at 100% TMCR for firing coal from the range of coal(s) specified shall be demonstrated. The urea consumption rate shall be measured during the test for Hybrid system (SCR+SNCR) efficiency for control of NOx emission. x) DM water consumption rate (Applicable in case of Hybrid (SCR+SNCR) system) Guaranteed DM water consumption rate (in ton/hr/unit) for making solution of urea and for dilution of urea at 100% TMCR for firing coal from the range of coal(s) specified shall be demonstrated. The DM water consumption rate shall be measured during the test for Hybrid system (SCR+SNCR) efficiency for control of NOx emission. xi) Particulate Emission/ ESP Efficiency Contractor's design shall ensure that the particulate emission from ESP(s) shall not be more than 17 mg/ Nm³ under guarantee point (refer clause no. 1.05.19 related to ESP sizing criteria Sub-Section–A-02, Part-B(Mechanical), Section-VI) condition at 100 %TMCR i.e. at 800 MW unit load with design coal firing. The corresponding ESP efficiency shall be worked out as per the procedure outlined in clause 1.01.06 of this Sub-section. xii) FGD SO₂ Removal Efficiency Contractor's design shall ensure that the SO₂ removal efficiency from FGD shall not be more than 80 mg/nm³ (6% O₂ dry basis) under guarantee point condition (refer clause no. 1.05.20.01 related to FGD sizing criteria, Sub-Section–A-02, Part-B (Mechanical), Section-VI). The corresponding SO₂ removal efficiency from FGD shall be worked out.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 6 OF 98

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1.01.02	xiii) Limestone Consumption Rate Limestone consumption of FGD system in kg/hr under guarantee point conditions (refer clause no. 1.05.20.01 related to FGD sizing criteria, Sub-Section–A-02, Part-B (Mechanical), Section-VI). xiv) Unit Auxiliary Power Consumption Unit auxiliary power consumption comprising of all Unit Auxiliaries shall be guaranteed in line with the requirements stipulated in clause 1.01.08.01 of this sub section. Power consumption of all unit auxiliaries (except Air Cooled Condenser Fans) shall be taken for continuous unit operation at 800 MW (i.e. 100% rated load) under rated steam conditions and at condenser pressure of 160 mm Hg (abs) with 0% make-up. Power consumption of Air Cooled Condenser Fans shall be taken at 840 MW (i.e. 105% rated load) under rated steam conditions, guaranteed condenser pressure and ambient temperature of 38 deg.C. xv) Auxiliary Power Consumption for Station Auxiliaries Station auxiliary power consumption comprising of all station Auxiliaries required for continuous station operation at 3 x 800 MW (i.e. 100% rated load of all the units) under rated steam conditions and at condenser pressure of 160 mm Hg (abs) with 0% make-up shall be guaranteed in line with the requirements stipulated in clause 1.01.08.02 of this sub section. Notes: (a) The 16000 hrs, as mentioned above for SCR/ Hybrid system efficiency and catalyst life, shall be based on actual running hours of operation of SCR system counted from the date of successful completion of 'Initial Operation' of unit or start of operation of SCR system on sustainable basis, whichever is later. (b) Power consumption of each of the pump/fan/compressors/ Conveyors etc. wherever mentioned shall be measured with its own drive at the switchgear end.			
	AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY-I GUARANTEES If the performance guarantee(s) specified at clause 1.01.01 are not met by the Contractor even after the modifications and/or replacements mentioned at clause 1.00.01 of this Sub-section but are achieved within the stipulated Acceptable Shortfall Limit as indicated in this clause, Employer will accept the equipment/system/plant after levying liquidated damages as indicated here under, however, if the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, the Employer may at his discretion reject the			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 7 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES																															
	equipment/system and recover the payment already made or accept the equipment/system only after levying liquidated damages against the Contractor, at the rates listed herein, and such liquidated damages shall be deducted from the Contract Price: <table><tr><th>S. No</th><th>Guarantee</th><th>Rate of Liquidated Damages (LD)</th><th>Acceptable Shortfall with LD</th></tr><tr><td>i)</td><td>For Increase in the Guaranteed Unit Heat rate</td><td></td><td></td></tr><tr><td></td><td>a) At 100% TMCR (800 MW) Unit Load</td><td>US \$ 322,952 (US Dollar Three hundred twenty two thousand nine hundred fifty two only) per 1 Kcal/Kwhr increase in heat rate</td><td>(+) 2.5% of the guaranteed Unit heat rate</td></tr><tr><td></td><td>b) At 75% TMCR (600 MW) Unit Load</td><td>US \$ 242,214 (US Dollar two hundred forty two thousand two hundred fourteen only) per 1 Kcal/Kwhr increase in heat rate</td><td>(+) 2.5% of the guaranteed Unit heat rate</td></tr><tr><td>ii)</td><td>For deficiency in Turbine Generator Output</td><td>US \$ 1097 (US Dollar one thousand ninety seven only) per 1 KW shortfall in TG output</td><td>(-) 2.0% of the guaranteed turbine generator output.</td></tr><tr><td>iii)</td><td>For deficiency in condenser pressure</td><td>US \$ 657,355 (US Dollar Six hundred fifty seven thousand three hundred fifty five only) per 1 mm Hg increase in condenser pressure</td><td>(+) 2.5% of the guaranteed condenser pressure</td></tr><tr><td>iv)</td><td>Steam Generator Capacity For shortfall in the guaranteed steam generating capacity in T/h at rated steam parameters at superheater outlet &</td><td>US \$ 137,021 (US Dollar One hundred thirty seven thousand twenty one only) for every 1 T/hr short fall in steam output from the guaranteed value.</td><td>(-) 1.0% of the guaranteed steam generator capacity</td></tr></table>				S. No	Guarantee	Rate of Liquidated Damages (LD)	Acceptable Shortfall with LD	i)	For Increase in the Guaranteed Unit Heat rate				a) At 100% TMCR (800 MW) Unit Load	US \$ 322,952 (US Dollar Three hundred twenty two thousand nine hundred fifty two only) per 1 Kcal/Kwhr increase in heat rate	(+) 2.5% of the guaranteed Unit heat rate		b) At 75% TMCR (600 MW) Unit Load	US \$ 242,214 (US Dollar two hundred forty two thousand two hundred fourteen only) per 1 Kcal/Kwhr increase in heat rate	(+) 2.5% of the guaranteed Unit heat rate	ii)	For deficiency in Turbine Generator Output	US \$ 1097 (US Dollar one thousand ninety seven only) per 1 KW shortfall in TG output	(-) 2.0% of the guaranteed turbine generator output.	iii)	For deficiency in condenser pressure	US \$ 657,355 (US Dollar Six hundred fifty seven thousand three hundred fifty five only) per 1 mm Hg increase in condenser pressure	(+) 2.5% of the guaranteed condenser pressure	iv)	Steam Generator Capacity For shortfall in the guaranteed steam generating capacity in T/h at rated steam parameters at superheater outlet &	US \$ 137,021 (US Dollar One hundred thirty seven thousand twenty one only) for every 1 T/hr short fall in steam output from the guaranteed value.	(-) 1.0% of the guaranteed steam generator capacity
S. No	Guarantee	Rate of Liquidated Damages (LD)	Acceptable Shortfall with LD																													
i)	For Increase in the Guaranteed Unit Heat rate																															
	a) At 100% TMCR (800 MW) Unit Load	US \$ 322,952 (US Dollar Three hundred twenty two thousand nine hundred fifty two only) per 1 Kcal/Kwhr increase in heat rate	(+) 2.5% of the guaranteed Unit heat rate																													
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iii)	For deficiency in condenser pressure	US \$ 657,355 (US Dollar Six hundred fifty seven thousand three hundred fifty five only) per 1 mm Hg increase in condenser pressure	(+) 2.5% of the guaranteed condenser pressure																													
iv)	Steam Generator Capacity For shortfall in the guaranteed steam generating capacity in T/h at rated steam parameters at superheater outlet &	US \$ 137,021 (US Dollar One hundred thirty seven thousand twenty one only) for every 1 T/hr short fall in steam output from the guaranteed value.	(-) 1.0% of the guaranteed steam generator capacity																													
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 8 OF 98																												

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
	S. No	Guarantee	Rate of Liquidated Damages (LD)	Acceptable Shortfall with LD
		rated steam temperature at reheater outlet (with any combination of mills working as per Employer's choice) with the coal being fired from within the range specified		
	v)	Coal Pulveriser Wear Parts Warranty Life of Coal Pulveriser wear parts in hours of operation	To be calculated as per clause 1.01.04 of this subsection.	(-) 500 hours
	vi)	SCR/ Hybrid (SCR+SNCR) Efficiency for Control of NOx Emission For shortfall in SCR efficiency for control of NOx emission in percentage point under condition stipulated in clause 1.01.01 (vi) of this Sub Section of Technical Specification	US \$ 136,643 (US Dollar One hundred thirty six thousand six hundred forty three only) for every 1% point shortfall in SCR/ Hybrid (SCR+SNCR) efficiency from the guaranteed value	(-) 10% points from the guaranteed value
	vii)	Shortfall in Catalyst Life For shortfall in catalyst life in hrs under condition stipulated in clause 1.01.01 (vii) of this Sub Section of Technical Specification	US \$ 40,976 (US Dollar Forty thousand nine hundred seventy six only) for every 100 hours shortfall in catalyst life from the guaranteed value	(-) 15% from the guaranteed value
	viii)	Ammonia Consumption Rate For increase in ammonia consumption rate (in Kg/hr/unit, 99.5wt %) under condition stipulated in	US \$ 74,521 (US Dollar Seventy four thousand five hundred twenty one only) for every 1 Kg/hr increase in ammonia consumption	(+) 10% of the guaranteed ammonia consumption
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 9 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
	S. No	Guarantee	Rate of Liquidated Damages (LD)	Acceptable Shortfall with LD
		clause 1.01.01 (viii) of this Sub Section of Technical Specification	rate from the guaranteed value	
	ix)	Urea Consumption Rate For increase in urea consumption rate (in Kg/hr/unit) under condition stipulated in clause 1.01.01 (ix) of this Sub Section of Technical Specification	US \$40,914 (US Dollar Forty thousand nine hundred fourteen only) for every 1 Kg/hr increase in urea consumption rate from the guaranteed value.	(+) 10% of the guaranteed urea consumption
	x)	DM water Consumption Rate For increase in DM water consumption rate (in ton/hr/unit) under condition stipulated in clause 1.01.01 (x) of this Sub Section of Technical Specification	US \$8,989 (US Dollar Eight thousand nine hundred eighty nine only) for every 1 ton/hr increase in DM water consumption rate from the guaranteed value	(+) 10% of the guaranteed DM water consumption
	xi)	ESP Efficiency For shortfall in guaranteed ESP efficiency in percentage points under conditions specified at clause 1.01.01 (xi) of this sub section	US \$ 1,354,181 (US Dollar One million three hundred fifty four thousand one hundred eighty one Only) for every 0.01% point shortfall in ESP Efficiency from the guaranteed value.	(-) 0.05% point from the guaranteed ESP efficiency
	xii)	FGD SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under condition stipulated in clause 1.01.01 (xii) of this Sub Section of Technical Specification	US \$ 50,854 (US Dollar Fifty thousand eight hundred fifty four only) for every 0.1% point shortfall in guaranteed SO2 removal efficiency	(-) 0.25% points from the guaranteed SO ₂ removal efficiency
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 10 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
	S. No	Guarantee	Rate of Liquidated Damages (LD)	Acceptable Shortfall with LD
	xiii)	Limestone Consumption Rate For increase in limestone consumption of FGD system in kg/hr/unit under condition stipulated in clause 1.01.01 (xiii) of this Sub Section of Technical Specification	US \$ 263,017 (US Dollar Two hundred sixty three thousand seventeen only) for every 100 Kg/hr increase in limestone consumption rate from the guaranteed value	(+) 10% of the guaranteed limestone consumption
	xiv)	Auxiliary power consumption for unit auxiliaries For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 1.01.01 and 1.01.08.01 of this sub section	US \$ 3025 (US Dollar Three thousand twenty five only) per 1 KW increase in Auxiliary Power Consumption	(+) 1.0% of the guaranteed Auxiliary Power Consumption.
	xv)	Auxiliary power consumption for station auxiliaries For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 1.01.01 and 1.01.08.02 of this sub section	US \$ 3025 (US Dollar Three thousand twenty five only) per 1 KW increase in Auxiliary Power Consumption	(+) 1.0% of the guaranteed Auxiliary Power Consumption.
NOTE: i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable. ii) If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract. iii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2		SUB-SECTION-IV FUNCTIONAL GUARANTEES PAGE 11 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
1.01.03	Contract (GCC)/ Special Conditions of Contract (SCC) iv) Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price. v) The LD values and acceptable shortfall limits are applicable on per unit basis except for the value indicated for auxiliary power consumption for station auxiliaries, which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies. UNIT HEAT RATE Tests for Turbine Cycle Heat Rate and Efficiency of Steam Generator shall be conducted simultaneously but independently and Unit Heat Rate is to be computed as follows: Unit Heat rate in kcal/kWhr under rated steam conditions at 160 mmHg(abs) Condenser pressure with zero make up at 800 MW unit load (i.e. 100% of rated load): $= \frac{\text{THR (100\%)}}{\text{SG_EFF(100\%)}}$ Unit Heat rate in kcal/kWhr under rated steam conditions at 160 mmHg(abs) Condenser pressure with zero make up at 600 MW unit load (i.e. 75% of rated load): $= \frac{\text{THR (75\%)}}{\text{SG_EFF(75\%)}}$ Where THR (100%) : Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 160 mmHg(abs) Condenser pressure with zero make up at 800 MW unit load (i.e. 100% of rated load). (To be calculated as per clause 1.01.03.01 of this sub-section) SG_EFF(100%): Efficiency of the Steam Generator at 800 MW unit load (i.e. 75% of rated load) with 27 degree Celsius ambient temperature and 60% RH, while firing the design coal, at rated steam parameters, rated coal fineness and rated excess air. (To be calculated as per clause 1.01.03.03 of this sub-section). The efficiency shall be based on Heat Input GCV of coal. THR (75%) : Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 160 mmHg(abs) Condenser pressure with zero make up at 600 MW unit load (i.e. 75% of rated load). (To be calculated as per clause 1.01.03.01 of this sub-section)			
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2 SUB-SECTION-IV FUNCTIONAL GUARANTEES PAGE 12 OF 98		

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1.01.06.05	Further, during the performance test of the Electrostatic Precipitator, if the contractor establishes that the average of three tested outlet dust burden (Do) values (uncorrected) are either equal to or less than 14 mg/Nm3 at ESP outlet before FGD system inlet, then the contractor shall also be deemed to have successfully met the guaranteed ESP efficiency.			
1.01.07	METHOD OF COMPUTING TEST EFFICIENCY OF FGD The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code. The details of the test shall, however be mutually agreed upon between the employer and the contractor.			
1.01.08	AUXILIARY POWER CONSUMPTION The respective auxiliary power consumption for unit and the station are to be calculated in isolation to calculate the respective guaranteed power consumption as is illustrated hereunder:			
1.01.08.01	Unit Auxiliary Power Consumption The unit auxiliary power consumption shall be calculated using the following relationship. Pau = Pu + TL (Unit) Pau = Guaranteed Unit Auxiliary Power Consumption. Pu = Power consumed by the auxiliaries of the unit under test. TL = Losses of the Generator Transformer and Unit Transformers supplied by bidder based on works test reports and the criteria specified under the Clause 1.01.08.02 (j) under the subheading Transformers. The power consumption (Pu) of entire unit auxiliaries fed from unit transformers shall be measured at the incomers of respective unit boards. Suitable correction for auxiliaries not in service at the time of this measured power consumption like MDBFP etc, shall be done on as per the technical specification. If GCB scheme is adopted, suitable corrections for station auxiliaries shall be done. While guaranteeing the auxiliary power consumption the bidder shall necessarily include all continuously operating unit auxiliaries. The auxiliaries to be considered shall include but not be limited to the following: (a) Turbine Unit Oil purifier. (b) Turbine Unit control oil purifier.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 24 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	(c) Electric oil heater for turbine lube oil tank (rated power shall be considered). (d) Feed and discharge pumps of turbine oil purification system. (e) Main turbine Condenser air evacuation pumps. (f) Air Cooled Condenser fans. (g) Condensate extraction pumps. (h) Drip pump (if envisaged). (i) Hydrazine dosing pumps (if required). (j) Ammonia dosing pumps (if required). (k) Oil purifiers of 2x50% TDBFPs and their feed and discharge pumps. (l) Lube oil pumps of 2x50% TDBFPs and the electrical oil heater for lube oil. (m) Auxiliary oil pump for MDBFP. (n) Oil pumps for HP-LP bypass system. (o) Motor Driven Boiler Feed Pump (For this purpose only 15% of the power consumed by the MDBFP and MDBP at design point as determined during shop test shall be considered). (p) DM Cooling (normally working) Water pumps to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling (Unit auxiliaries) water system. (q) Auxiliary Cooling (normally working) water pumps to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system. r) Mills. s) PA Fans. t) FD Fans. u) ID Fans. v) Air Heaters.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 25 OF 98

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	w) Coal Feeders. x) Steam Generator Start up drain recirculation Pumps (If required). y) Seal Air Fans. z) Lube oil pumps for fans/ Air heaters & mill system etc. aa) Scanner air fans. ab) • SCR System: i. Selective Catalytic Reduction (SCR) System is in service and SCR bypass gate in closed condition. SCR with cyclone separator including all heaters, dilution air fan etc. ii. Ammonia unloading handling and storage system, power consumption for continuous operating auxiliaries for unit operation at 100% TMCR. • HYBRID (SCR+SNCR) SYSTEM: i. Selective Catalytic Reduction (SCR) and Selective Non Catalytic Reduction (SNCR) System are in service and SCR bypass gate in closed condition. SCR with cyclone separator including all heaters, dilution air fan etc. ii. Urea unloading, handling and storage system and urea to ammonia convertor power consumption for continuous operating auxiliaries for unit operation at 100% TMCR. ac) Electrostatic Precipitator with all TR sets , all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes working and rapping system in normal operation. During the test all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes will be kept in continuously ON condition at 100% duty condition and set point temperature shall be kept 5 degree Celsius above the flue gas temperature. (Refer Note 3 below) ad) Gas Recirculation Fan (if applicable) ae) FGD System			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 26 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	i. Absorber Recirculation Pump(s) ii. Absorber Oxidation Air Blower(s)/Compressor(s) iii. Absorber Oxidation Tank Agitators iv. Gypsum Bleed Pumps v. Limestone Slurry Pump(s) vi. Process water pump(s) vii. Mist Eliminator Wash Water pump(s) viii. Booster Fans in case Booster Fan is provided by the Contractor. af) Power consumption of fans of Air washer units for TG building and fans of air filtration units for ESP and FGD buildings at its rated duty point to be arrived based on shop test. ag) Power consumption of any other continuously operating auxiliary for unit operation at 100% TMCR. ah) GCB Losses of Unit : Losses and fan power for Generator Circuit Breaker (if applicable) Note : 1. The bidder shall furnish a list of equipments to be covered under Unit auxiliary power consumption, which shall be subject to Employer's approval. 2. The bidder shall ensure that power supply to all such equipments to be covered under unit auxiliary power consumption is fed from unit board of the respective unit. 3. Power consumption of Air Cooled Condenser Fans shall be taken at 840 MW (i.e. 105% rated load) under rated steam conditions, guaranteed condenser pressure and ambient temperature of 38 deg.C. 4. Method of Computation of Auxiliary Power consumption for ESP:- The measurement for guaranteed auxiliary power consumption shall be carried out during ESP collection efficiency test. The method for computing the power shall be as described below:- a) Power consumption of ESP will be measured pass wise and for one pass (Say ESP-A) at a time with the help of energy meter in ESP MCC.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 27 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
1.01.08.02	b) Energy meter reading will be taken before starting the collection efficiency test and after completion of collection efficiency test. c) Before starting collection efficiency test, switch off all the TR sets, all hopper heaters, all insulator heaters/pent house fans (if applicable) and rapping systems serving to one pass (ESP-A) temporally and note down energy meter readings for period t1 i.e. E1. The power consumption shall be $W2=E2/t1$. d) During the collection efficiency test the total energy fed in to ESP MCC of one pass (say ESP-A) will be measured during entire period of collection efficiency test i.e. E2. Total time period (t2) of test shall be noted. The power consumption shall be $W2=E2/t2$. During the test all hopper heaters of all ESP passes will be in ON condition and set point temperature shall be kept 5 degree Celsius above the flue gas temperature. e) Measured power consumption for one ESP pass (say ESP-A)=(W2-W1) f) Measured Electrostatic Precipitator power of one unit= Power of (ESP-A + ESP-B + ESP-C + ESP-D + ESP-E + ESP-F).			
	Station Auxiliary Power Consumption The station auxiliary power consumption shall be calculated using the following relationship. $P. Stn = Pau. Stn + T_{L - Stn}$ $Pau. Stn = \sum (P_i \times D_i)$ Where, P. Stn = Power consumed by the station auxiliaries Pau. Stn = Total Power Consumption, while running at 100% design load for all the auxiliaries of the station supplied by bidder. P_i = Power consumed by each station auxiliary. D_i = Duty factor to be considered for each station auxiliary. $T_{L - Stn}$ = Transformer Losses of the station/standby/startup transformers for meeting the station auxiliary power supply and that of any other transformer supplied by the bidder based on work test report.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 28 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES	एन टी पी सी NTPC																		
	Losses of all transformers included in bidder's scope, based on the works test reports as per the criteria specified under Clause 1.01.08.02 (j) under the subheading Transformers, associated with station auxiliary power supply distribution system (excluding those included in Unit system like GT, UT etc.) shall be included. While guaranteeing the station auxiliary power consumption the bidder shall necessarily include all the station auxiliaries <u>running at full load</u> with duty factors as have been defined at the ensuing para of this chapter. The station auxiliaries that shall be running during the guarantee test for calculating " Pau. Stn " shall include but not be limited to the following: (Where duty factor is not indicated the same is to be considered as 1.0) a) Plant & Instrument air compressors & Air drying plant Power consumption of:- <table><tr><td>i)</td><td>Instrument Air compressor</td><td>2 Nos.</td><td>Duty Factor =0.6</td></tr><tr><td>ii)</td><td>Plant Air compressor</td><td>2 Nos.</td><td>Duty Factor = 0.33</td></tr><tr><td>iii)</td><td>Air Drying plant (Heaters) (if applicable)</td><td>2 Nos.</td><td>Duty Factor =0.5</td></tr><tr><td>iv)</td><td>Air Drying plant (Blowers) (if applicable)</td><td>2 Nos.</td><td>Duty Factor = 1.0</td></tr></table> Power consumption at rated duty point for compressors to be arrived based on shop test and power consumption at rated duty point for Air Drying plant to be arrived based on site test. b) Air Conditioning System & Ventilation System Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of Chilling machines, Chilled water Pumps, Condenser water Pumps, Air handling unit (AHU) fans, for the Air conditioning system of main plant building, Ash handling control room, Ash handling VFD room, FGD control room, ESP control room of each units, switchyard (GIS building), service building, administrative building and Canteen building. Power consumption at rated duty point for Air cooled & water cooled chiller shall be based on site test and for other drives like chilled water pumps, Condenser water Pumps & AHU fans shall be based on shop test.	i)	Instrument Air compressor	2 Nos.	Duty Factor =0.6	ii)	Plant Air compressor	2 Nos.	Duty Factor = 0.33	iii)	Air Drying plant (Heaters) (if applicable)	2 Nos.	Duty Factor =0.5	iv)	Air Drying plant (Blowers) (if applicable)	2 Nos.	Duty Factor = 1.0			
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 29 OF 98																

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	Note: 33.33% of the total auxiliary power consumption of air-conditioning system as specified at above shall be considered for Unit#1, 33.33% for Unit#2 and balance 33.34% for Unit#3. c) Hydrogen Generation Plant One third (33%) of power consumption of one stream of hydrogen generation plant shall be based on shop test) d) FGD System i. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries ii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries iii. Booster water pump iv. Waste water pump v. Limestone Slurry Tank Agitators vi. Filtrate Pump(s) vii. Belt Filter Wash Water Pump viii. Hydro-cyclone Waste Water Sump Pump and Waste Water Pump ix. all other continuous running Agitators e) Auxiliary Water System Pumps (Working Pumps) i. Makeup (Clarified water) water pump (if applicable) ii. AC & Ventilation system make-up pumps. iii. DM water make up pump iv. Potable water pumps v. Filtered water feed pumps for DM plant vi. Degassed water pump (if applicable) vii. High pressure pumps for RO based DM plant (if applicable)			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 30 OF 98	

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
1.02.00	<u>GUARANTEES UNDER CATEGORY - II</u> NOT USED			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 34 OF 98

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES		
	<u>GUARANTEES UNDER CATEGORY – III</u>		
1.03.00	The parameters/capabilities to be demonstrated for various systems/ equipments shall include but not be limited to the following:		
1.03.01	Noise All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in General Technical Requirement, Part-C Section-VI of the technical specifications. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.		
1.03.02	Steam Turbine and Auxiliaries		
	Turbine hall and other EOT Crane :		
	Over load test, travel & hoist speed checks etc., shall be demonstrated as per IS: 3177 (latest edition).		
1.03.03	Steam Generator and Auxiliaries		
	Category-III Guarantees of this sub-section for various systems/ equipment for steam generator and auxiliaries shall be based on and demonstrated corresponding to ambient air condition of 27 deg. C temperature & 60% RH.		
	(i) Coal Pulverizer capacity at rated fineness		
	Performance testing shall be conducted on coal pulverizers toward		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID Doc. No.- CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES PAGE 35 OF 98

CLAUSE NO.	GUARANTEE TEST PROCEDURE											
	ANNEXURE – IIA FORMAT FOR SUBMISSION OF GUARANTEE TEST PROCEDURE <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="384 481 647 680"> Clause No. as per LOA/ Tech. Specs. </th> <th data-bbox="647 481 879 680"> Provision of LOA / Tech. Specs. </th> <th data-bbox="879 481 1121 680"> Name and Methodology of Test proposed by Vendor </th> <th data-bbox="1121 481 1353 680"> NTPC comments on the tests proposed by vendor </th> </tr> </thead> <tbody> <tr> <td data-bbox="384 680 647 1691"></td> <td data-bbox="647 680 879 1691"></td> <td data-bbox="879 680 1121 1691"></td> <td data-bbox="1121 680 1353 1691"></td> </tr> </tbody> </table>				Clause No. as per LOA/ Tech. Specs.	Provision of LOA / Tech. Specs.	Name and Methodology of Test proposed by Vendor	NTPC comments on the tests proposed by vendor				
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A Bidding Doc No CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 86 OF 98									

CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A Bidding Doc No CS-9585-001-2	SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 87 OF 98	

CLAUSE NO.	GUARANTEE TEST PROCEDURE																												
	APPENDIX-IV GUARANTEE TEST PROFORMA POWER MEASUREMENT Project : Package : Date : 1. Equipment/Stream Composition : 2. Motor Description : 3. Sr. No. of meters used : 4. Date of Calibration of instrument and name of test house : 5. Multiplying factor (M.F.) of the wattmeter : 6. Wattmeter Readings (to be taken at 1 minute intervals) : <table border="1"> <thead> <tr> <th rowspan="2">Sl. No.</th> <th rowspan="2">Measure ment Terminal Location</th> <th rowspan="2">Time</th> <th rowspan="2">Votage (Volts)</th> <th rowspan="2">Curren t (amps)</th> <th colspan="2">kw Reading M.F.</th> <th rowspan="2">Total (W1+W2) MF kw</th> <th rowspan="2">Remarks</th> </tr> <tr> <th>W1</th> <th>W2</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>									Sl. No.	Measure ment Terminal Location	Time	Votage (Volts)	Curren t (amps)	kw Reading M.F.		Total (W1+W2) MF kw	Remarks	W1	W2									
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)			TECHNICAL SPECIFICATIONS SECTION – VI, PART-A Bidding Doc No CS-9585-001-2			SUB-SECTION-IV FUNCTIONAL GUARANTEES		PAGE 90 OF 98																					

CLAUSE NO.	GUARANTEE TEST PROCEDURE एन टी पी सी NTPC																			
	APPENDIX-V																			
	GUARANTEE TEST PROFORMA VIBRATION LEVEL MEASUREMENTS Project : Package : Date : Time : Details of vibration Level Meter 1. Make 2. Model & SI.No. 3. Date of calibration with name of Test House <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <th rowspan="2" style="width: 10%;">SI.No.</th> <th rowspan="2" style="width: 20%;">Equipment</th> <th rowspan="2" style="width: 10%;">Pick *Point</th> <th colspan="3" style="width: 60%;">Vibration level Amplitude/Velocity</th> </tr> <tr> <th style="width: 20%;">Horizontal Micron/ mm/ sec.</th> <th style="width: 20%;">Vertical micron/ mm/sec.</th> <th style="width: 20%;">Axial Micron / mm/sec.</th> </tr> <tr> <td style="height: 40px;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> * Reading shall be taken at all the bearings of motor, gear box and driven equipment. In case of conveyor galleries, vibrations shall be measured at min. three locations, at midpoint of stringer between two short supports. NTPC Contractor					SI.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity			Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.						
SI.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity																	
			Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.															
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A Bidding Doc No CS-9585-001-2		SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 92 OF 98															

CLAUSE NO.	GUARANTEE TEST PROCEDURE 																
	APPENDIX-VI GUARANTEE TEST PROFORMA NOISE LEVEL MEASUREMENT Project: Package : Date : Details of Sound Level Meter 1. Make 2. Model 3. Date of calibration with name of Test House <table border="1"> <thead> <tr> <th>Sl.No</th> <th>Equipment with location</th> <th>Equipment load/capacity</th> <th>Measurement* point no.</th> <th>Sound level dBA.</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> NTPC Contractor * For each equipment location, a Projected Plan Diagram shall be made and the location of measurement points shall be identified.					Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks						
Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks												
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-1 (3X800 MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A Bidding Doc No CS-9585-001-2		SUB-SECTION-IV FUNCTIONAL GUARANTEES	PAGE 93 OF 98												



TITLE:

**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I, SUB-SECTION-C2C

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

CUSTOMER SPECIFICATION: PAINTING SPECIFICATION

SUB – SECTION – A-12

SURFACE PREPARATION & PAINTING

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			
1.00.00	SPECIFICATION OF SURFACE PREPARATION & PAINTING			
1.01.00	Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.			
1.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.			
1.03.00	Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.			
1.04.00	All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering.			
1.05.00	SURFACE PREPARATION			
1.05.01	All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents.			
1.05.02	The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.			
	SP1	Solvent cleaning		
	SP2	Application of rust converter (Ruskil or equivalent grade)		
	SP3	Power tool cleaning		
	SP4	Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)		
	SP4*	Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns		
	SP5	Shot blasting/ abrasive blasting.		
	SP6	Emery sheet cleaning/Manual wire brush cleaning.		
1.06.00	APPLICATION OF PRIMER/PAINT			
1.06.01	The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.			
1.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.			
1.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day			
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-12 SURFACE PREPARATION & PAINTING
Page 1 of 9				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.04	as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.			
1.06.05	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured. Following are the Primer/painting schemes envisaged herein: PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104. PS3* - Zinc Chrome primer (Alkyd base) by dip coat. PS4 - Synthetic Enamel (long oil alkyd) to IS2932. PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744 PS9 - Aluminium paint to IS 2339. PS9* - Heat resistant Aluminium paint to IS-13183 Gr.-1 PS13 - Rust preventive fluid by spray, dip or brush. PS14 - weldable primer-Deoxaluminat or equivalent. PS16 - High Build Epoxy CDC mastic `15' . PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.) PS18 - Epoxy based TiO2 pigmented coat PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=40.0(min.) PS-20 - Epoxy based finish paint			
1.06.06	All weld edge preparation for site welding shall be applied with one coat of weldable primer.			
1.06.07	For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.			
1.06.08	SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.			
1.06.09	a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron. The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner: ▪ Primer coat – Epoxy based zinc phosphate ▪ Intermediate - Epoxy based TiO2 pigmented coat ▪ Finish coat - Epoxy based finish coat b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron. c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard			
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-12 SURFACE PREPARATION & PAINTING	Page 2 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.10	A) Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows: Primer : One coat of unmodified epoxy resin along with polyimide hardener. Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct hardener. Total thickness of primer and paint should not be less than 400 microns.			
	B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows: i) For Indoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be done either manually or by any other approved method. (b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns. (c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns. (d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns. Total DFT of paint system shall not be less than 150 microns. ii) For Outdoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard. (b) Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (d) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided. The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied. Total DFT shall not be less than 300 microns.			
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-12 SURFACE PREPARATION & PAINTING	Page 3 of 9



- ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

F) FGD System

- (i) Surface preparation shall be blast cleaned conforming to Sa 2-1/2 Swiss Standard.
- (ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.
- (iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.
- (iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided.

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	BID DOC. NO. CS-9585-001-2	TECHNICAL SPECIFICATIONS SECTION VI, PART-B	TECHNICAL REQUIREMENTS	SUB-SECTION -A-12 Surface Preparation & Painting	Page 9 of 9
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Reference: null109:6559

Date:04-12-19

From:	B DASH AGM	To:	BHEL BHEL sirifort New delhi
		CC:	Gauravbhatia@bhel.in sajal@bhel.in pmgrishipal@bhel.in
SUBJECT : PSTPP, EPC-FGD Please find enclosed following drawings/documents for necessary action at your end as indicated in purpose code.			
VENDOR DRG NO:	null		
NTPC DRG NO:	9585-001-109-PVM-H-001		
REVISION NO:	07		
DRG TITLE:	Painting schedule of FGD System		
APP CATEGORY:	I		
RELEASE DATE:	04-12-19		
COMMENTS:	No comments.		



Engineering Division
ISO 9001:2008 Certified

अभियंत्रिकी कार्यालय परिसर, प्लॉट नं.- ए 8ए, सेक्टर-24, पोस्ट बॉक्स नं.- 13, नोएडा (उ प्र) पिन-201 307
टेलिफोन नं.- 0120-2410333, 2410116 फैक्स-0120-2410136, 2410137
पंजीकृत कार्यालय: एनटीपीसी भवन, स्कोप कॉम्प्लेक्स, 7 इंस्टीट्यूशनल एरिया, लोधी रोड, नई दिल्ली-110 003
टेलिफोन नं.- 011-24361018 फैक्स-011-24361018, वेबसाइट: www.ntpc.co.in
ENGINEERING OFFICE COMPLEX, Plot No: A-8A, Sector-24, Post Box No: 13, Noida (UP), Pin-201 307
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Telephone No: 011-24360100 Fax-011-24361018, Website: www.ntpc.co.in

 RANIPET	Bharat Heavy Electricals Limited Boiler Auxiliaries Plant Ranipet – 632 406		BHEL DOC NO.	PS : PATR :FGD: R4R3-R4S4
			REVISION NO.	07
			DATE	25.11.2019

PATRATU STPP FGD PACKAGE

PAINTING SCHEME for FGD SYSTEM, GATES& DAMPERS
NTPC CONTRACT NO: 01/PVUNL-CS-9585-001-2/N0A-SC
NTPC DRG NO: 9585-001-109-PVM-H-001

BHEL RANIPET Customer No(s).: R4R3, R4S3-R4S4

Prepared By	Reviewed & Approved By
 Rajamanickam M Dy. Mgr/QA	 Signature K.C. Narayana Kumar Digitally signed by K.C. Narayana Kumar Date: 2019.12.04 15:00:05 IST Reason: CAT I Location: NTPCEOC

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

RECORD OF REVISION

REV NO		DATE	DETAILS OF REVISION					
00		25.08.2018	Original Issue - First Submission					
			Revised Issue NTPC comments: This document can be reviewed in totality after receipt of inputs on FGD system. Any equipment detail and any missing equipment can be reviewed only after receiving of basic drawings of FGD system BHEL reply: We wish to submit that the painting scheme was prepared after taking all the inputs from Engg in the form of PGMA release. Hence there will not be any equipment missed. Also Engg has confirmed that it has started the submission of basic documents. NTPC comments: SI no: 09 of FGD, what all items are covered under emergency quench system? Kindly mention here BHEL reply: Items covered under the emergency quench system are mentioned in the PGMA details at the end of the document. NTPC comments: SI no: 10 of FGD, kindly include details of items covered under air oxidation system BHEL reply: Items covered under air oxidation system are mentioned in the PGMA details at the end of the document. NTPC comments: SI no: 11 of FGD, kindly include details of items covered under oxidation air distribution system BHEL reply: Items covered under the oxidation air distribution system are mentioned in the PGMA details at the end of the document. NTPC comments: SI no: 12 of FGD, Description not clear. Kindly give detail & Indicate temperature & Primer paint BHEL reply: Expansion joint comes in the bypass ducts. It is of straight pieces without any round corner joints. It is of metallic in construction. The items covered in the PGMA are mentioned in the PGMA details at the end of the document. Temperature and primer paint is changed as per comments and finish paint is incorporated. NTPC comments: SI no: 13 of FGD, Description not clear. Kindly give detail& indicate temperature & primer paint BHEL reply: Expansion joints between scrubbers comes in the absorber region. It is of non-metallic in construction. The reason for giving painting is that items like flanges and sleeves are envisaged in this PGMA, hence painting is given. Temperature is indicated in the document. Primer paint is changed as per comments and finish paint incorporated. NTPC comments: SI no: 14&15 of FGD, Indicate temperature ad primer and finish paints BHEL reply: Temperature, Primer and finish paints are incorporated in the document. NTPC comments: SI no: 16, 17, 19, 23, 29,30,34, 37 of FGD, comments on paints BHEL reply: Comments on paints are incorporated in all the above si nos. Also since as per spec for civil works, finish coat of 70 microns only specified, hence finish DFT of 70µ and Total DFT of 245µ is indicated. NTPC comments: SI no: 21, 27, 32 of FGD, Furnish details BHEL reply: Details of all PGMA's are mentioned at the end of the document.					
01		06.12.2018						

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02	11.01.2019		NTPC comments: SI no: 4& 5 Give details surface finish and primer on inside surfaces					
			BHEL reply: Incorporated in the document.					
			NTPC comments: PHC, SHC & Vacuum Belt Filter related items to be covered.					
			BHEL reply: Incorporated in the document.					
			NTPC comments: Blower with motor, is it seal air fan, kindly give basis for painting of this item; Motor paint will be RAL 5012.					
			BHEL reply: It is seal air fan as it supplies seal air. Motor paint shade will be RAL 5012 only which will be indicated by the electrical group in the drawing. The basis for selecting the paint is as per Sub- Section A-12, B) Steam generator and Auxiliaries and Clause 20.03.00 of Part- C Section VI. Since it is under auxiliaries, we have chosen this painting. Also the surfaces are less than 95°C. Hence we request you to retain the same painting specification.					
			NTPC comments: Furnish paint details of major electrical equipment like motors, Transformers, bus duct, MCC & control panels, cable trays etc					
			BHEL reply: Electrical items are bought out items and therefore the painting specification will be given by respective Engg group as per the tender specification in the drawing itself which will be submitted to NTPC for approval. Therefore, the painting of electrical items is not covered under this painting scheme. This is the practice which is being followed for Auxiliaries as well. Also we would like to state that same comment was given for Dadri FGD painting scheme and the above reply was also accepted by M/s NTPC. We request you to kindly accept our explanation and accord approval.					
03	30.01.2019		NTPC comments: Please include the surface coating and painting details for individual equipment of LHP/GHP					
			BHEL reply: We would like to state that scope of LHP, Limestone handling plant and GHP, Gypsum handling plant lies with BHEL, ISG, Bangalore. They will be submitting the separate painting scheme for the LHP and GHP. Also we would like to inform that all items pertaining to Ranipet scope of supply has been included in this painting scheme. We request you to kindly approve the painting scheme.					
			NTPC comments: The same has to be ensured and taken care in the respective equipment drawings.					
			BHEL reply: BHEL will ensure the same in the respective equipment drawings.					
			NTPC comments: SI no: 5& 7 of FGD, Inorganic ethyl zinc silicate primer to be applied as per spec requirement as proposed for all other items.					
			BHEL reply: Incorporated in the document.					
			NTPC comments: SI no: 24 of FGD, Other Items Blast cleaning					
			BHEL reply: Incorporated in the document.					
			NTPC comments: Please clarify whether SS lining is all around the cylindrical and conical portion of silo?					
			The inside painting of silo where SS lining is not provided shall be as per structural steel painting scheme					
			BHEL reply: SS lining is all around the conical portion of silo. For cylindrical portion- inside painting, primer as given for structural steel painting scheme is incorporated in the document.					
			NTPC comments: SI no: 39 to 41, Painting scheme to be followed as per (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9) in line with other FGD components. Details of related items to be included in the list.					
			BHEL reply: Incorporated in the document.					

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				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
03	30.01.2019		NTPC comments: SI no: 03 of Painting scheme to be followed as per (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9) in line with other FGD components. Motor paint RAL 5012 BHEL reply: We wish to state that the referred item is coming under gates and dampers which is part of auxiliaries and therefore painting under Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9 is considered. Also these components are sub-items to the main component. Hence we request you to accept the painting as mentioned under above spec. NTPC comments: Note 11 to be incorporated BHEL reply: Note incorporated in the document.					
04	18.02.2019		NTPC comments: Inside surface painting on silo (cylindrical portion) shall be as per outside surface painting scheme of Limestone silo BHEL reply: We wish to state that the painting envisaged is until erection only. Once the system is commissioned, paint will peel off completely and application of intermediate and finish paints will become redundant, therefore we have proposed only primer. Also primer given is of Inorganic Zinc silicate which offers superior protection against corrosion, abrasion and chemical resistance. Hence we request you to kindly consider and approve the painting envisaged. NTPC comments: Blast cleaning to be done. Is there any liner provided on mill inside surface? Inorganic ethyl zinc silicate primer to be applied as per spec requirement as proposed for all other items. BHEL reply: Blast cleaning is incorporated in the document. We wish to state that rubber liner is provided on the mill inside surface as per the specification. Primer paint of Epoxy zinc phosphate primer is envisaged as per the spec requirement vide clause Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9 . We request you to kindly accept our proposed painting and approve our document.					
05	05.03.2019		NTPC comments: As commented earlier, all painting coats on inside surface of silo (cylindrical portion) shall be same as per outside surface painting scheme of Limestone silo. BHEL reply: Based on NTPC directive, we have incorporated in the document. Kindly approve the document.					
06	25.10.2019		Revised Issue- New PGMAs added under FGD system and Engg has deleted some PGMAs too as they have been amalgamated, hence addition & deletion of new PGMAs done under SI nos: 2,3,5,7,11,13,15,20, 21,22, 23, 24, 28,29, 30, 34, 35, 36, 37, 38, 40, 41, 42, 46, 47& 48 under FGD and resubmitted for your kind approval. There is no change in the painting scheme, only the PGMAs are added/deleted under the above mentioned SI nos. We request you to kindly review and approve our painting scheme.					
07	25.11.2019		NTPC comments: SI no: 18 of FGD, earlier painting scheme as per S.N. 17 (PGMA 257) is different. BHEL reply: We wish to submit that the painting for PGMA 257 is same only. The commented SI no is SI no: 18 which is of duct structures hence painting as per Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03 is given. NTPC comments: Miscellaneous FGD system removed in this revision? Limestone silo accessories missing in this revision. BHEL reply: We wish to submit that our Engg has removed this PGMA as they have added the items under new PGMAs for which painting is given in SI no: 30 of this painting scheme. (FW 725 is Nozzles and Flanges which are Miscellaneous FGD items and FW 723& 724 are limestone silo accessories). We also wish to add that there is no change in the painting specification. Since many of the PGMAs are added and some are deleted, we have gone for this resubmission of the painting scheme. We request you to kindly approve the painting scheme.					

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		NTPC comments: PHC & SHC and accessories structural items missing in this revision. BHEL reply: Our Engg has amalgamated these PGMAs with FW 738 PGMA (Gypsum Belt filter and accessories). Hence those PGMAs are removed from the painting scheme. We wish to add that there is no change in the painting specification and same painting specification is only retained. We request you to kindly approve the painting scheme.						
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1. FGD SYSTEM

1	Slurry recirculation pump System (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 212	Blast Cleaning to SA 2 1/2 (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Light Blue, RAL 5012	75	300
2	Absorber System Internals – Structural items (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 213	Blast cleaning to Sa 2 1/2	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75	300
3	Mist eliminator and accessories, Absorber baffle grating support, Mist eliminator support& Absorber Spray pipe support - Structural items (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 215 FW 216 FW 217 FW 218	Blast cleaning to Sa 2 1/2	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75	300

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4	Absorber System- Base (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 219	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
5	Absorber system structures, Absorber shear plate, Hook up duct structure (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 220 FW 231 FW 238	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245

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6	Absorber system casing bottom (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03) Inside surfaces of Absorber casing top& bottom is lined with C-276 material, hence no paint is envisaged.	FW 221	Blast cleaning to Sa 2 1/2 (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
7	Absorber system casing top, Duct supports & Structures for RC pump house (Tec. Spec. Sec.VI, Part-B, Subsection- D-01, cl. 6.04.03)	FW 222 FW 232 FW 234 FW 236	Blast cleaning to Sa 2 1/2 (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
8	Absorber system accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 223	Blast Cleaning to SA 2 1/2 (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ	75 25	300

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11	Emergency quench system Handling Equipment RC pump (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 227 FW 249	Blast Cleaning to SA 2 1/2 (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002	75 25	300
12	Air oxidation system (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 230	Blast Cleaning to SA 2 1/2 (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002	75 25	300
13	Oxidation Air distribution system & Slurry distribution system, Absorber W/D interface and W/D wash system (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 228 FW 229 FW 243 FW 244	Blast Cleaning to SA 2 1/2 (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Sky blue, Shade no.101 of IS:5	75 25	300
14	Expansion joint between bypass (Inside)	FW 251	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (two coats)	60	NIL	--	60

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	(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9) Temp>60°C		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	40
15	Expansion joint between scrubbers	FW 252	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
	(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9) Temp>60°C		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	40
16	Ducts between bypass duct inlet& Absorber	FW 255	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
	(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9) Temp-150°C		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	40

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					PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
17	Ducts between Absorber & Stack (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9) Temp-60°C	Flue gas swept surface (Inside)	FW 257	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	40
18	Duct structure between by pass duct & Absorber (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)		FW 260	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE)	70	245

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19	Duct structure between Absorber & Stack (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 262	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245

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20	Foundation material for duct structures, Absorber, RC shed,tanks, pipe racks& Silo Structure	FW 280 FW 281 FW 282 FW 283 FW 740 FW 760 FW 762 FW 763		Temporary rust preventive fluid application as per PRQA 523 DFT- 20µ All Threaded and other surfaces of foundation bolt and its materials shall be coated with temporary rust preventive fluid. During execution of civil works the dried film of coating will be removed using Organic Solvents.				
21	Structures for Elevator& Supporting structures for Emergency Quench Water Tank (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 285 FW 292	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 			

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23	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.08, 6.04.09)	FW 237 FW 610 FW 612 FW 613 FW 722	Gratings- Blast cleaning to Sa 2½	Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (minimum)				
24	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks – Structures other than the above (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 237 FW 610 FW 612 FW 613 FW 722	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
25	Slurry pumps & accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 701	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ	75	300

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				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				intermediate paint pigmented with MIO/TiO ₂ DFT- 100µ		Shade: Light Blue, RAL 5012		
26	Water pumps & accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 702	Blast Cleaning to SA 2 1/2 (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO ₂ DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Light Blue, RAL 5012	75 25	300
27	Monorail for hoist & cranes (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 710	Blast cleaning to Sa 2 1/2 (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
28	Handling Equipment in FGD (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 713 FW 714	Blast Cleaning to SA 2 1/2 (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO ₂ DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002	75 25	300

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
29	Man hole door & Viewing ports (Tec. Spec Sec VI, Part B, Subsection A-12 Page 6 of 9)	FW 239 FW 717	Power Tool Cleaning to st3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
30	Agitator support, Air cannon silo, Bag filter and fan assy silo and Nozzles and Flanges (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 721 FW 723 FW 724 FW 725	Blast Cleaning to SA 2 1/2 (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002	75 25	300
31	Limestone silo structures (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 730	Blast cleaning to Sa 2 1/2 (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
32	Limestone Silo- Outside surfaces (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
33	Lime stone Silo- Inside surfaces (Conical portion)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm conforming to ISO 8501-1	Primer: Two coats of Red Oxide Zinc phosphate primer to IS: 12744 (SS lining is inside the Limestone silo conical portion, hence primer is only envisaged; SS lining will be done at shops itself)	60	NIL	--	60
34	Lime stone Silo- Inside surfaces (Cylindrical portion)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)	
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)		
35	Limestone silo approach platform, Platform for Pipe racks (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.08, 6.04.09)	FW 733 FW 766 FW 767	Gratings- Blast cleaning to Sa 2½;	Hand rails, Ladders, Gratings- Hot dip galvanizing to 610gms/sq. m (minimum) and to a coating thickness of 87µm (minimum)					
36	Limestone silo approach platform, Pipe racks platform- Structures other than the above (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 733 FW 766 FW 767	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245	
37	Limestone Mill – Outside surfaces (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 735	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002	75	25	300
38	Lime stone mill- Inside surfaces	FW 735	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ	100	--	--	100	

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
39	Gypsum belt filter and accessories Structural items (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 738	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002	75 25	300
40	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydro cyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary Hydro-cyclone feed tank Outside surfaces (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 785 FW 786 FW 802	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
41	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydro cyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary Hydro-cyclone feed tank Inside surfaces	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 749 FW 785 FW 786 FW 802	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	Primer: Two coats of Red Oxide Zinc phosphate primer to IS: 12744 (Lining is inside the tanks, hence primer is only envisaged for protection till erection)	60	NIL	--	60

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
42	Process water pipe accessories, Cooling water pipe accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	FW 751 FW 752	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sea Green Shade no: 217 as per IS 5	70	150
43	Slurry pipe accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	FW 753	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sea Green Shade no: 217 as per IS 5	70	150
44	Service Air pipe accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	FW 754	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5	70	150
45	Instrument air pipe accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	FW 755	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5	70	150
46	All Valves and fittings (Temp <95 deg C) (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	FW 815 to FW 851	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat	70	150

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
47	Structure for Pipe racks Trestle for pipe racks & Structures inside Gypsum dewatering building and Ball mill building (Tec. Spec. Sec.- VI, Part- B, Sub section D-01, cl. 6.04.03)	FW 761 FW 765 FW 768 FW 769 FW 787	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
48	Supports for Cable trays, Tools, Air receivers, commissioning spares (Tec. Spec. Sec.- VI, Part- B, Sub section A-12 Page 9 of 9)	FW 779 FW 798 FW 988 FW 996 FW 997	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002	75	300

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

2-GATES & DAMPERS

01	Gates & Dampers > 95° C Insulated Surfaces & Uninsulated surfaces (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9)	57 560 57 570 57 580 57 583	Power Tool Cleaning to St3 (SSPC-SP3)	One coat of HR Aluminium paint to IS 13183 Gr. I	20	One coat of HR Aluminium paint to IS 13183 Gr. I	20	40
02	Seal air piping (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	57 141	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5	70	150
03	Blower with Motor Knife Gate valve (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9) & (Clause 20.03.00 of Part- C Section VI)	57 491 57 497	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats) Motor paint Shade: RAL 5012	40	100
04	Ladder, Cage for Ladder Toe Guard Plate Floor Grill, Hand Rails, Hand Rail Post (Tec. Spec. Sec.- VI, Part-B, Sub section D- 01, cl. 6.04.08, 6.04.09)	57 466	Gratings- Blast cleaning to Sa 2½	Hot Dip Galvanizing to 610 gm per sq. Meter (minimum) and to a coating thickness of 87 µm (minimum)				
05	Other Structural Items- Other than sl.no. 4 of above & Mounting bracket	57 209 57 466	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
	(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9)							

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

3. PAINTING OF DAMAGED AREAS

Areas where paint has deteriorated badly by erosion and areas where the paint film has lost its adhesion property and where the steel has got rusted appreciably - these areas are to be repainted as per the following procedure:

SL NO	SURFACE LOCATION	SURFACE PREPARATION	PRIMER, INTERMEDIATE & FINISH
1	Paint damaged Components falling under FGD SI no.01,02,03,04,05,06,07,08,09,11,12,13,18 19,21,22,24,25,26,27,28,30,31,32,34,36,37,39,40,47& 48 of FGD.	Hand/ Power Tool cleaning to Bare metal to minimum 6 inches peripheral area adjoining to damaged area	Primer: Epoxy Zinc rich primer to IS 14589, DFT-70µ (If Metal surface exposed) followed by intermediate & finish coat as per respective scheme If primer is intact- Intermediate & finish as per respective scheme
2	Paint damaged components failing under other SI nos of FGD & Gates & Dampers	Power Tool Cleaning to Bare metal	Primer and Finish : As given in respective scheme

GENERAL NOTES

1. No painting is required for Galvanized, non-ferrous & stainless steel items, except as indicated above.
2. Machined items are to be applied with coat of temporary rust preventive oil
3. PGMAs covered in sub-supplier (ie., Purchased) items viz., Agitator and other sub-delivery components etc., are not indicated in the above list. However, the Painting Schedule for all items supplied by all sub-suppliers and BOI under the scope of BHEL shall be same as for main equipment covered in this document.
4. In sub-assy, wherever plates / sheets of thickness less than or equal to 5mm and rods are used - Power Tool or Hand Tool Cleaning to SSPC - SP 3 / SP 2 shall be followed and painting shall be as per SI no:05 of GAD.
5. Ground shade/colour of finish paints and identification tag/band for equipments, fans, piping, pipe services, supporting structures and other components is followed as per NTPC doc no: QS-01-DIV-W-4 at site.
6. All components covered under different PGMAs are to be painted. In case any component is left out, the same shall deemed to be included under the relevant section.
7. All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, Sleeves shall be coated with temporary rust preventive fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.
8. Painting requirement for all electrical equipment shall be as per the details identified in specification for the respective equipment.
9. All steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of corrosivity category C3 (durability high) as per ISO 12944.
10. Finish coat to be applied after an interval of min 10 hrs and within 6 months (after completion of intermediate coat).
11. Bottom of base plate including below zero level portion marked in Supporting Columns of structures which will be embedded in concrete, those surfaces shall be prepared by manual cleaning to ST3 and provided with primer coat of chlorinated rubber based zinc phosphate primer of min. 50 µm DFT.

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

PAINTING SCHEME- DETAILS OF PROCUREMENT & APPLICATION PROCESSES

SL NO	TYPE OF PAINT	SPECIFICATION OF PAINT	NO OF PACK	VOLUME OF SOLIDS (% Min)	MODE OF APPLICATION	MIN. OVER COATING INTERVAL (hours)	SHADE
01	Epoxy Zinc phosphate primer	IS 13238	2	40	Spray	24	Grey
02	Zinc Ethyl silicate primer (% Zn on dry film = 80 (min))	IS 14946	2	60	Airless Spray only	24	Grey
03	Epoxy High solid-Polyamide cured Epoxy based MIO pigmented intermediate coat	--	2	80	Airless Spray only	16	Brown
04	Epoxy based finish paint	IS 14209	2	62	Airless Spray only	16	Corresponding shade no
05	Aliphatic isocyanate acrylic polyurethane paint	IS 13213	2	55	Spray	16	Corresponding shade no
06	Heat resistant aluminium paint	IS 13183 Grade II	1	--	Brush/ Spray	24	--
07	Synthetic Enamel undercoat	IS 2932	1	40	Brush/ Spray	12	--
08	Long oil alkyl Synthetic enamel finish paint	IS 2932	1	35	Brush/ Spray	12	Corresponding shade no
09	Red oxide Zinc phosphate primer	IS 12744	1	--	Brush/ spray	12	--

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

PGMA DETAILS

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
01	FW 212	Slurry recirculation pump system	RC Pumps incl Shaft seal Common Base Plate Coupling and Guard Gear Box Expansion Bellow Anchor Bolts & Fasteners Special Tools
02	FW 219	Absorber system base	Absorber tank bottom plate
03	FW 220	Absorber system structures	Absorber tank structure Absorber tower structure Spray headers structure
04	FW 221	Absorber system casing bottom	Absorber tank wall casing- bottom
05	FW 222	Absorber system casing top	Absorber Tank wall casing –Top Mist Eliminator supports Spray pipe supports Internal Beam Shim plates in Absorber area Internal Struts
06	FW 223	Absorber system accessories	Nozzles and flanges Inspection doors & Man holes Viewing ports Antifoam dosing equipment Suction strainers- FRP
07	FW 226	Emergency Quench water tank	Base Plate & its supports Roof, Shell
08	FW 227	Emergency Quench System	Emergency Quenching Spray Pipe Nozzle for Emergency Pipe Fasteners Gaskets
09	FW 230	Air oxidation System	Oxidation Blowers Common Base Plate Coupling and Guard Anchor Bolts & Fasteners Expansion Bellow Suction & Discharge Silencers Acoustic Enclosure Water Injection cooling system

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

		Pipe, Valves & Instruments Special Tools					
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SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS				
10	FW 244	Oxidation air distribution System	Pipe & Fittings Flanges				
11	FW 251	Expansion joint between bypass	Pipe Hanger, Bottom Elbow, Bottom sliding supports Expansion joints Seal Plates & Fasteners				
12	FW 252	Expansion joint between scrubbers	Fabric & its fixing fasteners Sleeves & Flanges Gaskets				
13	FW 255	Ducts between bypass duct inlet & booster fan	Plates & Stiffeners Guide Vanes				
14	FW 256	Ducts between Booster fan & Absorber	Plates & Stiffeners Guide Vanes				
15	FW 257	Ducts between Absorber & stack	Plates & Stiffeners Guide Vanes				
16	FW 260	Duct structure between bypass duct& Booster fan	Duct Supports Gusset Plate Divider plate Internal Struts Support bearings				
17	FW 261 FW 262	Duct structure between booster fan& absorber & Absorber and Stack	Duct Supports Gusset Plate Divider plate Internal Struts Support bearings				
18	FW 292	Structures for Elevator	Columns Seal Plate Bracings Enclosure (Purlin& sheeting)				
19	FW 293	Elevator and accessories	Base Frame Buffer Spring Mast Section Cage Control Panel & AC Mandatory Spares				

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS				
20	FW 310	Structures for booster fan handling	Columns Beams Bracings Seal plate				
21	FW 610 FW 722	Galleries & railings for Scrubbers, Tank	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners				
22	FW 701	Slurry pumps & accessories	Slurry Pumps incl Shaft seal Common Base Plate Coupling and Guard Belt & Pulley Expansion Bellow Anchor Bolts & Fasteners Motor & accessories Sump Pumps incl Shaft seal Common Base Plate Coupling and Guard Belt & Pulley Anchor Bolts & Fasteners Motor & accessories				
23	FW 710	Monorail for hoist& cranes	Insert Plate Stiffener plate Monorail beam				
24	FW 721	Agitator support	Channels & Beams				
25	FW 730	Limestone silo structures	Columns Beams Bracings Seal plate Angles, channels				

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS					
26	FW 731	Limestone silo	Base plate & its supports Shell, Roof					
27	FW 723 FW 724 FW 725	Air cannon Bag filter Nozzles & flanges	Bag filter Air cannon bin activator Nozzles & Flanges					
28	FW 733	Limestone silo approach platforms	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners					
29	FW 734	Limestone mill	Wet ball mill Hydro cyclone- Mill area Mill circuit pump Mill separator tank with Agitator					
30	FW 742	Lime stone slurry storage tank	Base plate & its supports Shell, Roof					
31	FW 743	Auxiliary Absorber tank	Base plate & its supports Shell, Roof					
32	FW 744	Filtrate tank	Base plate & its supports Shell, Roof					
33	FW 745	Wastage water tank	Base plate & its supports Shell, Roof					
34	FW 747	Hydro cyclone waste water tank	Base plate & its supports Shell, Roof					
35	FW 748 FW 785 FW 786	Process Water tank Belt filter washing tank Primary Hydro cyclone feed tank	Base plate & its supports Shell, Roof					
36	FW 751 FW 752	Process water pipe accessories Cooling water pipe accessories	CS/FRP Pipes & Fittings Sight Glass R Orifice Gaskets & Fasteners					
37	FW 753	Slurry pipe accessories	CSRL/FRP Pipes & Fittings Strainer (Cone) Expansion Joint-Rubber R Orifice Gaskets & Fasteners					

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS				
38	FW 754	Service air pipe accessories	GI Pipes & Fittings Flexible Hose Expansion Joint (Metallic) Hose connector R Orifice Gaskets & Fasteners				
39	FW 755	Instrument air pipe accessories	SS Pipes & Fittings Strainer(Y Type) Gaskets & Fasteners				
40	FW 815 to FW 851	Valves and fittings	Globe valves Ball Valves Butterfly Valves Diaphragm Valves Gate Valves CheckValves Pinch Valves Knife Gate Valves Control Valves Relief Valves				
41	FW 761 FW 765	Structures for Pipe racks Structures for Sub pipe racks	Bracings Columns				
42	FW 280 FW 281 FW 282 FW 283 FW 740 FW 760 FW 763	Foundation material for duct structure Foundation material for absorber Foundation material for Tanks Foundation material for Pipe racks Foundation material for Elevator Foundation material for RC pump shed	Foundation bolts Template				
43	FW 766	Platforms for Pipe rack	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners Truss Beams, Supports for all Pipes				
44	FW 768 FW 769	Trestle for Main & sub Pipe racks	Double Sup Channel & Base plates				
45	FW 779	Supports for cable tray	Single Sup Channel & Base plates				

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

				Cantilever Arm Fasteners & clamps Brackets				
46	FW 996		Tools					
SNO	PGMA		PGMA DESCRIPTION					
47	FW 798		Air receivers	Erection , commissioning, special tools PGMA DETAILS				
				Instrument Air receivers Any Instruments/Valves				
48	FW 800		Clarified water tank	Base plate & its supports Shell, Roof				
49	FW 802		Neutralization tank & accessories	Base plate & its supports Shell, Roof				
50	FW 988 FW 997 FW 999		Commissioning spares & Mandatory spares	Startup & commissioning spares Mandatory spares				



TITLE:

**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I, SUB-SECTION-C3

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

TECHNICAL SPECIFICATION OF AGITATORS (ELECTRICAL PORTION)

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR AGITATOR 3X800 MW PVUNL PATRATU TPP PHASE-1	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 09.01.2020
		SHEET : 2 OF 3

1.0

EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a)

Services and equipment as per “Electrical Scope between BHEL and Vendor”.

b)

Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c)

Supply of mandatory spares as specified in the specifications of mechanical equipments.

d)

Electrical load requirement for **AGITATOR**.

e)

All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f)

Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g)

Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h)

Motor shall meet minimum requirement of motor specification.

i)

Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

j)

Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0

EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0

DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1

The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR AGITATOR 3X800 MW PVUNL PATRATU TPP PHASE-1	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 09.01.2020
		SHEET : 3 OF 3

compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor
- b) Customer (NTPC) specification for Motors
- c) Customer (NTPC) specification for cable lugs and glands
- d) Quality plan for motors & NTPC quality assurance
- e) Datasheet A & C (Annexure- I)
- f) Sub vendor List for Motors & other Electrical items (Annexure-II)
- g) Electrical Load data format (Annexure –III)
- h) BHEL cable listing format (Annexure –IV)

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: AGITATOR (Supply Package)

PROJECT: 3X800 MW PATRATU TPS

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	415 V MCC	BHEL	BHEL	415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motors.
3	Power cables, control cables and screened control cables	BHEL	BHEL	Incoming cable from BHEL supplied MCC will be informed by BHEL. Vendor shall provide lugs & glands accordingly.
4	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
5	Cable glands and lugs for equipments supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
6	Conduit and conduit accessories for cabling between equipments supplied by vendor	BHEL	BHEL	
7	Equipment grounding & lightning protection	BHEL	BHEL	
8	Below grade grounding	BHEL	BHEL	
9	LT Motors with base plate and foundation hardware	Vendor	BHEL	Makes shall be subject to BHEL approval at contract stage.
10	Mandatory spares	Vendor	-	Vendor to quote as per specification.
11	Recommended O & M spares	Vendor	-	As per specification
12	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
13	Electrical equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

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

SUB-SECTION – B-07

MOTORS

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

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	MOTORS			
1.00.00	GENERAL REQUIREMENTS			
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.			
1.02.00	All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.			
1.03.00	Contractor shall provide fully compatible electrical system, equipment, accessories and services.			
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.			
1.05.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.			
1.06.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances for contractors equipment and systems shall be under the contractor scope.			
1.07.00	Degree of Protection			
	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-			
	i) Indoor motors	-	IP 54	
	ii) Outdoor motors	-	IP 55	
	iii) Cable box-indoor area	-	IP 54	
	iv) Cable box-Outdoor area	-	IP 55	
2.00.00	CODES AND STANDARDS			
	1) Three phase induction motors	:	IS/IEC:60034	
	2) Single phase AC motors	:	IS/IEC:60034	
	3) Crane duty motors	:	IS:3177, IS/IEC:60034	
	4) DC motors/generators	:	IS/IEC:60034	
	5) Energy Efficient motors	:	IS 12615, IEC: 60034-30	
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-B-07 MOTORS
				PAGE 1 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.00.00	TYPE			
3.01.00	AC Motors: a) Squirrel cage induction motor suitable for direct-on-line starting. b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. c) Crane duty motors shall be squirrel cage Induction motor as per the requirement. d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.			
3.02.00	DC Motors	Shunt wound		
4.00.00	RATING			
	(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. (b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations. (c) For BFP motors, starting MVA shall be restricted to meet requirements indicated in B-0.			
5.00.00	TEMPERATURE RISE			
	Air cooled motors 70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.			
	Water cooled 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.			
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-B-07 MOTORS	PAGE 2 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	41 deg.C over inlet cooling water maximum temperature of 39 deg.C for thermal class 90 (Y) wet wound Boiler circulation pump motor.			
6.00.00	OPERATIONAL REQUIREMENTS			
6.01.00	Starting Time			
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.			
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.			
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.			
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.			
6.02.00	Torque Requirements			
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.			
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.			
6.03.00	Starting voltage requirement			
	(a) Up to 85% of rated voltage for ratings below 110 KW			
	(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW			
	(c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW			
	(d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW			
	(e) Up to 75 % of rated voltage for ratings above 4000KW			
	Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.			
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-B-07 MOTORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS
7.00.00	DESIGN AND CONSTRUCTIONAL FEATURES
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below (a) Fuel oil area : Group – IIB (b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA / IEC60034)
7.03.00	Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (c) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Pressure Impregnated i.e. resin poor method. The lightning Impulse & intertern insulation surge withstand level shall be as per IEC-60034 part-15. However winding insulation for wet wound Boiler circulation pump motor shall be thermal class 90 (Y) or better. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.
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-B-07 MOTORS	
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CLAUSE NO.	TECHNICAL REQUIREMENTS
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7.06.00	Noise level for all the motors shall be limited to 85dB (A) except for BFP motor for which the maximum limit shall be 90 dB(A). Vibration shall be limited within the limits prescribed in IS/IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.
7.08.00	Motor body shall have two earthing points on opposite sides.
7.09.00	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
7.10.00	3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) shall be provided.
7.11.00	The spacing between gland plate & center of terminal stud shall be as per Table-I.
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	The size and number of cables (for HT and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same.
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-B-07 MOTORS	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.			
	(a) 50 kW to 110 kW	:	11.0	
	(b) From 110 KW & upto 200 KW	:	9.0	
	(c) Above 200 KW & upto 1000KW	:	10.0	
	(d) From 1001KW & upto 4000KW	:	9.0	
	(e) Above 4000KW	:	6 to 6.5	
9.00.00	CW motor shall be designed with minimum power factor of 0.8 at design duty point.			
10.00.00	TYPE TEST			
10.01.00	HT MOTORS			
10.01.01	The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer’s engineer.			
10.01.02	The type tests shall be carried out in presence of the employer’s representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer’s approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.			
10.01.03	In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the employer for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.			
10.01.04	Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED “and carried out within last ten years from the date of bid opening. These reports should be for			
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-B-07 MOTORS
PAGE 6 OF 10				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.02.00	LT Motors			
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for employer’s approval the reports of all the type tests as listed in this specification and carried out within last <i>ten</i> years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.			
10.02.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/ employer’s representative and submit the reports for approval.			
10.02.03	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip. 5. Temperature rise test. 6. Momentary excess torque test. 7. High voltage test. 8. Test for vibration severity of motor. 9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section) 10. Test for degree of protection and 11. Over speed 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-B-07 MOTORS	PAGE 8 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS																				
12.	Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1																				
10.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.																				
10.04.00	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.																				
TABLE - I DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS <table><thead><tr><th>Motor MCR in KW</th><th>Minimum distance between centre of stud and gland plate in mm</th></tr><tr><th>UP to 3 KW</th><th>As per manufacturer's practice.</th></tr></thead><tbody><tr><td>Above 3 KW - upto 7 KW</td><td>85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td>115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td>167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td>196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td>249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td>277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td>331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td>203</td></tr></tbody></table> For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm. PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE: NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:		Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm	UP to 3 KW	As per manufacturer's practice.	Above 3 KW - upto 7 KW	85	Above 7 KW - upto 13 KW	115	Above 13 KW - upto 24 KW	167	Above 24 KW - upto 37 KW	196	Above 37 KW - upto 55 KW	249	Above 55 KW - upto 90 KW	277	Above 90 KW - upto 125 KW	331	Above 125 KW-upto 200 KW	203
Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm																				
UP to 3 KW	As per manufacturer's practice.																				
Above 3 KW - upto 7 KW	85																				
Above 7 KW - upto 13 KW	115																				
Above 13 KW - upto 24 KW	167																				
Above 24 KW - upto 37 KW	196																				
Above 37 KW - upto 55 KW	249																				
Above 55 KW - upto 90 KW	277																				
Above 90 KW - upto 125 KW	331																				
Above 125 KW-upto 200 KW	203																				
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-B-07 MOTORS	PAGE 9 OF 10																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Motor MCR in KW UP to 110 KW Above 110 KW and upto 150 KW Above 150 KW	Clearance 10mm 12.5mm 19mm		
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-B-07 MOTORS PAGE 10 OF 10

Cable glands

Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

Cable lugs/ferrules

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards

	QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :					
			BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION : TITLE :					
	SHEET 2 OF 2		SYSTEM CAT.		ITEM AC ELECT. MOTORS BELOW 55KW (LV)		VOLUME III					
	SL. NO.	COMPONENT/OPERATION CHARACTERISTICS CHECK	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.												
<u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL		PARTICULARS		BIDDER/VENDOR								
		NAME										
		SIGNATURE										
		DATE										
BIDDER'S/VENDORS COMPANY SEAL												

CUSTOMER :			PROJECT		SPECIFICATION :	
BIDDER/ VENDOR			TITLE		NUMBER :	
QUALITY PLAN			QUALITY PLAN		TITLE	
SHEET 1 OF 9			NUMBER PED-506-00-Q-007, REV-03		SECTION	
COMPONENT/OPERATION			REFERENCE DOCUMENT		AGENCY	
CHARACTERISTIC CHECK			EXTENT OF CHECK		VOLUME III	
SL. NO.			TYPE/ METHOD OF CHECK		REMARKS	
1			4		P W V	
2			5		10	
3			6		11	
1.0 RAW MATERIAL & BOUGHT OUT CONTROL			7		8	
1.1 SHEET STEEL PLATES, SECTION, EYEBOLTS			9		10	
1.2 HARDWARES			11		12	
1.3 CASTING			13		14	
1.4 PAINT & VARNISH			15		16	
BHEL			PARTICULARS		BIDDER/VENDOR	
			NAME		SIGNATURE	
			DATE		BIDDER'S/VENDORS COMPANY SEAL	

		CUSTOMER :		PROJECT		SPECIFICATION :															
		QUALITY PLAN		TITLE		NUMBER :															
						SPECIFICATION :															
						TITLE															
SHEET 2 OF 9		BIDDER/ VENDOR		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV-03		SECTION		VOLUME III											
CHARACTERISTIC CHECK		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		AGENCY		REMARKS					
P		W		V																	
SL. NO.		COMPONENT/OPERATION		3		4		5		6		7		8		9		10		11	
1		2																			
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED									
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2										
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2										
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE									
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2										
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2										
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2										
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2										
BHEL		PARTICULARS		BIDDER/VENDOR																	
		NAME																			
		SIGNATURE																			
		DATE																			
		BIDDER'S/VENDORS COMPANY SEAL																			

BHEL		QUALITY PLAN			CUSTOMER :		PROJECT		SPECIFICATION :		
SHEET 3 OF 9		BIDDER/ VENDOR		TITLE		NUMBER :			TITLE		
		SYSTEM		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV.03			SECTION		
		CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
SL. NO.	COMPONENT/OPERATION	3	4	5	6	7	8	9	10	11	
1	2										
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3 - 2		
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3 - 2		
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3 - -		
			MA	MEASUREMENT	SAMPLE	MANUF'S DRG. .	MANUF'S DRG.	-DO-	3 - 2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT	
			MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3 - 2		
			MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3* - 2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.	
			MA	ELECT. & MECH. TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3 - 2		
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
				BIDDER'S/VENDORS COMPANY SEAL							

			CUSTOMER :		PROJECT		SPECIFICATION :							
QUALITY PLAN			BIDDER/ VENDOR		TITLE		NUMBER :							
SHEET 4 OF 9			SYSTEM		QUALITY PLAN		TITLE							
COMPONENT/OPERATION			CAT.		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		SECTION		VOLUME III	
SL. NO.	CHARACTERISTIC CHECK		TYPE/METHOD OF CHECK	EXTENT OF CHECK	7	8	9	AGENCY			REMARKS			
1	2	3	4	5	6	7	8	9	10	11				
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2			
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	-DO-	3	-	2		
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	-DO-	3	-	2		
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	-DO-	3	-	2		
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-			
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	-DO-	3	-	-		
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	-DO-	3	-	2		
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	-DO-	3	-	2		
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	-DO-	3	-	-		
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	-DO-	3	-	-		
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	-DO-	3	-	-		
		BHEL												
PARTICULARS			BIDDER/VENDOR											
NAME														
SIGNATURE														
DATE														
BIDDER'S/VENDORS COMPANY SEAL														

QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :						
SHEET 5 OF 9		BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III			
									AGENCY	REMARKS		
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'R'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
		1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
2.3	PAINTING	2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL		PARTICULARS			BIDDER/VENDOR							
		NAME										
		SIGNATURE										
		DATE										
					BIDDER'S/VENDORS COMPANY SEAL							

GE T&E T&M 		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :				
SHEET 6 OF 9		BIDDER/ VENDOR		SYSTEM		QUALITY PLAN NUMBER PED-506-Q-007, REV-03		SPECIFICATION : TITLE				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS		
1	2	3	4	5	6	7	8	9	P W I V	10 11		
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUF'R'S SPEC.	MANUF'R'S SPEC.	Log Book	2 -	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2 -	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2 1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUF'R'S SPEC./BHEL SPEC.	MANUF'R'S SPEC./BHEL SPEC.	Log Book	2 -	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2 -	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2 -	1		
2.6	IMPREGNATION	4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2 -	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2 -	-		
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2 -	1		
		FOR MV MOTOR										
		1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2 -	-	THREE DIPS TO BE GIVEN	
		2.TEMP. PRESSURE VACCUUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2 -	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2 -	1		
BHEL		PARTICULARS		BIDDER/VENDOR								
		NAME										
		SIGNATURE										
		DATE										
										BIDDER'S/VENDORS COMPANY SEAL		

		QUALITY PLAN			CUSTOMER :		PROJECT		SPECIFICATION :			
					BIDDER/ VENDOR		TITLE		NUMBER :			
		SHEET 7 OF 9			SYSTEM		QUALITY PLAN		SPECIFICATION :			
							NUMBER PED-506-00-Q-007, REV-03		TITLE			
							ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		VOLUME III			
							REFERENCE		SECTION			
							DOCUMENT		AGENCY			
							NORM		P			
							EXTENT OF CHECK		W			
							METHOD OF CHECK		V			
							CAT.		REMARKS			
							TYPE/					
							METHOD OF					
							CHECK					
							CHECK					
							5					
							6					
							7					
							8					
							9					
							10					
							11					

QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :							
SHEET 8 OF 9		BIDDER/ VENDOR		TITLE		NUMBER :							
COMPONENT/OPERATION		SYSTEM		QUALITY PLAN		SPECIFICATION :							
SL. NO.	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	VOLUME III					
								SECTION	AGENCY	REMARKS			
								P	W	V			
1	2	3	4	5	6	7	8	9	10	11			
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3. VIBRATION & NOISE LEVEL 4. OVERALL DIMENSIONS AND ORIENTATION 5. DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	MA	ELECT. TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1	
			MA	-DO-	100%	-DO-	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-		
			MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3	
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2	
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2	
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^{\$}	1	\$ NOTE - 2	
			MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3	
			MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^{\$}	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2	
BHEL		PARTICULARS		BIDDER/VENDOR									
		NAME											
		SIGNATURE											
		DATE											

	QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :					
			BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-Q-007, REV-03		SPECIFICATION : TITLE					
	SHEET 9 OF 9		SYSTEM CAT.		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD	
	CHARACTERISTIC CHECK		TYPE/ METHOD OF CHECK		6		7		8		9	
SL. NO.	COMPONENT/OPERATION	3	4	5	6	7	8	9	10	11	VOLUME III REMARKS	
1	2	3	4	5	6	7	8	9	10	11		
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDORS COMPANY SEAL												

MOTOR

TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y			Y		
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes, for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y						
Complete Motor	Y	Y	Y						
Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW. 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard 3. Makes of major bought out items for HT motors will be subject to NTPC approval. Y1 = for HT Motor / Machines only.									

CLAUSE NO.		QUALITY ASSURANCE							एनटीपीसी NTPC	
MOTOR										
TESTS/CHECKS ITEMS/ COMPONENTS	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034/IEC 60079-1	vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.										
Shaft										
Magnetic Material	Y		Y							
Rotor										
Copper/Aluminium										
Stator copper			Y							
SC Ring										
Insulating Material			Y							
Tubes for Cooler		Y								
Sleeve Bearing		Y								
Stator/Rotor, Exciter Coils										
Castings, stator frame, terminal box and bearing housing etc.										
Fabrication & machining of stator, rotor, terminal box										
Wound stator										
Wound Exciter										
Rotor complete				Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly										
Accessories, RTD, BTD,CT, , Space heater, antifriction bearing, gaskets etc.										
Complete Motor						Y	Y	Y	Y1	Y
Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW. 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard 3. Makes of major bought out items for HT motors will be subject to NTPC approval. Y1 = for HT Motor / Machines only.										
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-E-51 MOTORS		Page 2 of 2	

	TITLE	LV MOTORS <u>DATA SHEET-A</u> ANNEXURE - I	SPECIFICATION NO.
			VOLUME II B
			SECTION D
			REV NO. 00 DATE 02.08.2019
			SHEET 1 OF 1
1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	≤200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection (Indoor/Outdoor)	:	IP54/IP55
5.0	Type of Cooling	:	TEFC/CACA/TETV
6.0	Details of supply system		
a)	Rated voltage (with variation)	:	415V ± 10%
b)	Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
c)	Combined voltage & freq. variation	:	10%
d)	System fault level at rated voltage	:	50 kA for 1 sec
e)	Short time rating for terminal boxes		
	○ 110kW & Above (Breaker controlled)	:	50 kA for 1 sec
	○ Below 110kW (SFU+ Contactor controlled)	:	50 KA for 0.20 sec.
f)	LV System grounding	:	Solidly
7.0	Class of insulation	:	Refer clause 7.03.00 of Customer Motor Specification
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	Refer clause 6.03.00 of Customer Motor Specification
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable upto 0.20 kW
13.0	Tests	:	As per Customer motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	As per Customer spec. requirement
Also detail Customer spec. for Motors to be referred as enclosed with the specification.			

DATASHEET C

CLAUSE NO.	Bidder's Name				
	DE-1B	LT MOTORS			
	A.	GENERAL			
	5.	Manufacturer & Country of origin. (Shall be as per approved QA make)			
	6.	Equipment driven by motor			
	7.	Motor type			
	8.	Quantity			
	B.	DESIGN AND PERFORMANCE DATA			
	18.	Frame size			
	19.	Type of duty			
	20.	Type of enclosure /Method of cooling/ Degree of			
	21.	Applicable standard to which motor generally			
	22.	Efficiency class as per IS 12615			
	23.	(a)Whether motor is flame proof	Yes/No		
		(b)If yes, the gas group to which it conforms as per IS:2148			
	24.	Type of mounting			
	25.	Direction of rotation as viewed from DE END			
	26.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)			
	27.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)			
	28.	Maximum continuous load demand of driven			
	29.	Rated Voltage (volts)			
	30.	Permissible variation of :			
		a. Voltage (Volts)			
		b. Frequency (Hz)			
		c. Combined voltage and frequency			
	31.	Rated speed at rated voltage and			
	32.	At rated Voltage and frequency:			
		a. Full load current			
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)				
	TECHNICAL DATA SHEETS SECTION – VI, PART-G BID DOC. NO:CS-9585-001-2				
	DB07: MOTORS				
	PAGE 13 OF 17				

CLAUSE NO.	Bidder's Name						
		b. No load current					
	33.	Power Factor at					
		a. 100% load					
		b. NO load					
		c. Starting.					
	34.	Efficiency at rated voltage and frequency,					
		a. 100% load					
		b. 75% load					
		c. 50% load					
	35.	Starting current (amps) at					
		a. 100 % voltage					
		b. 85% voltage					
		c. 80% voltage					
	36.	Minimum permissible starting Voltage (Volts)					
	37.	Starting time with minimum permissible voltage					
		a. Without driven equipment coupled					
		b. With driven equipment coupled					
	38.	Safe stall time with 100% and 110% of rated					
		a. From hot condition					
		b. From cold condition					
	39.	Torques :					
		a. Starting torque at min. permissible voltage(kg-					
		b. Pull up torque at rated voltage.					
		c. Pull out torque					
		d. Min accelerating torque (kg.m) available					
		e. Rated torque (kg.m)					
	40.	Stator winding resistance per phase (ohms at 20					
	41.	GD ² value of motors					
<table border="1"> <tr> <td>EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)</td> <td>TECHNICAL DATA SHEETS SECTION – VI, PART-G BID DOC. NO:CS-9585-001-2</td> <td>DB07: MOTORS</td> <td>PAGE 14 OF 17</td> </tr> </table>				EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)	TECHNICAL DATA SHEETS SECTION – VI, PART-G BID DOC. NO:CS-9585-001-2	DB07: MOTORS	PAGE 14 OF 17
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)	TECHNICAL DATA SHEETS SECTION – VI, PART-G BID DOC. NO:CS-9585-001-2	DB07: MOTORS	PAGE 14 OF 17				

CLAUSE NO.	Bidder's Name			
	42.	No of permissible successive starts when motor is in hot condition		
	43.	Locked Rotor KVA Input		
	44.	Locked Rotor KVA/KW		
	45.	Vibration limit :Velocity (mm/s)		
	46.	Noise level limit (dBA)		
	C.	CONSTRUCTIONAL FEATURES		
	1.	Stator winding insulation		
		a. Class & Type		
		b. Winding Insulation Process		
		c. Tropicalised (Yes/No)		
		d. Temperature rise over specified maximum ambient temperature of 50 deg C		
		e. Method of temperature measurement		
		f. Stator winding connection		
	2.	Main Terminal Box		
		a. Type		
		b. Location(viewed from NDE side)		
		c. Entry of cables(bottom/side)		
		d. Recommended cable size(To be matched with cable size envisaged by owner)		
		e. Fault level (MVA),Fault level duration(sec)		
		f. Cable glands & lugs details (shall be suitable for		
	3.	Type of DE/NDE Bearing		
	4.	Motor Paint shade		
	5.	Weight of		
		a. Motor stator (KG)		
		b. Motor Rotor (KG)		
		c. Total weight (KG)		
	D.	List of accessories.		
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL DATA SHEETS SECTION – VI, PART-G BID DOC. NO:CS-9585-001-2	DB07: MOTORS
				PAGE 15 OF 17

CLAUSE NO.	Bidder's Name				
	1.	3	Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)		
	2.		Terminal Box for Space Heater (Yes/No)		
	3.		Speed switch (Yes/No)		
	4.		Insulation of bearing (Yes/No)		
	5.		Noise reducer(Yes/No)		
	6.		Grounding pads		
			i) No and size on motor body		
			ii) Nos on terminal Box		
	7.		Vibration pads		
			i) Nos and size		
			ii) Location		
	8.		Any other fitments		
	E.		List of curves.		
	1.		Torque speed characteristic of the motor		
	2.		Thermal withstand characteristic		
	3.		Starting. current Vs. Time		
	4.		Starting. current Vs speed		
	5.		P.F. and Effi. Vs Load		
	F.		Additional Data to be filled for each rating of DC Motor		
	1.		Rated armature voltage (Volt)		
	2.		Rated field excitation (Amp)		
	3.		Permissible % variation in voltage		
	4.		Minimum Permissible Starting voltage (volt)		
	5.		At rated voltage		
			i)Full load Armature current.(Amp)		
			ii)Full load Field current (Amp)		
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL DATA SHEETS SECTION – VI, PART-G BID DOC. NO:CS-9585-001-2		DB07: MOTORS
					PAGE 16 OF 17

CLAUSE NO.	Bidder's Name			
		iii) No load Armature current (Amp)		
	6.	Full load Field current (Amp)		
	7.	No load Armature current (Amp)		
	8.	Minimum permissible field current (Amp) to avoid		
		i) Maximum permissible voltage		
		ii) Rated voltage		
		iii) Minimum Permissible Voltage		
	9.	Resistance (indicative Values) in ohm		
		i) Armature winding (Arm + IP + Series) at 25		
		ii) Field Winding at 25 deg. C		
	10..	Inductance (indicative values)		
		i) Armature winding		
		ii) Field winding		
	11	Value of trimmer resistance (ohm) to be connected in series with the shunt field to		
		i) 220 V DC		
		ii) 250 V DC		
		iii) 187 V DC		
	12	Value of the external resistance (ohm) required to be connected in series with armature during starting only		
	13	Technical data sheet for external resistance box		
	14	GA drawing of motor		
	15	Starting time calculation		
	16	Starter resistance design calculation		
	17	Electrical connection diagram of motor		
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)			TECHNICAL DATA SHEETS SECTION – VI, PART-G BID DOC. NO:CS-9585-001-2
	DB07: MOTORS		PAGE 17 OF 17	

Vendor to refer to this list for items in their scope only(as indicated in Electrical scope sheet between BHEL & Vendor)

ANNEXURE II

		PROJECT : PATRATU STPS (3X800 MW) PACKAGE : EPC Sub Package: MOTORS & VVF Drive Panels CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL			REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 20 th April 2017	
Sl. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-QOE	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL. STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
1)	L T (415 V) Motors	Refer Note 1				ABB	FARIDABAD	A		UPTO 55KW
						ABB	BANGALORE	A		55KW - 200KW
						BHARAT BIULEE	MUMBAI	A		RQP, FOR FLAME PROOF ALSO
						CGL	AHMEDNAGAR	A		FOR FLAME PROOF ALSO
						JYOTI	BARODA	A		
						KEC	BANGALORE	A		FOR FLAMEVPROOF ALSO
						KEC	HUBLI	A		UPTO 90KW; FOR FLAME PROOF ALSO
						LHP	SOLAPUR	A		UPTO 200KW
						MARATHON	KOLKATA	A		FOR FLAME PROOF ALSO
						NGEF	BANGALORE	A		UPTO 15KW
						SIEMENS	MUMBAI	A		
2)	HT MOTOR					BHEL	BIHOPAL	A		

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		PROJECT : PATRATU STPS (3X800 MW) PACAKGE : EPC Sub Package: MOTORS & VVF Drive Panels CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL				REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 20th April 2017	
Sl. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-....	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL. STATUS AS	SC APPL SCHE	REMARKS	

NOTE 1 : FOR LT MOTORS

a) Less than 30 KW

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

b) 30 KW -50KW

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

c) Above 50 KW as per NTPC approved quality plan

Approval Conditions attached to above vendors-as applicable shall prevail.

General Notes:

- 1) Vendor list & category of the mandatory spares shall be as mentioned above.
- 2) For item not appearing in the above list, main contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
- 3) NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.



For
(JATIN GAHLAWAT)
BHEL



PROJECT : Patratu STPP (2X660 MW)
PACKAGE : EPC
Sub Package: Electrical Equipment Supply & Erection
CONTRACTOR : M/S BHEL
CONT. NO. CS-9585-001-2

LIST OF ITEMS REQUIRING QP
APPROVAL & ACCEPTABLE
VENDOR
Contractor-M/S BHEL

REF NO : 9585-001-QOE-R-01
REVISION NO. 00
DATE 24th April 2017

Sl. No.	ITEM	QP/INS CAT	QP No:- 9578-001-QVE	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS
13.	Junction boxes / Link Boxes/ Test Link Box/ Adaptor box, Switch Boxes, Pull Boxes (Hot Dip Galvanized)	III				Main contractor approved sources with galvanization from NTPC approved sources (Note-2)		Noted		
14.	FRP Junction boxes	II	10			Main Contractor approved sources		Noted		

16.	Cable glands	III				Main contractor approved sources		Noted		
17.	Cable lugs	III				M/s Dowell M/s Billets Elektro Werke Ltd.	Mumbai Umbergaon	A A		



		PROJECT : Patratu STPP (2X660 MW) PACAKGE : EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL				REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017	
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS ASPER NTPC	SC AP PL SC HE DU LE	REMARKS	
						(3 D) M/s Chelna	Nasik	A			
						Additionally Any make's model with VDE or CE or UL or CSA marking or BIS approved with CML no. Refer Note-3					
								Noted			



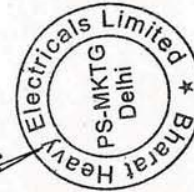
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		PROJECT : Patratu STPP (2X660 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL				REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017	
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE	QP SUB. SCH. L	QP APP SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC PL SC HE DU LE	REMARKS	
1.	M/s M J Engg, Delhi					8. M/s National Galvanizer, Kolkata					
2.	M/s Jamma Metal, Delhi					9. M/s Unistar Galvanizer, Kolkata					
3.	M/s A.V. Engg, Kolkata					10. M/s B.P. Project, Kolkata					
4.	M/s Inar Profiles, Vishakapatnam					11. M/s Bajaj Pune					
5.	M/s Anand Udyog, Mumbai					12. M/s Electrocure Industries, Mumbai					
6.	M/s Techno Engg, Chandigarh					13. M/s B.G. Shirke, Pune					
7.	M/S Steelite Engg, Mumbai					14. M/s Gurpreet Galvanizer, Hyderabad					
						15. M/s Sigma, Mumbai					
						16. M/s Radhakrishnan Shetty, Chennai					
						17. Karamtara Mumbai					
						18. Poona Galvanizers Pune					
						19. Ncha Galvanizer- Kolkata					
						20. Unitech galvanizers- Hoogly					
						21. Gurpreet galvanizers- Hyderabad					
						22- DMP Projects- Kolkata					

Note-3 : VDE / CE / UL / CSA MARKING FOR PRODUCT QUALITY: SELF CERTIFICATION/VALID CERTIFICATION FROM THIRD PARTY AGENCY OR BIS APPROVAL LETTER WITH CML NO. FOR PRODUCT QUALITY SHALL BE SUBMITTED FOR NTPC'S INFORMATION



for
(JATIN GHANAWAT)
BHEL

[illegible]

LIST OF MAKES OF SUB-VENDOR ITEMS



TITLE:
PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I, Sub Section-D

REV. 00

DATE: DEC 2019

SHEET : 1

Sl.no.	Item	Category of Inspection	Sub-vendor	Place	Remarks
1.	PAINT	III	ASIAN PAINT		
		III	BERGER		
		III	KANSAI NEROLAC		
		III	JOTUN		
		III	SHALIMAR		
		III	JENSON & NICHOLSON (I) LTD		
		III	CDC CARBOLINE (I) LTD.		
		III	ADDISON PAINTS LTD		
		III	GRAND POLYCOAT		

NOTES: INSPECTION CATEGORIZATION

CAT I: INSPECTION BY OWNER, BHEL/BHEL NOMINATED TPIA & VENDOR. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.

CAT II: INSPECTION BY BHEL/BHEL NOMINATED TPIA & VENDOR. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.

CAT III: MDCC WILL BE ISSUED BASED COC & MTC ISSUED BY VENDOR AND VERIFICATION BY BHEL / OWNER IN LINE WITH APPROVED QAP/CHECK LIST



TITLE:
PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I, Sub Section-D

REV. 00

DATE: DEC 2019

SHEET : 2

ANNEXURE-A

- Refer electrical specification for applicable sub-vendor list for motors.
- The list of all bought out items like gearbox, coupling, bearings etc. with makes and country of origin and contact details of the manufacturers to be mentioned along with offer to be submitted in the format attached in section II Annexure-6 as an information to BHEL.
- Acceptance of makes shall be subject to BHEL/ End customer acceptance during the detailed engineering without cost and delivery implication to BHEL.
- Make of any unlisted items shall be subject to customer / BHEL approval during detail engineering. For such items, bidder to furnish list of sub-vendors during detail engineering stage for Customer / BHEL's review and approval. Bidder shall furnish following supporting documentation within 1 month of placement of LOI. Thereafter no request for additional sub-vendor shall be entertained.
 - a) Documentation to show that the equipment /system has been supplied for a plant of similar or higher capacity.
 - b) Documentation in the form of certificate that the equipment/system has been operating satisfactorily for two years as on the scheduled date of bid opening.
- The complete list will be necessarily submitted within one month of placement of LOI to ensure timely placement of order for BOIs. Bidder to assess the capability of their proposed sub-vendors in terms of preparation of drawings, calculations, documents, quality assurance, supply of material etc. as per project schedule before placing the order on them.



TITLE:
PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I Sub Section-D

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

ANNEXURE-II

MANDATORY SPARE LIST

TECHNICAL SPECIFICATION FOR AGITATOR 3 X 800 MW PATRATU STPP		SPECIFICATION NO. :PE-TS-434-571-18000-A001
MANDATORY SPARE LIST		ANNEXURE-II
Sl. No.	PARTICULARS	Unit /Quantity (Nos./SET/%)
1.22.05	AGITATORS	
1.22.05.1	AUXILIARY ABSORBENT TANK AGITATOR	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
1.22.05.2	LIMESTONE SLURRY STORAGE TANK AGITATORS	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
1.22.05.3	PRIMARY HYDRO-CYCLONE FEED TANK AGITATOR	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
1.22.05.4	SECONDARY HYDROCYCLONE FEED TANK AGITATOR	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
1.22.05.5	FILTRATE WATER TANK AGITATOR	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
1.22.05.6	WASTE WATER TANK AGITATOR	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type

TECHNICAL SPECIFICATION FOR AGITATOR 3 X 800 MW PATRATU STPP		SPECIFICATION NO. :PE-TS-434-571-18000-A001
MANDATORY SPARE LIST		ANNEXURE-II
Sl. No.	PARTICULARS	Unit /Quantity (Nos./SET/%)
1.22.05.7	ABSORBER AREA DRAIN SUMP AGITATOR	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
1.22.05.8	GYPSUM AREA DRAIN SUMP AGITATOR	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
1.22.05.9	LIMESTONE AREA DRAIN SUMP AGITATOR	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	2 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
Note:		
1)One set means 100% complete replacement of the particular component/equipment, as mentioned i.e., Set for the particular equipment, would include all components required to replace the item. For example, a set of bearing shall include all hardware normally required while replacing the bearings. It is further, intended that the assembly / sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly / sub-assembly, these shall be considered as different types of assembly/sub-assembly.		
2) Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.		
3) In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.		
4) Any item which is quoted as “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.		
5) Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.		
6) All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be pre-set and/or pre-programmed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre-setting/pre-programming before putting them in to service. The spare shall be treated and properly packed for long term storage.		
7. Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, ontainers and other packages must be suitably marked and numbered for the purpose of identification.		



TITLE:
PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I Sub Section-D

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

ANNEXURE-III

INPUT DRAWINGS (GAD OF TANKS)



3x800 MW PATRATU TPS

AGITATORS

TECHNICAL SPECIFICATION

INPUT DRAWING LIST

SPECIFICATION No: PE-TS-434-571-18000-A

SECTION : I

SUB-SECTION : D

REV 00

SHEET 1 OF 1

ANNEXURE-III

INPUT DRAWINGS BY BHEL

Sl.No.	Drawing Title	PVUNL/NTPC Drawing No.
1.	Data Sheet & General Arrangement of Limestone Slurry Storage Tank	9585-001-109-PVM-B-015
2.	General Arrangement of Secondary Hydro cyclone Feed Tank	9585-001-109-PVM-B-016
3.	General Arrangement of Filtrate Water Tank	9585-001-109-PVM-B-023
4.	General Arrangement of Waste Water Tank	9585-001-109-PVM-B-027
5.	General Arrangement of Auxiliary Absorbent(Storage) Tank	9585-001-109-PVM-B-031
6	General Arrangement of Primary Hydro cyclone Feed Tank	2-FW-000-00-407
7	Drawing of Drain Pit (Typical) for Absorber Area Drain Sump, Gypsum Area Drain Sump, Limestone area drain sump.	----

01	03.12.2019	Revised as per NTPC Comments	AKS	KBP	VVS
00	12.11.2019	Fresh Issue	AKS	KBP	VVS
REV	DATE	DESCRIPTION / NOTE	PRD	CHD	APD

REVISIONS

TITLE :

Data Sheet & General Arrangement of Limestone Slurry Storage Tank

OWNER / PROJECT:



PATRATU VIDYUT UTPADAN NIGAM LIMITED
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE-I (3 X 800 M W)

EPC CONTRACTOR:



BHARAT HEAVY ELECTRICALS LTD.
BOILER AUXILIARIES PLANT, RANIPET

COLLABORATOR:



mitsubishi hitachi power systems, ltd
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

	BHEL	Sign	
PREPARED BY	A K SAHANI	-sd-	STATUS : <i>FOR APPROVAL</i>
CHECKED BY	K B PADHI	-sd-	BHEL CUST NO : R4R3, R4S3, R4S4
APPROVED BY	V V SUNDAR	-sd-	BHEL DOC NO : 03-FW-000-00-505
			REV NO : 01
CUSTOMER DRG./DOC NO.: 9585-001-109-PVM-B-015			

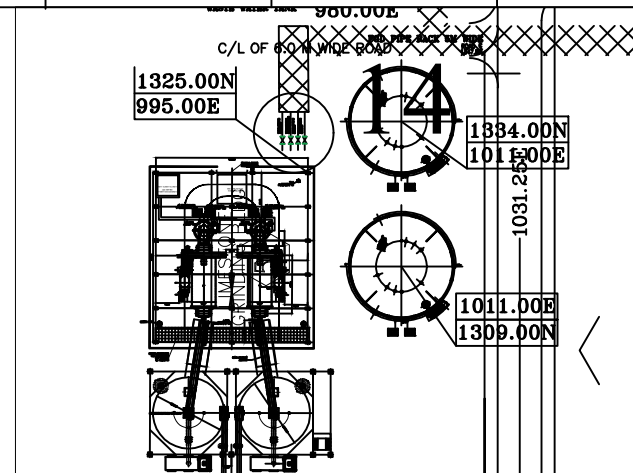
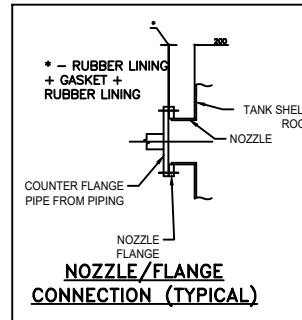
Document title: Data Sheet & GA of Limestone Slurry Storage Tank**NTPC Drawing No: 9585-001-109-PVM-B-015****Reply to Rev00:**

S.NO	NTPC COMMENTS	BHEL REPLY
1.	Both the LT shall be placed diagonally opposite to each other on tank top. Accordingly revise the location of the flange in the drg.	Document revised as per the comment.
2.	What is the opening size of agitator? What is agitator height? What is the maintenance procedure of agitator?	Agitator is a bought out item and details can be provided after finalisation of the vendor in the data sheet P&IDs of agitators.
3.	Pl. check	Document checked and modified
4.	Pl. check	Document checked and modified
5.	As per clause 10.01.00 of Sub-section A-05, Part-B, additional corrosion allowance of 3mm on the min. tank steel thickness	Document checked and modified
6.	What is the basis of plate thickness?	As per IS:803
7.	6 not indicated in the elevation 12mm, 7mm is also indicated in the elevation	Modified in the revised document
8.	Kindly provide stress values of plate material at design temperature for calculating plate thickness.	Yield stress of E250 grade plate at design temperature will be 250mPa as per IS:800
9.	Include Agitator details	Agitator is a bought out item and details can be provided after finalisation of the vendor in the data sheet P&IDs of agitators.
10	What is the width of spiral staircase?	Width of spiral staircase will be 800mm.
11	Include the foundation load data	Included in the revised document
12	To be finalised.	Agitator details will be finalised after vendor finalisation and nozzle details will be finalised after piping layout finalisation.
13	1) Indicate key plan for location of the tank with coordinates. 2) Indicate RL/EL level of the area where the tank is located.	Document revised as per the comment.
14	Indicate Patratu project specific data	Document Modified
15	Patratu STPS EXP Phase-I Patratu Vidyut Utpadan Nigam Limited	Document Modified



DESIGN DATA		
DESIGN CODE	–	IS:803 1976 (REAFFIRMED 2013)
STORAGE PRODUCT	–	LIMESTONE SLURRY
TANK CAPACITY (HOLD VOLUME)	M ³	4642.19
TANK CAPACITY (EFFECTIVE)	M ³	4242
TYPE OF TANK	–	VERTICAL CYLINDRICAL FIXED CONE ROOF
ROOF SLOPE	–	5°
DESIGN PRESSURE	–	HYDROSTATIC HEAD
OPERATING PRESSURE	–	ATMOSPHERIC
OPERATING TEMPERATURE	°C	36.7
SPECIFIC GRAVITY	Kg/M ³	1218
HYDOR TESTING	–	WATER FILLED HEAD UPTO OVERFLOW NOZZLE
JOINT EFFECIENCY	–	0.7
RADIOGRAPHY	–	NO APPLICABLE
CORROSION ALLOWANCE	MM	3.0 MM FOR SHELL AND BOTTOM PLATE
WIND CODE	–	AS PER CONTRACT SPECIFICATION
SEISMIC CODE	–	AS PER CONTRACT SPECIFICATION
NO. OF TANK	NO.	02
DIAMETER (I.D)	MM	17500
HEIGHT	MM	19800
ROOF PLATE THICKNESS	MM	8
SHELL PLATE THICKNESS	MM	25,20,16,12,10,8,7 (REFER ELEVATION)
BOTTOM PLATE THICKNESS	MM	8
INSULATION	–	NOT APPLICABLE
INSIDE LINING	–	5MM THICK OF BEST QUALITY BROMINE BUTYL RUBBER LINING WITH HARDNESS 53±5 (SHORE A HARDNESS)

MATERIAL SPECIFICATION	
ITEM	MATERIAL
SHELL, ROOF, BASE AND BAFFLE PLATE	IS:2062 E250 GRADE BR
STRUCTURES	IS:2062 E250 GRADE A/BR
STAIRWAYS & PLTFS	IS:2062 E250 GRADE A/BR
MANHOLE	IS:2062 E250 GRADE BR
NOZZLE	A106 Gr B
NOZZLE FLANGES	IS:2062 E250 GRADE BR
NOZZLE REINFORCEMNT	IS:2062 E250 GRADE BR
NOZZLE NECKS	IS:1239
HAND RAILING	IS:1161
GASKETS	BUTYL RUBBER
BOLT	IS: 1367 CLASS 4.4
FITTINGS	A-105
EARTHING LUG	IS:2062 E250 GRADE BR
ANCHOR BOLT	IS:2062 E250 GRADE BR



KEY PLAN

NOZZLE SCHEDULE								
NOZZLE			QTY	FLANGE			SERVICE	REMARKS
MARK	SIZE	Sch. No.		RATING	FACING	STANDARD		
A-1	—	—	—	—	—	—	AGITATOR	
MH-1	NB800	—	1	—	SOFF	PLATE	MANHOLE	WITH HINGE
MH-2	NB800	—	1	PLATE	SOFF	—	MANHOLE	
N-1A/B	NB350	—	2	150	SOFF	ANSI B16.5	LIQUID INLET	
N-2	NB300	—	1	150	SOFF	ANSI B16.5	MINIMUM FLOW	
N-3	NB150	—	1	150	SOFF	ANSI B16.5	OVER FLOW	
LT-1&2	NB150	—	2	150	SOFF	ANSI B16.5	LEVEL TRANSMITTER	
V	NB80	—	1	150	SOFF	ANSI B16.5	VENT	
N-4	NB150	—	1	150	SOFF	ANSI B16.5	BOTTOM DRAIN	
N-5A/B/ C	NB200	—	1	150	SOFF	ANSI B16.5	PUMP SUCTION	

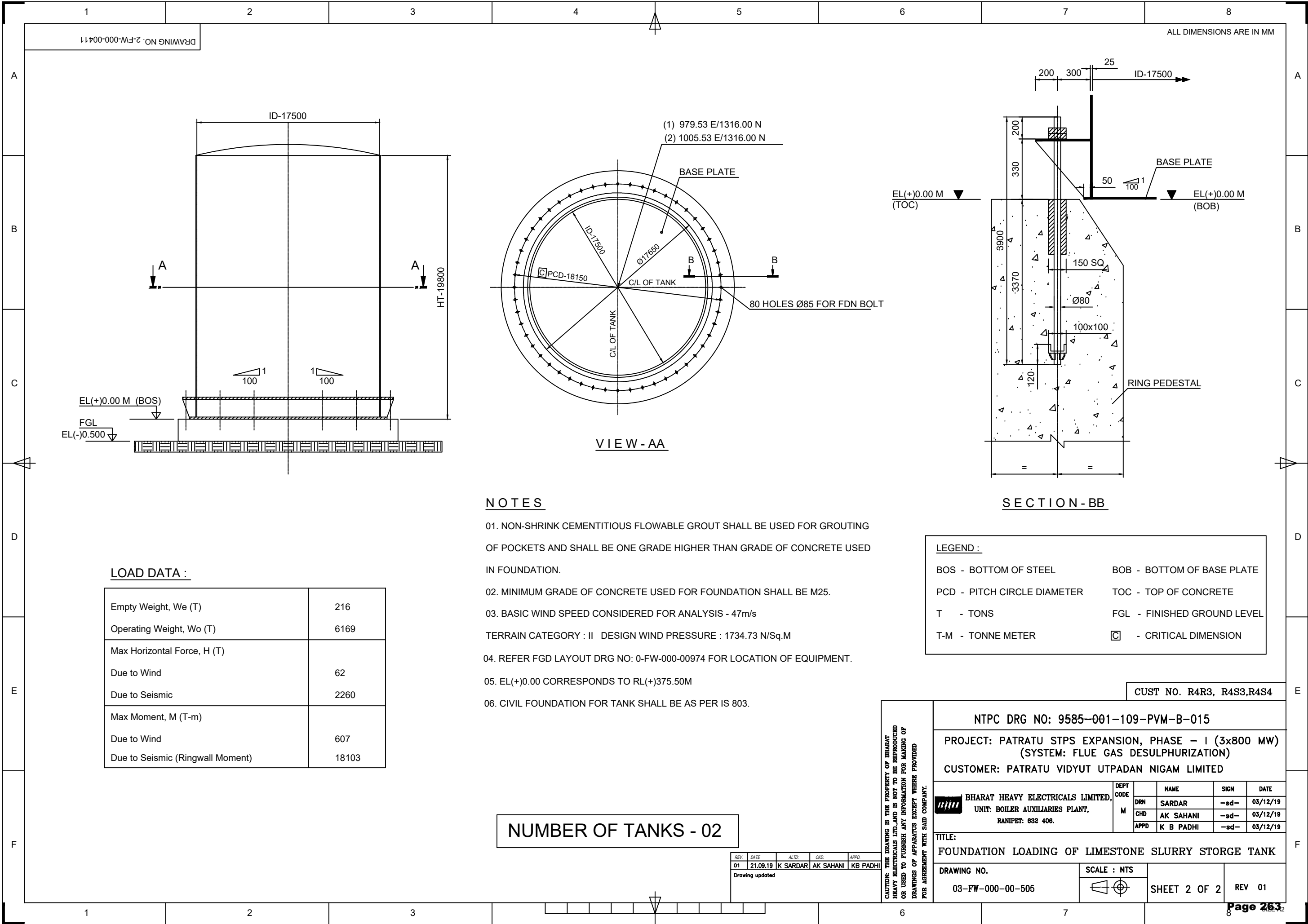
NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
2. EL($\pm$)0.000 IS THE GROUND FLOOR LEVEL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO RL(+375.50M. FGL OF THE AREA IS EL(-)0.500 i.e RL(+375.00M
3. FOR LOCATION REFER FGD SYSTEM LAYOUT, DRG NO 9585-001-109-PVM-F-001.
4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803.
6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
7. ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
8. NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS:803.
9. ALL BOLT HOLES SHALL STRADDLE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
10. ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
11. HYDRO TEST SHALL BE AS PER IS:803. LINING SHALL BE CARRIED-OUT AFTER HYDRO TEST.
12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
15. EARTHING LUG SHALL BE WELDED TO TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
16. REFER NEXT SHEET FOR LOADING DETAILS.
17. PAINTING SHALL BE AS PER APPROVED PAINTING SCHEDULE.

REV.	DATE	ALT.D.	CHKD.	APPD.
01	28.11.19	SARDAR K	AK SAHANI	KB PAD
DRAWING UPDATED AS PER CUSTOMER COMMENTS				

CUST NO. B483 B489 B484 SHARAT HEAVY ELECTRICALS LIMITED, UNIT: POWER EQUIPMENT PLANT, RAIPUR, INDIA	NTPC DRG. No. 9585-001-109-FVM-B-015				
	PROJECT:	PATRATU STPS EXPANSION, PHASE-I (3X300MW) (SYSTEM : PLUG GAS DESULPHURIZATION)			
	CUSTOMER:	PATRATU VIDYUT UTPADAN NIGAM LIMITED.			
	DEPT	NAME	REV	DATE	
	N	SRI SANDIP CHD PLANT AUTHRY APP: A.S.SAHAN	-#- -#- -#-	05.11.18 05.11.18 05.11.18	
TITLE:	GENERAL ARRANGEMENT AND DATA SHEET OF LIMESTONE SLURRY STORAGE TANK			SCALE : NTS 	
DRAWING NO.	03-FW-000-00-505		SH 01 OF 01	REV. 01	

** AGITATOR SHOWN ARE INDICATIVE WILL BE FINALIZED
 DURING DETAIL ENGINEERING.
 *** NOZZLE LOCATION SHOWN IN DRAWING ARE INDICATIVE
 WILL BE FINALIZED DURING DETAIL ENGINEERING.



00	12.11.2019	Fresh Issue	AKS	KBP	VVS
REV	DATE	DESCRIPTION / NOTE	PRD	CHD	APD

REVISIONS

TITLE :

General Arrangement of Secondary Hydrocyclone Feed Tank

OWNER / PROJECT:



PATRATU VIDYUT UTPADAN NIGAM LIMITED
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE-I (3 X 800 M W)

EPC CONTRACTOR:



BHARAT HEAVY ELECTRICALS LTD.
BOILER AUXILIARIES PLANT, RANIPET

COLLABORATOR:



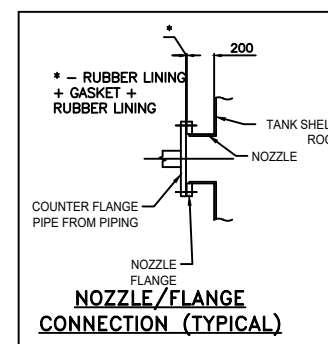
MITSUBISHI HITACHI POWER SYSTEMS, LTD
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

	BHEL	Sign	
PREPARED BY	A K SAHANI	-sd-	STATUS : <i>FOR APPROVAL</i>
CHECKED BY	K B PADHI	-sd-	BHEL CUST NO : R4R3, R4S3, R4S4
APPROVED BY	V V SUNDAR	-sd-	BHEL DOC NO : 03-FW-000-00-506
			REV NO : 00
CUSTOMER DRG./DOC NO.: 9585-001-109-PVM-B-016			



DESIGN DATA		
DESIGN CODE	-	IS:803 1976 (REAFFIRMED 2013)
STORAGE PRODUCT	-	ABSORBER BLEED
TANK CAPACITY (HOLD VOLUME)	m ³	623.45
TANK CAPACITY (EFFECTIVE)	m ³	528.03
TYPE OF TANK	-	VERTICAL CYLINDRICAL FIXED CONE ROOF
ROOF SLOPE	-	5°
DESIGN PRESSURE	-	HYDROSTATIC HEAD
OPERATING PRESSURE	-	ATMOSPHERIC
OPERATING TEMPERATURE	°C	58
SPECIFIC GRAVITY	Kg/m ³	1114
HYDOR TESTING	-	WATER FILLED HEAD UPTO OVERFLOW NOZZLE
JOINT EFFECIENCY	-	0.7
RADIOGRAPHY	-	NO APPLICABLE
CORROSION ALLOWANCE	MM	1.5MM FOR SHELL AND BOTTOM PLATE
WIND CODE	-	AS PER CONTRACT SPECIFICATION
SEISMIC CODE	-	AS PER CONTRACT SPECIFICATION
NO. OF TANK	NO.	01
DIAMETER (I.D)	MM	9000
HEIGHT	MM	10300
ROOF PLATE THICKNESS	MM	8
SHELL PLATE THICKNESS	MM	8,6 (REFER ELEVATION)
BOTTOM PLATE THICKNESS	MM	8
INSULATION	-	NOT APPLICABLE
INSIDE LINING	-	5MM THICK OF BEST QUALITY BROMINE BUTYL RUBBER LINING WITH HARDNESS 53±5 (SHORE A HARDNESS)

MATERIAL SPECIFICATION	
ITEM	MATERIAL
SHELL, ROOF, BASE AND BAFFLE PLATE	IS:2062 E250 GRADE BR
STRUCTURES	IS:2062 E250 GRADE A/BR
STAIRWAYS & PLTFS	IS:2062 E250 GRADE A/BR
MANHOLE	IS:2062 E250 GRADE BR
NOZZLE	A106 Gr B
NOZZLE FLANGES	IS:2062 E250 GRADE BR
NOZZLE REINFORCEMNT	IS:2062 E250 GRADE BR
NOZZLE NECKS	IS:1239
HAND RAILING	IS:1161
GASKETS	BUTYL RUBBER
BOLT	IS: 1367 CLASS 4.4
FITTINGS	A-105
EARTHING LUG	IS:2062 E250 GRADE BR
ANCHOR BOLT	IS:2062 E250 GRADE BR



NOZZLE SCHEDULE								
NOZZLE			QTY	FLANGE			SERVICE	REMARKS
MARK	SIZE	Sch. No.		RATING	FACING	STANDARD		
A-1	—	—	—	—	—	—	AGITATOR	
MH-1	NB800	—	1	—	SOFF	PLATE	MANHOLE	WITH HINGE
MH-2	NB800	—	1	PLATE	SOFF	—	MANHOLE	
N-1A/B	NB550	—	2	150	SOFF	ANSI B16.5	LIQUID INLET	
N-2	NB400	—	1	150	SOFF	ANSI B16.5	MINIMUM FLOW	
N-3	NB200	—	1	150	SOFF	ANSI B16.5	OVERFLOW	
LT-1&2	NB150	—	2	150	SOFF	ANSI B16.5	LEVEL TRANSMITTER	
V	NB80	—	1	150	SOFF	ANSI B16.5	VENT	
N-4	NB200	—	1	150	SOFF	ANSI B16.5	BOTTOM DRAIN	
N-5A/B	NB400	—	2	150	SOFF	ANSI B16.5	PUMP SUCTION	

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
2. EL(±)0.000 IS THE GROUND FLOOR LEVEL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO RL(+375.50M. FGL OF THE AREA IS EL(-)0.500 i.e RL(+375.00M
3. FOR LOCATION REFER FGD SYSTEM LAYOUT, DRG NO 9585-001-109-PVM-F-001.
4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803.
6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
7. ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
8. NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS803.
9. ALL BOLT HOLES SHALL STRADDLE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
10. ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
11. HYDRO TEST SHALL BE AS PER IS803. LINING SHALL BE CARRIED-OUT AFTER HYDRO TEST.
12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
15. EARTHING LUG SHALL BE WELDED TO TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
16. REFER 2-FW-000-00409 SH 2 FOR LOADING DETAILS.

** AGITATOR SHOWN ARE INDICATIVE WILL BE FINALIZED
 DURING DETAIL ENGINEERING.
 *** NOZZLE LOCATION SHOWN IN DRAWING ARE INDICATIVE
 WILL BE FINALIZED DURING DETAIL ENGINEERING.

REV.	DATE	ALTD.	CHKD.	APPD.
-	-	-	-	-
-				

CUSTY NO R483 R483 R484	NTPC DRG. No. 9585-001-109-PVM-B-016					
	PROJECT:	PATRATRU, PHASE-I (3X800MW) (SYSTEM : FLUE GAS DESULPHURIZATION)				
	CUSTOMER (Unit of origin) NTPC	NTPC LIMITED. (A GOVERNMENT OF INDIA ENTERPRISE)				
		SHARAD HEAVY ELECTRICALS LIMITED, UNIT-108, AUTOMOBILE PLANT, BOHATERA G.O.	DESIGNED BY HSE	CHECKED BY CH	DATE 12.11.11	
		APPROVED BY A.K.SANANI	DATE 04-12-11	DATE 12.11.11	DATE 04-12-11	
TITLE: GENERAL ARRANGEMENT AND DATA SHEET OF SECONDARY HYDRO-CYCLONE FEED TANK						
DRAWING NO.		03-FW-000-00-506		SH 01 OF 01		REV. 00

02	03.12.2019	Revised as per NTPC Comments	AKS	KBP	VVS
01	12.11.2019	Wrong upload in previous revision	AKS	KBP	VVS
00	09.09.2019	Fresh Issue	AKS	KBP	VVS
REV	DATE	DESCRIPTION / NOTE	PRD	CHD	APD

REVISIONS

TITLE :

General Arrangement of Filtrate Water Tank

OWNER / PROJECT:



PATRATU VIDYUT UTPADAN NIGAM LIMITED
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE-I (3 X 800 M W)

EPC CONTRACTOR:



BHARAT HEAVY ELECTRICALS LTD.
BOILER AUXILIARIES PLANT, RANIPET

COLLABORATOR:

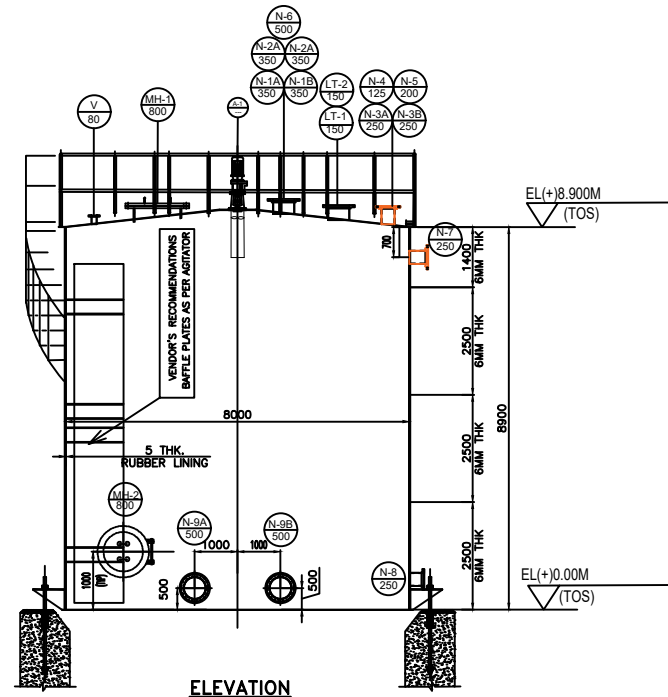


MITSUBISHI HITACHI POWER SYSTEMS, LTD
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

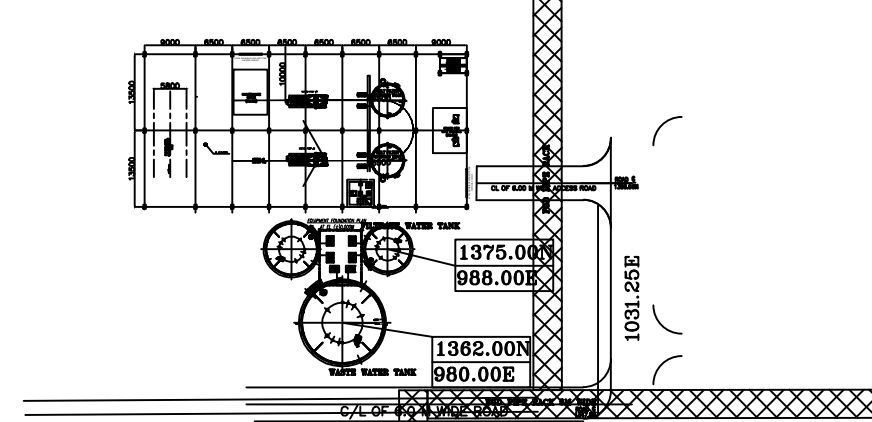
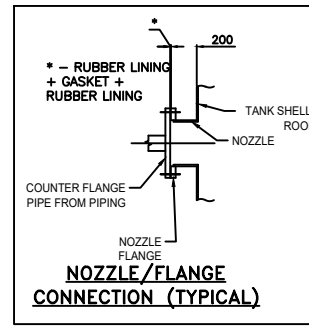
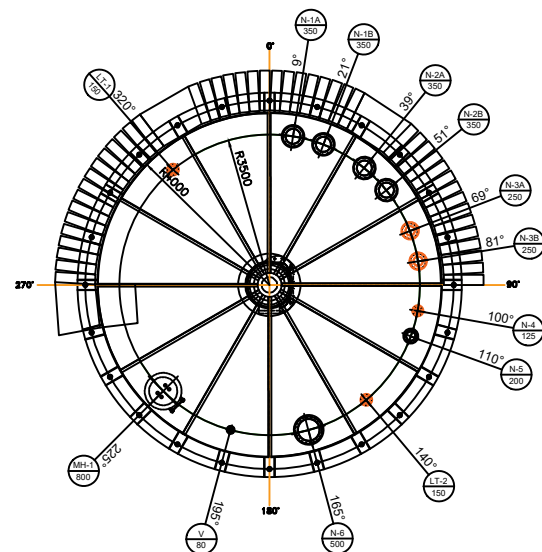
	BHEL	Sign	
PREPARED BY	A K SAHANI	-sd-	STATUS : <i>FOR APPROVAL</i>
CHECKED BY	K B PADHI	-sd-	BHEL CUST NO : R4R3, R4S3, R4S4
APPROVED BY	V V SUNDAR	-sd-	BHEL DOC NO : 03-FW-000-00-512
			REV NO : 02
CUSTOMER DRG./DOC NO.: 9585-001-109-PVM-B-023			

Document title: Data Sheet & GA of Filtrate Water Tank**NTPC Drawing No: 9585-001-109-PVM-B-023****Reply to Rev00:**

S.NO	NTPC COMMENTS	BHEL REPLY
1.	Both the LT shall be placed diagonally opposite to each other on tank top. Accordingly revise the location of the flange in the drg.	Document revised as per the comment.
2.	What is the opening size of agitator? What is agitator height? What is the maintenance procedure of agitator?	Agitator is a bought out item and details can be provided after finalisation of the vendor in the data sheet P&IDs of agitators.
3.	Check wrt Mass Flow Balance	Checked and document modified
4.	As per clause 10.01.00 of Sub-section A-05, Part-B, additional corrosion allowance of 3mm on the min. tank steel thickness	Document checked and modified
5.	What is the basis of plate thickness?	As per IS:803
6.	Kindly provide stress values of plate material at design temperature for calculating plate thickness.	Yield stress of E250 grade plate at design temperature will be 250mPa as per IS:800
7.	Include Agitator details	Agitator is a bought out item and details can be provided after finalisation of the vendor in the data sheet P&IDs of agitators.
8.	What is the width of spiral staircase?	Width of spiral staircase will be 800mm.
9.	Include the foundation load data	Included in the revised document
10	To be finalised.	Agitator details will be finalised after vendor finalisation and nozzle details will be finalised after piping layout finalisation.
11	Indicate key plan for location of the tank with coordinates.	Document revised as per the comment.
12	Patratu STPS EXP Phase-I Patratu Vidyut Utpadan Nigam Limited	Document Modified



DESIGN DATA		
DESIGN CODE	—	IS:803 1976 (REAFFIRMED 2013)
STORAGE PRODUCT	—	ABSORBER BLEED
TANK CAPACITY (HOLD VOLUME)	M ³	422.20
TANK CAPACITY (EFFECTIVE)	M ³	351.86
TYPE OF TANK	—	VERTICAL CYLINDRICAL FIXED CONE ROOF
ROOF SLOPE	—	5°
DESIGN PRESSURE	—	HYDROSTATIC HEAD
OPERATING PRESSURE	—	ATMOSPHERIC
OPERATING TEMPERATURE	°C	58.3
SPECIFIC GRAVITY	Kg/M ³	1098
HYDOR TESTING	—	WATER FILLED HEAD UPTO OVERFLOW NOZZLE
JOINT EFFECIENCY	—	0.7
RADIOGRAPHY	—	NO APPLICABLE
CORROSION ALLOWANCE	MM	3.0 MM FOR SHELL AND BOTTOM PLATE
WIND CODE	—	AS PER CONTRACT SPECIFICATION
SEISMIC CODE	—	AS PER CONTRACT SPECIFICATION
NO. OF TANK	NO.	01
DIAMETER (I.D)	MM	8000
HEIGHT	MM	8900
ROOF PLATE THICKNESS	MM	8
SHELL PLATE THICKNESS	MM	6 (REFER ELEVATION)
BOTTOM PLATE THICKNESS	MM	8
INSULATION	—	NOT APPLICABLE
INSIDE LINING	—	5MM THICK OF BEST QUALITY BROMINE BUTYL RUBBER LINING WITH HARDNESS 53±5 (SHORE A HARDNESS)



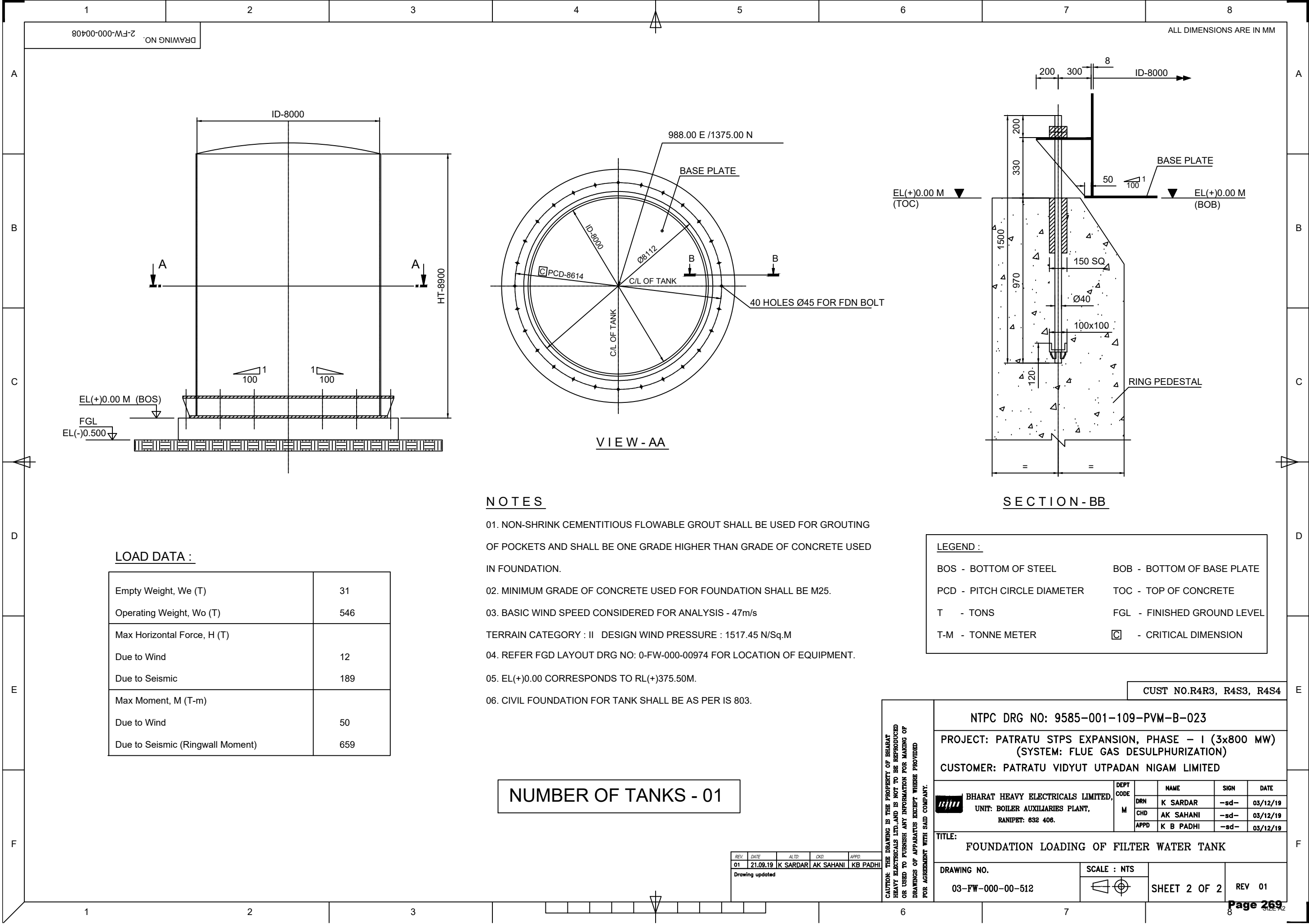
NOZZLE SCHEDULE								
NOZZLE			QTY	FLANGE			SERVICE	REMARKS
MARK	SIZE	Sch. No.		RATING	FACING	STANDARD		
A-1	—	—	—	—	—	—	AGITATOR	
MH-1	NB800	—	1	—	SOFF	PLATE	MANHOLE	WITH HINGE
MH-2	NB800	—	1	PLATE	SOFF	—	MANHOLE	
N-1A/B	NB350	—	2	150	SOFF	ANSI B16.5	LIQUID INLET	
N-2A/B	NB350	—	2	150	SOFF	ANSI B16.5	LIQUID INLET	
N-3A/B	NB250	—	2	150	SOFF	ANSI B16.5	LIQUID INLET	
LT-1&2	NB150	—	2	150	SOFF	ANSI B16.5	LEVEL TRANSMITTER	
V	NB80	—	1	150	SOFF	ANSI B16.5	VENT	
N-4	NB125	—	1	150	SOFF	ANSI B16.5	LIQUID INLET	
N-5	NB200	—	1	150	SOFF	ANSI B16.5	LIQUID INLET	
N-6	NB500	—	1	150	SOFF	ANSI B16.5	MINIMUM FLOW	
N-7	NB250	—	1	150	SOFF	ANSI B16.5	OVERFLOW	
N-8	NB250	—	1	150	SOFF	ANSI B16.5	BOTTOM DRAIN	
N-9A/B	NB500	—	2	150	SOFF	ANSI B16.5	PUMP SUCTION	

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
2. $EL(\pm)0.000$ IS THE GROUND FLOOR LEVEL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO $RL(+)375.50M$. FGL OF THE AREA IS $EL(-)0.500$ i.e. $RL(+)375.00M$
3. FOR LOCATION REFER FGD SYSTEM LAYOUT, DRG NO 9585-001-109-PVM-F-001.
4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803.
6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
7. ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
8. NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS803.
9. ALL BOLT HOLES SHALL STRADDE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
10. ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
11. HYDRO TEST SHALL BE AS PER IS803. LINING SHALL BE CARRIED-OUT AFTER HYDRO TEST.
12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
15. EARTHING LUG SHALL BE WELDED TO TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
16. REFER NEXT SHEET FOR LOADING DETAILS.
17. PAINTING SHALL BE AS PER APPROVED PAINTING SCHEDULE.

REV.	DATE	ALTD:	CKD.	APPD.
01	28.11.19	SARDAR K	AK SAHANI	KB PADHI
DRAWING UPDATED AS PER CUSTOMER COMMENTS				

CUST NO. RAB MBS MSS	NTPC DRG. No. 9585-001-109-PVM-B-023										
	PROJECT:	PATRATU STPS EXPANSION, PHASE-I (XSBOMW) (SYSTEM : FLUE GAS DESULPHURIZATION)									
		CUSTOMER:	PATRATU VIDYUT UTPADAN NIGAM LIMITED.								
	HARSHAT HEAVY ELECTRICALS LIMITED, UNIT: POWER AUXILIARY PLANT, RAIPURHORE AHS.				DEPT CODE M	NAME SHRI SAMBAR CHD PULI ANTONY A.K.SAHANI	DATE -/- -/- -/-	TIME 05.11.99 05.11.99 05.11.99			
	TITLE: GENERAL ARRANGEMENT AND DATA SHEET OF FILTRATE WATER TANK								SCALE : MTS		
	DRAWING NO. 3-FW-000-00-512								SH 01 OF 01	REV. 01	



00	12.11.2019	Fresh Issue	AKS	KBP	VVS
REV	DATE	DESCRIPTION / NOTE	PRD	CHD	APD

REVISIONS

TITLE :

General Arrangement of Waste Water Tank

OWNER / PROJECT:



PATRATU VIDYUT UTPADAN NIGAM LIMITED
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE-I (3 X 800 M W)

EPC CONTRACTOR:



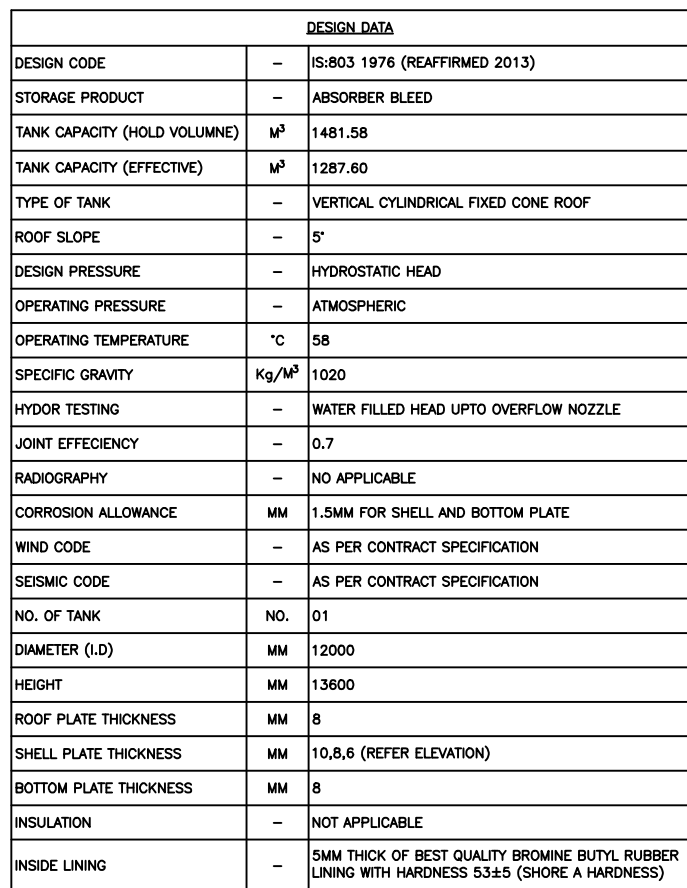
BHARAT HEAVY ELECTRICALS LTD.
BOILER AUXILIARIES PLANT, RANIPET

COLLABORATOR:

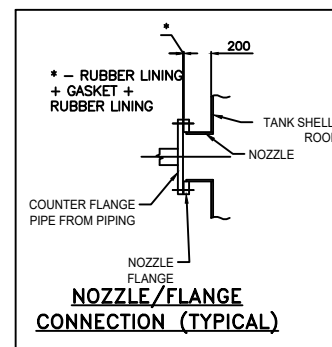
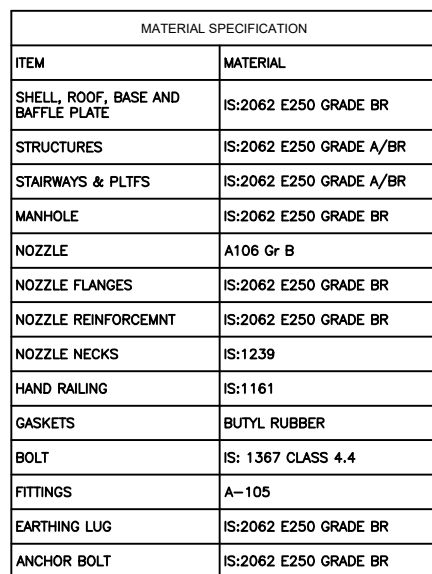


MITSUBISHI HITACHI POWER SYSTEMS, LTD
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

	BHEL	Sign	
PREPARED BY	A K SAHANI	-sd-	STATUS : <i>FOR APPROVAL</i>
CHECKED BY	K B PADHI	-sd-	BHEL CUST NO : R4R3, R4S3, R4S4
APPROVED BY	V V SUNDAR	-sd-	BHEL DOC NO : 03-FW-000-00-515
			REV NO : 00
CUSTOMER DRG./DOC NO.: 9585-001-109-PVM-B-027			



NOZZLE SCHEDULE								
NOZZLE			QTY	FLANGE			SERVICE	REMARKS
MARK	SIZE	Sch. No.		RATING	FACING	STANDARD		
A-1	—	—	—	—	—	—	AGITATOR	
MH-1	NB800	—	1	—	SOFF	PLATE	MANHOLE	WITH HINGE
MH-2	NB800	—	1	PLATE	SOFF	—	MANHOLE	
N-1A/B	NB450	—	2	150	SOFF	ANSI B16.5	LIQUID INLET	
N-2	NB100	—	1	150	SOFF	ANSI B16.5	MINIMUM FLOW	
N-3	NB200	—	1	150	SOFF	ANSI B16.5	MINIMUM FLOW	
LT-1&2	NB150	—	2	150	SOFF	ANSI B16.5	LEVEL TRANSMITTER	
V	NB80	—	1	150	SOFF	ANSI B16.5	VENT	
N-4	NB150	—	1	150	SOFF	ANSI B16.5	OVERFLOW	
N-5	NB150	—	1	150	SOFF	ANSI B16.5	BOTTOM DRAIN	
N-6A/B	NB300	—	2	150	SOFF	ANSI B16.5	PUMP SUCTION	



- NOTES:**
1. ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
 2. EL(±)0.000 IS THE GROUND FLOOR LEVEL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO RL(+375.50M. FGL OF THE AREA IS EL(-0.500 i.e RL(+375.00M
 3. FOR LOCATION REFER FGD SYSTEM LAYOUT, DRG NO 9585-001-109-PVM-F-001.
 4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
 5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803.
 6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
 7. ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
 8. NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS:803.
 9. ALL BOLT HOLES SHALL STRADDLE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
 10. ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
 11. HYDRO TEST SHALL BE AS PER IS803. LINING SHALL BE CARRIED-OUT AFTER HYDRO TEST.
 12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
 13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
 14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
 15. EARTHING LUG SHALL BE WELDED TO TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
 16. REFER 2-FW-000-00410 SH 2 FOR LOADING DETAILS.

** AGITATOR SHOWN ARE INDICATIVE WILL BE FINALIZED
 DURING DETAIL ENGINEERING.
 *** NOZZLE LOCATION SHOWN IN DRAWING ARE INDICATIVE
 WILL BE FINALIZED DURING DETAIL ENGINEERING.

REV.	DATE	ALTD.	CHKD.	APPD.
-	-	-	-	-

CUSTOM NO. R4RS R4SS R4SA PROJECT: CONTRACT NO.  NTPS DRAWING NO.	NTPC DRG. No. 9585-001-109-PVM-B-027				
	(SYSTEM : FLUE GAS DESULPHURIZATION)				
	N Patratu Vidyut Utpadan Nigam				
	REARAY HEAVY ELECTRICALS LIMITED, UNIT: BOILER AIRHEATING PLANT, BARRAPURAH GIL. KOLKATA-700014	DEPT. N	NAME DRW SAGDAR CHD PRLEK ANTONY APPD A.K.SAMANI	SNO -01 -02 -03	DATE 12.11.19 12.11.19 12.11.19
	TITLE: GENERAL ARRANGEMENT AND DATA SHEET OF WASTE WATER TANK				
	DRAWING NO. 3-FW-000-00-515 SH 01 Of 01 REV. 00				

01	03.12.2019	Revised as per NTPC Comments	AKS	KBP	VVS
00	12.11.2019	Fresh Issue	AKS	KBP	VVS
REV	DATE	DESCRIPTION / NOTE	PRD	CHD	APD

REVISIONS

TITLE :

General Arrangement of Auxiliary Absorbent(Storage) Tank

OWNER / PROJECT:



PATRATU VIDYUT UTPADAN NIGAM LIMITED
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE-I (3 X 800 M W)

EPC CONTRACTOR:



BHARAT HEAVY ELECTRICALS LTD.
BOILER AUXILIARIES PLANT, RANIPET

COLLABORATOR:



MITSUBISHI HITACHI POWER SYSTEMS, LTD
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

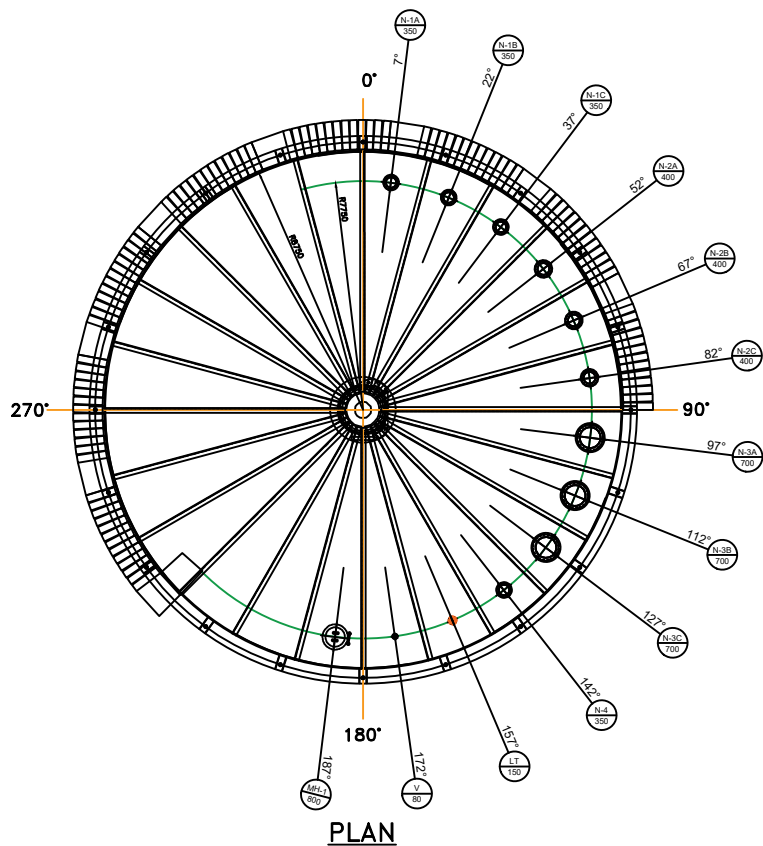
	BHEL	Sign	
PREPARED BY	A K SAHANI	-sd-	STATUS : FOR APPROVAL
CHECKED BY	K B PADHI	-sd-	BHEL CUST NO : R4R3, R4S3, R4S4
APPROVED BY	V V SUNDAR	-sd-	BHEL DOC NO : 03-FW-000-00-519
			REV NO : 01
CUSTOMER DRG./DOC NO.: 9585-001-109-PVM-B-031			

Document title: Data Sheet & GA of Auxiliary Absorbent(Storage) Tank

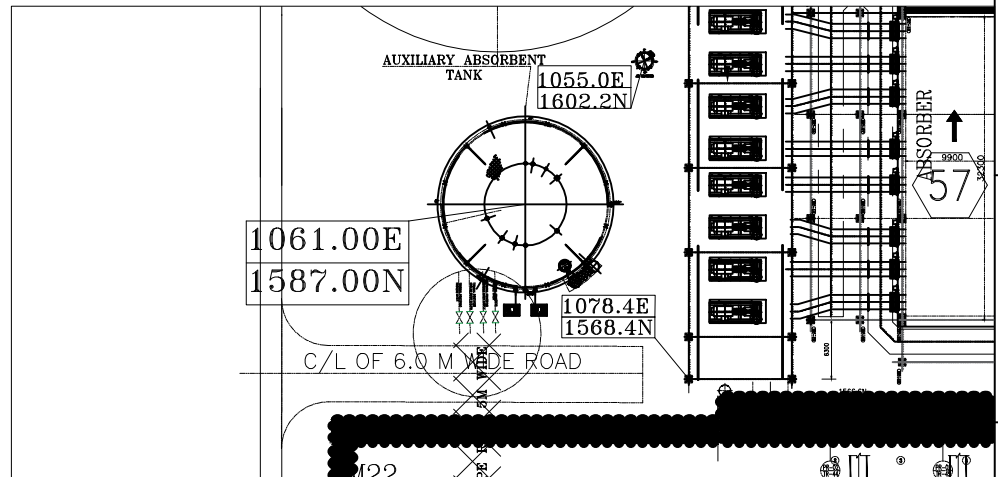
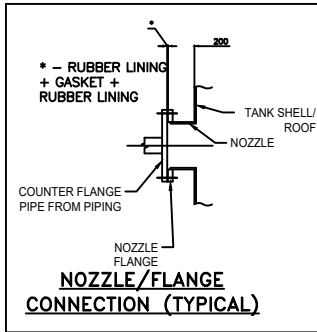
NTPC Drawing No: 9585-001-109-PVM-B-031

Reply to Rev00:

S.NO	NTPC COMMENTS	BHEL REPLY
1.	Both the LT shall be placed diagonally opposite to each other on tank top. Accordingly revise the location of the flange in the drg.	Document revised as per the comment.
2.	What is the opening size of agitator? What is agitator height? What is the maintenance procedure of agitator?	Agitator is a bought out item and details can be provided after finalisation of the vendor in the data sheet P&IDs of agitators.
3.	Agitator shall be provided with emergency flushing system. Kindly identify the same.	Flushing system for agitators is not provided as per the standard MHPS practice.
4.	The Auxiliary Absorbent tank shall be equipped with an opening to enable easy entry of a man with wheelbarrow. BHEL to confirm.	Noted and confirmed
5.	4666.25 m3	Checked and document modified
6.	As per clause 10.01.00 of Sub-section A-05, Part-B, additional corrosion allowance of 3mm on the min. tank steel thickness	Document checked and modified
7.	What is the basis of plate thickness?	As per IS:803
8.	Kindly provide stress values of plate material at design temperature for calculating plate thickness.	Yield stress of E250 grade plate at design temperature will be 250mPa as per IS:800
9.	What is the width of spiral staircase?	Width of spiral staircase will be 800mm.
10	Include the foundation load data	Included in the revised document
11	To be finalised.	Agitator details will be finalised after vendor finalisation and nozzle details will be finalised after piping layout finalisation.
12	Indicate key plan for location of the tank with coordinates.	Document revised as per the comment.
13	Include Agitator details	Agitator is a bought out item and details can be provided after finalisation of the vendor in the data sheet P&IDs of agitators.
14	Patratu STPS EXP Phase-I Patratu Vidyut Utpadan Nigam Limited	Document Modified



MATERIAL SPECIFICATION	
ITEM	MATERIAL
SHELL, ROOF, BASE AND BAFFLE PLATE	IS:2062 E250 GRADE BR
STRUCTURES	IS:2062 E250 GRADE A/BR
STAIRWAYS & PLTFS	IS:2062 E250 GRADE A/BR
MANHOLE	IS:2062 E250 GRADE BR
NOZZLE	A106 Gr B
NOZZLE FLANGES	IS:2062 E250 GRADE BR
NOZZLE REINFORCEMNT	IS:2062 E250 GRADE BR
NOZZLE NECKS	IS:1239
HAND RAILING	IS:1161
GASKETS	BUTYL RUBBER
BOLT	IS: 1367 CLASS 4.4
FITTINGS	A-105
EARTHING LUG	IS:2062 E250 GRADE BR
ANCHOR BOLT	IS:2062 E250 GRADE BR



NOZZLE			QTY	FLANGE			SERVICE	REMARKS
MARK	SIZE	Sch. No.		RATING	FACING	STANDARD		
A-1	—	—	—	—	—	—	AGITATOR	AS PER VENDOR
MH-1	NB800	—	1	—	SOFF	PLATE	MANHOLE	WITH HINGE
MH-2	NB800	—	1	PLATE	SOFF	—	MANHOLE	
N-1A/B/C	NB350	—	3	150	SOFF	ANSI B16.5	LIQUID INLET	
N-2A/B/C	NB400	—	3	150	SOFF	ANSI B16.5	LIQUID INLET	
N-3A/B/C	NB700	—	3	150	SOFF	ANSI B16.5	LIQUID INLET	
LT	NB150	—	1	150	SOFF	ANSI B16.5	LEVEL TRANSMITTER	
V	NB80	—	1	150	SOFF	ANSI B16.5	VENT	
N-4	NB350	—	1	150	SOFF	ANSI B16.5	MINIMUM FLOW	
N-5	NB200	—	1	150	SOFF	ANSI B16.5	OVERFLOW	
N-6	NB200	—	1	150	SOFF	ANSI B16.5	BOTTOM DRAIN	
N-7	NB350	—	1	150	SOFF	ANSI B16.5	PUMP SUCTION	

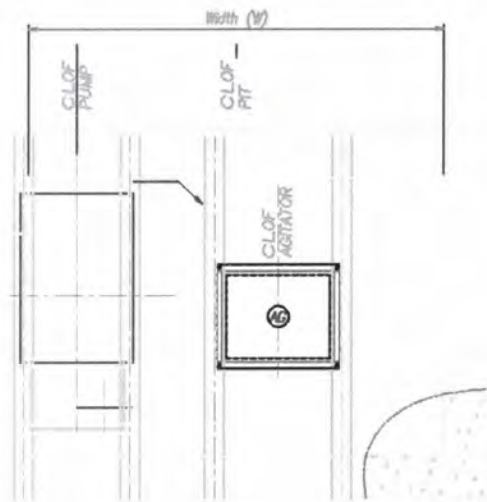
- NOTES:**
1. ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
 2. EL($\pm$)0.000 IS THE GROUND FLOOR LEVEL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO RL(+)-375.50M. FGL OF THE AREA IS EL(-)0.500 i.e RL(+)-375.00M
 3. FOR LOCATION REFER FGD SYSTEM LAYOUT, DRG NO 9585-001-109-PVM-F-001.
 4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
 5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803.
 6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
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 12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
 13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
 14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
 15. EARTHING LUG SHALL BE WELDED TO TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
 16. REFER SEPARATE SHEET FOR LOADING DETAILS.
 17. PAINTING SHALL BE AS PER APPROVED PAINTING SCHEDULE.

REV.	DATE	ALTD.	CHKD.	APPD.
01	28.11.19	SARDAR K	AK SAHANI	KB PADHI
DRAWING UPDATED AS PER CUSTOMER COMMENTS				

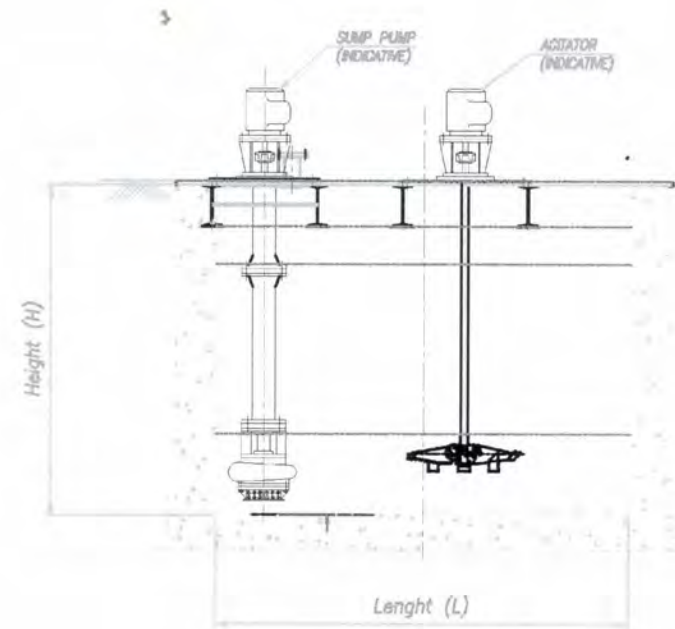
CUST NO R433 R433 R434 THIS DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD. IN WHATEVER FORM OR BY WHATEVER MEANS IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF BHARAT HEAVY ELECTRICALS LTD.	NTPC DRG. No. 9585-001-109-PVM-B-031												
	PROJECT: PATRATRU STPS EXPANSION, PHASE-1 (3300MW) (SYSTEM : FLUE GAS DESULFURATION)												
	CUSTOMER: PATRATRU VIDYUT UTPADAN NIGAM LIMITED.												
		BHARAT HEAVY ELECTRICALS LIMITED.		DEPT	DESIGN	DATE	REV	DATE					
		UNIT: BOKARO AUTOMOBILE PLANT, RUMKHA, INDIA.		CODE	CODE	CODE	CODE	CODE					
TITLE: GENERAL ARRANGEMENT AND DATA SHEET OF AUXILIARY ABSORBENT (STORAGE) TANK										SCALE : NTS			
DRAWING NO. 3-FW-000-00-519										SH 01 OF 01		REV. 01	

Sketch of Drain Pit (Typical)

All dimensions are in mm



Plan



Elevation

Note:

For dimension, please refer clause no: 5.1 Table No: 4 of technical specificaion



TITLE:

**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I, SUB-SECTION- D

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

ANNEXURE-IV

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION



TITLE:	PATRATU STPP FGD PACKAGE TECHNICAL SPECIFICATION FOR AGITATORS	SPEC. NO.: PE-TS-434-571-18000-A001
		SECTION-I, SUB-SECTION- D, ANNEXURE-IV
		REV. NO.: 00 DATE DEC 2019

DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

The successful bidder shall submit the following drawings / documents during detail engineering for approval / information / reference (as the case may be): -

Sl. No.	BHEL Drawing / Document No.	Title	Schedule Date	Drawing Classification
1	PE-V0-434-XXX-A001	GA drawing, Exploded view, sectional view with Material of construction, mechanical seal , gearbox for all Agitator models	2 weeks from LOI	Primary
2	PE-V0-434-XXX-A002	Data sheet for all Agitator	2 weeks from LOI	Primary
3	PE-V0-434-XXX-A003	Agitator Performance curve of all Agitators	2 weeks from LOI	Primary
4	PE-V0-434-XXX-A004	Electrical motor GA drawing & Data sheet and performance curves of all motors	2 weeks from LOI	Primary
5	PE-V0-434-XXX-A005	Quality plan & Inspection and Test Procedure	2 weeks from LOI	Primary
6	PE-V0-434-XXX-A006	Agitator and Motor Sizing Calculation	2 weeks from LOI	Primary
7	PE-V0-434-XXX-A007	O&M Manual for Agitator	4 weeks from LOI	Secondary
8	PE-V0-434-XXX-A008	Utility Consumption	4 weeks from LOI	Secondary
9	PE-V0-434-XXX-A009	Foundation Data including Anchor plan	4 weeks from LOI	Secondary
10	PE-V0-434-XXX-A010	Lubricating oil list	4 weeks from LOI	Secondary
11	PE-V0-434-XXX-A011	Special tools list, Start-up & Commissioning Spares	4 weeks from LOI	Secondary
12	PE-V0-434-XXX-A012	Installation and assembly procedure including Pre Commissioning Check List	4 weeks from LOI	Secondary



TITLE:

**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPEC. NO.: PE-TS-434-571-18000-A001

SECTION-I, SUB-SECTION- D, ANNEXURE-IV

REV. NO.: 00

DATE DEC 2019

NOTE: Drwg/ Document shall be uploaded by the successful bidder on WRENCH /DMS.Procedure for the same will be informed after award of contract.

1.The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above

may not be applicable, some additional drawings may also be required based on scope of work.

2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.

4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:

a) All drawings and documents shall indicate the list of all reference drawings including General Arrangement.

b) All drawings shall include / show plan, elevation, side view, cross-section, skin section, blow-up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C... etc. while drawings documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.



TITLE:

**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPEC. NO.: PE-TS-434-571-18000-A001

SECTION-I, SUB-SECTION- D, ANNEXURE-IV

REV. NO.: 00

DATE DEC 2019

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No. Documents marked for submission to BHEL's Customer shall also bear BHEL's Customer's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments.

o) The primary drawings are to be considered as the basic engineering drawings.

Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

COMPANY SEAL

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____



TITLE:

**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-I, SUB-SECTION- D

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

ANNEXURE-V

SEA-WORTHY PACKING PROCEDURE



Mechanical Auxiliaries Department,
PEM, PPEI Building,
NOIDA

Ref No.: PEA00-Misc/PKD

Date: 12/08/10

Sub: Technical specification for Seaworthy Packing for Export Jobs

A taskforce was constituted vide order dated 21/06/2010 for finalization of seaworthy packing specification for export jobs with the following members.

Mr. SK Anand,
Mr. Ashwani Khanna
Mr. Rajnish Goyal
Mr. PK Das

After several rounds of discussions among task force members it was decided to have latest practices being followed in other industries for export packing. Same was arranged from few industries.

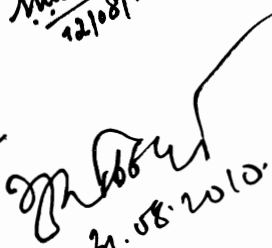
A detailed specification for seaworthy packing for export jobs has been prepared taking care of latest practices being followed and requirements in our existing specification for wooden box/crates. Same is enclosed for reference and final issue.


(PK DAS)
Convener (Task Force)

GM/MAX


12/08/10

ED/PEM


31.08.2010

VOLUME IIB

**TECHNICAL SPECIFICATION
FOR
SEAWORTHY PACKING FOR EXPORT JOBS**

SPECIFICATION NO. PE-TS-888-100-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI, INDIA**

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 1	OF 52

1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

2.0 SCOPE

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.

3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

4.0 Definitions

- "BHEL" : Main EPC vendor
- "OWNER" : Customer for a particular export project.
- "VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.
- "GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.
- "PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .
- "FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

5. General Information

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 2	OF 52

The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves VENDOR of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support GOODS during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the GOODS to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the GOODS during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When VENDOR do not have packing capabilities/facilities of their own and therefore intends to sub-contract, VENDOR have to inform BHEL/Purchaser of the name and address of proposed PACKER(s) for approval.

6.0 Criteria for Selection of Packaging

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the GOODS have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If VENDOR has any doubt about the correct method of protection or packing, he should contact BHEL/Purchaser in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
-

Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

6.1 Hazardous Materials

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

6.2 Non-Hazardous GOODS

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

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7.0 Marking Instructions & Despatch details, Storage Code

7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- "KEEP DRY"

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.

The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.

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7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour**.

- X Crates or packages to be stored outdoor without covers
- XX Crates or packages to be stored under tarpaulin
- XXX Crates or packages to be stored in covered or enclosed premises
- XXXX Crates or packages which must be stored in air-conditioned premises

8.0 GUIDELINES FOR PACKING GOODS

8.1 In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

IMPORTANT NOTE:

Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.

8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.

All pipes 2" included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.

All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

8.1.4 Structural Steel

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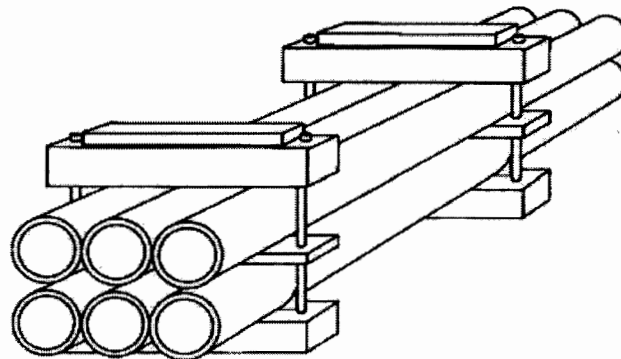
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

8.2 Bundling – Packing Category I

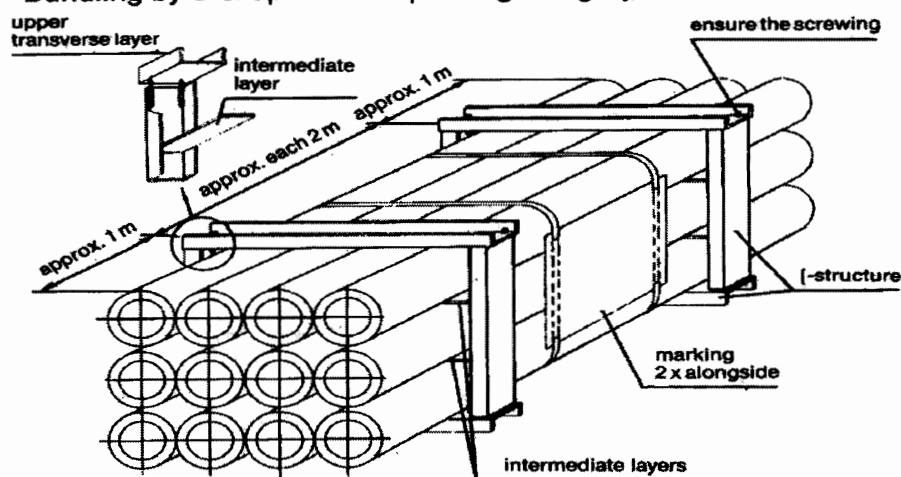
8.2.1 Type of Equipment

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.

Packing category I



Bundling by U-shaped iron – packing category I A



8.2.2 Type of Construction

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- Bundling has to be effected
- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

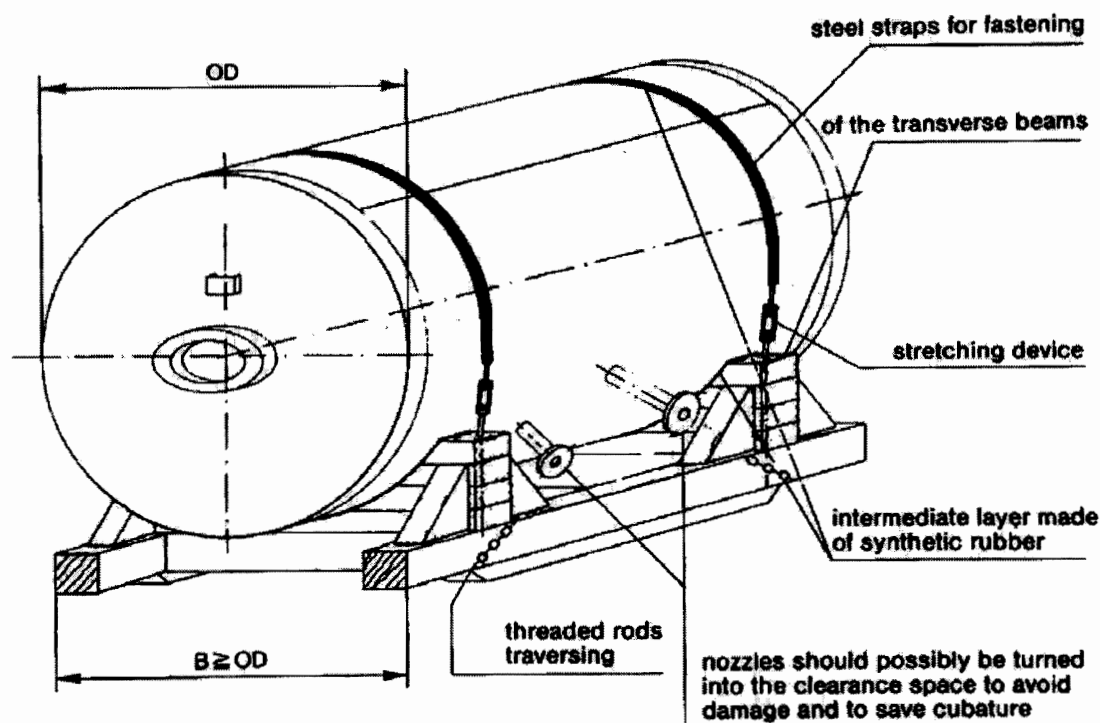
8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



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8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.

8.4.1 Packing Category III

8.4.1.1 Type of Equipment

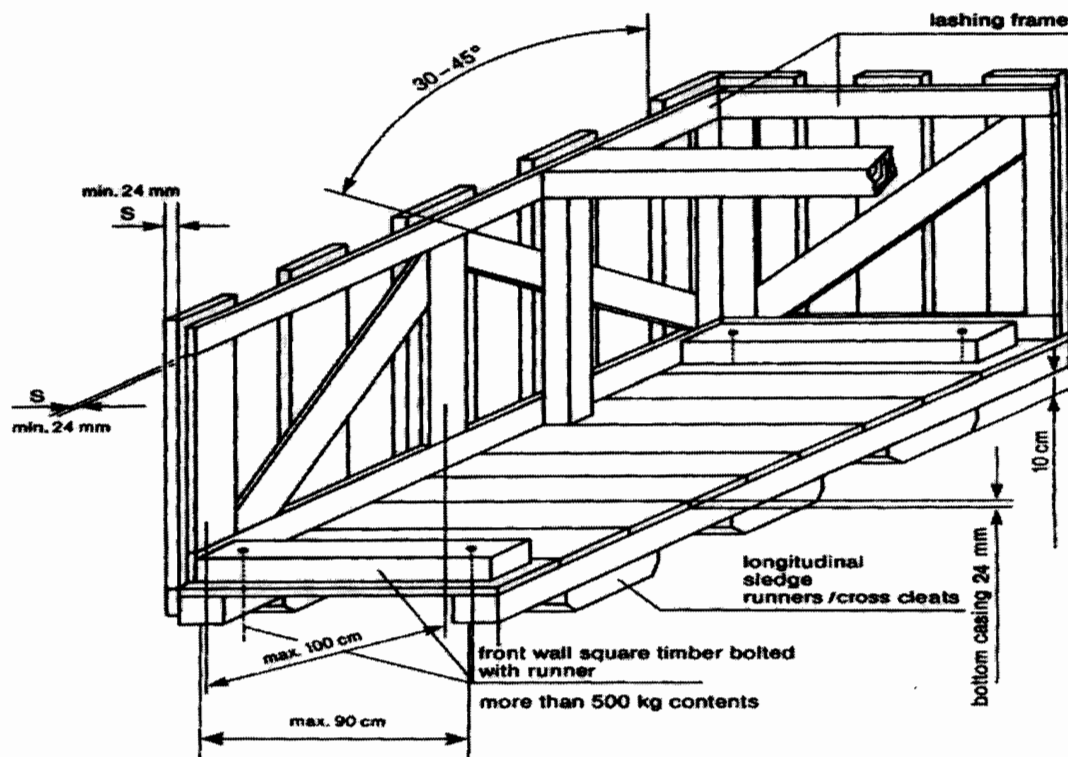
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

Packing Category III



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8.4.2 Cases with Lining – Packing Category IV

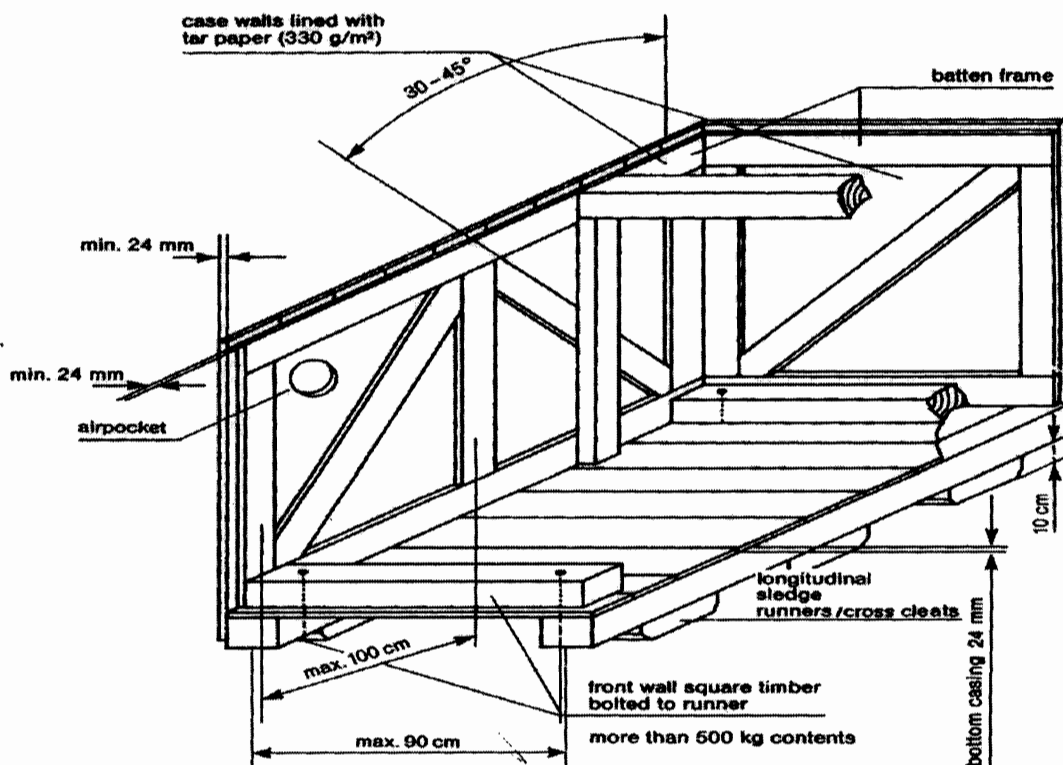
8.4.2.1 Type of Equipment

Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.

8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

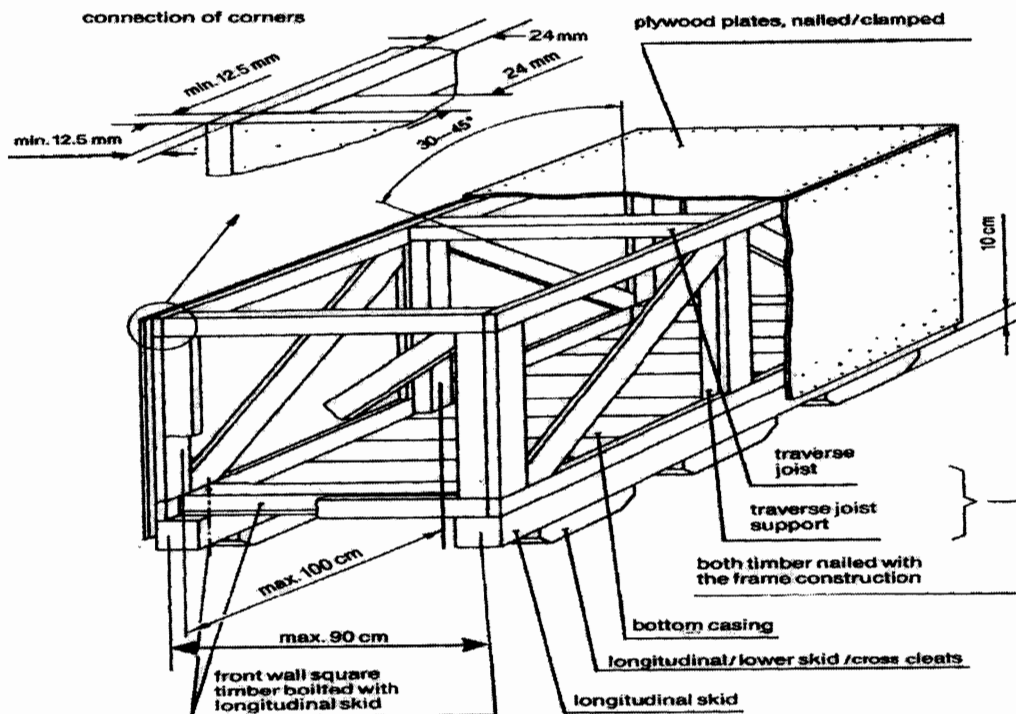
Packing Category IV



8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A

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Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

8.4.4.2 Type of Construction

Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.

Additional marking:

- Case with desiccants.

8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

8.4.5.1 Type of Equipment

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Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

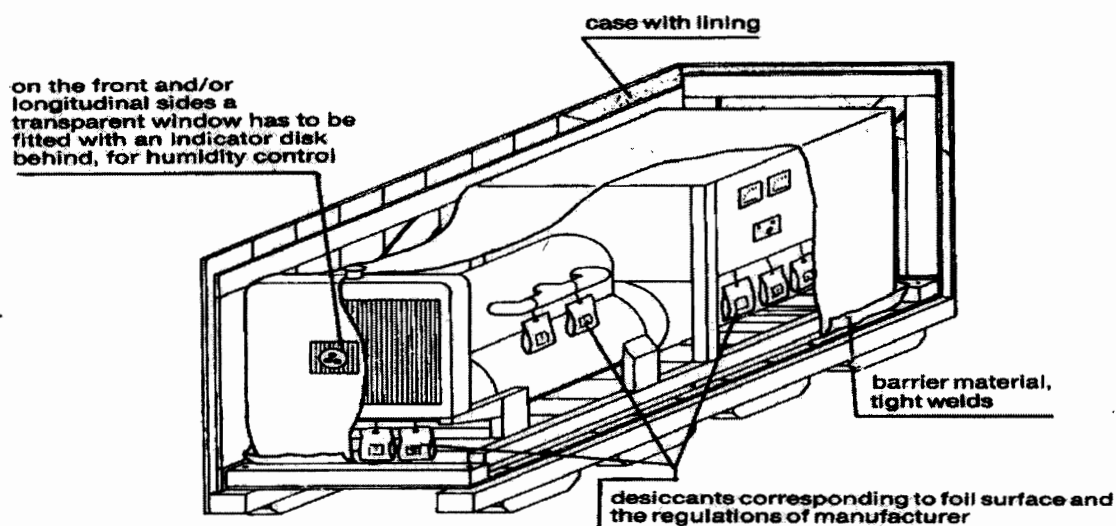
8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:

- Case with desiccants.

Packing Category V/VI



8.4.6 Double Case – Packing Category VII

8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

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8.4.7 Cable Drum – Packing Category VIII

8.4.7.1 Type of Equipment

All type of cables, wires, ropes, hoses.

8.4.7.2 Type of Construction

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/protected cable ends prior to packing.

8.4.8 Hazardous Materials – Packing Category IX

8.4.8.1 Type of Equipment

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

8.4.8.2 Type of Construction

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

8.4.9 Wooden Floor as a Transport Support – Packing Category X

8.4.9.1 Type of Equipment

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

8.4.9.2 Type of Construction

- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

8.5 Air Transport Packing

8.5.1 General

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.

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8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
 - Wooden/cardboard packing cases.
 - Plywood cases.
- Are to be adapted to pallets used for air transportation.

9.0 Detailed specification for Wooden Crates/Boxes/Cases and other packing materials

9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

9.2 Chemical Treatment of Wood:

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

9.3.1.1 Bottom Frame

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The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

9.3.1.2 TOP FRAME

The construction of top frame shall be as per fig-3.

9.3.1.3 END PANELS

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

9.3.1.4 Sling Plate

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

9.3.1.5 Angle Iron Cleats

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

9.3.1.6 Other Requirements

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

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shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.
- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.
- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.
- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.



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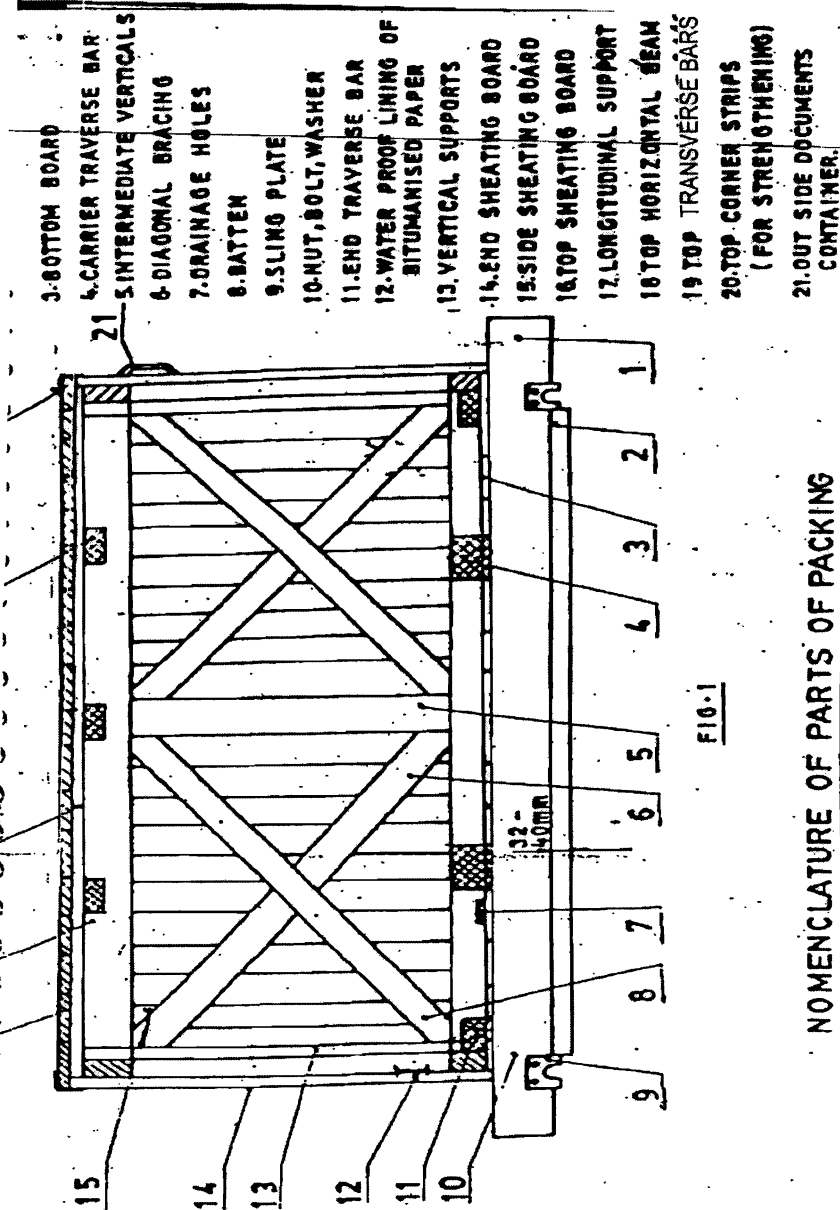
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BOTTOM FRAME ARRANGEMENTS

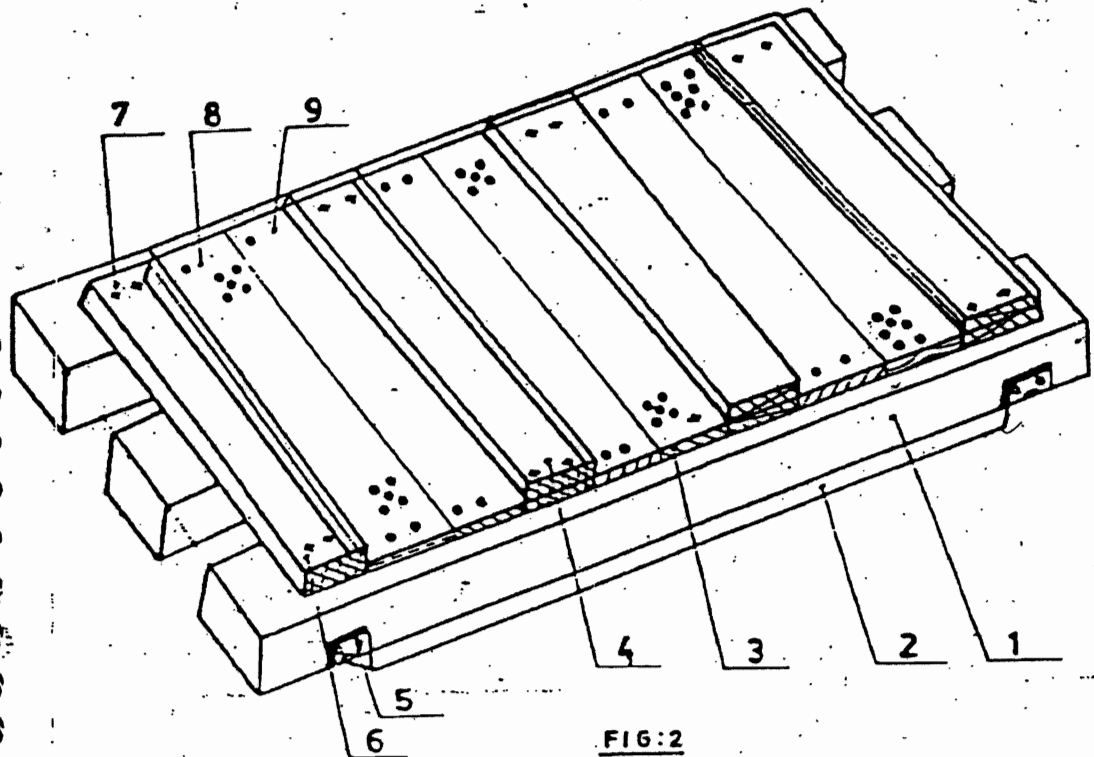


FIG:2

Nos. of slides: Minimum 2 Nos.
For length more than 1800 mm or
load more than 1000kg, Nos. of
slides shall be minimum 3 Nos.
For dimensions of slides, refer Table 1
Cross section of end transverse bar; 100x100 mm.
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

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TOP FRAME ARRANGEMENT

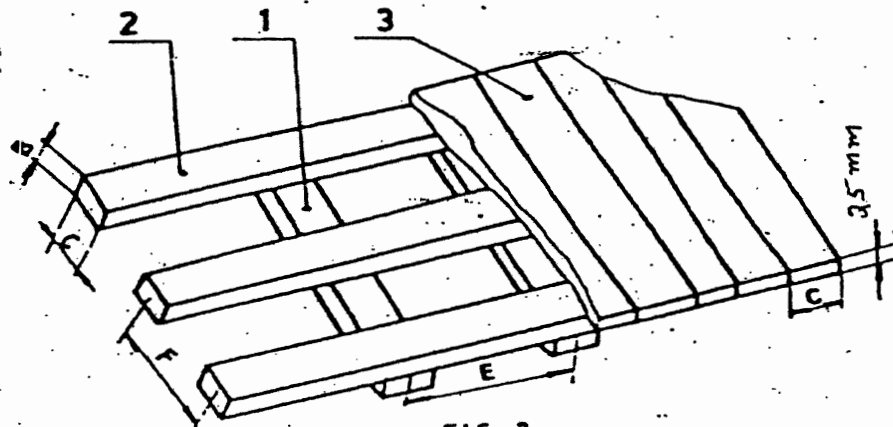
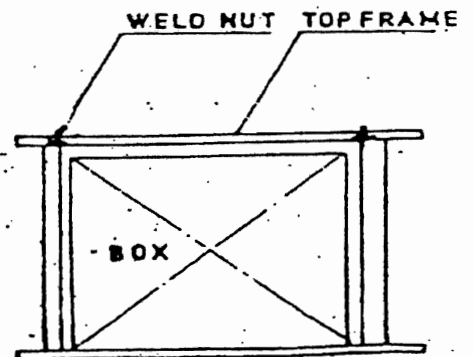
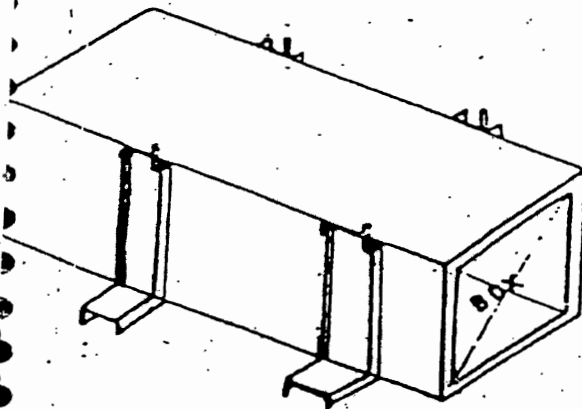


FIG-3

F : 700 to 1000 mm
E : 500 to 900 mm
30 x 100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Soans
- 3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES



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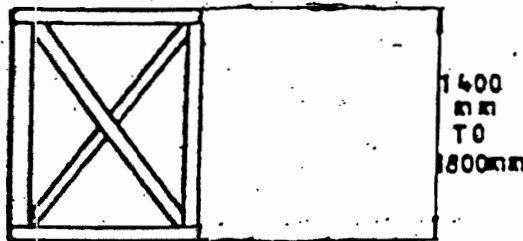
**ARRANGEMENT OF DIAGONAL BRACING AND
HORIZONTAL SUPPORT**

FIG:6

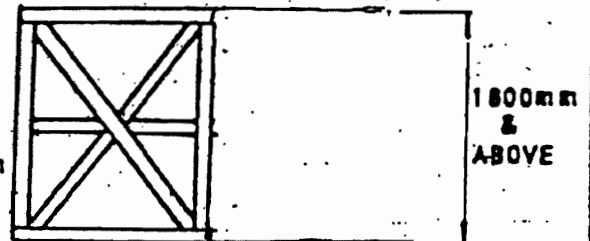


FIG:8

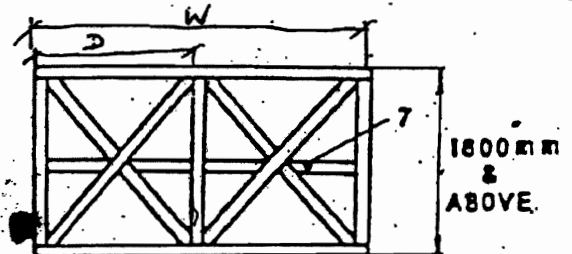


FIG:7

7- Middle Horizontal Support

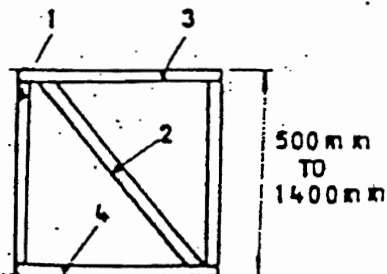


FIG:5

1- Vertical Support

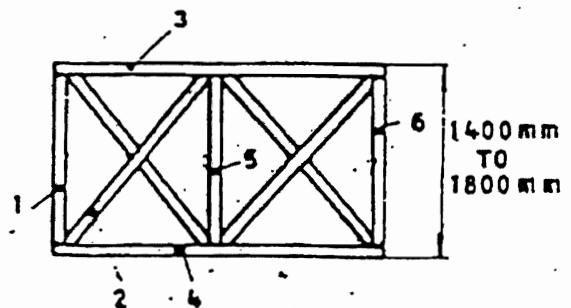


FIG:7

1, 5, 6 - Vertical Support

029

**TITLE**

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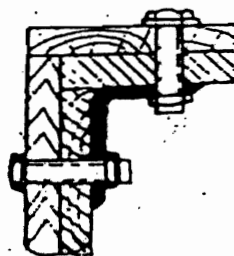
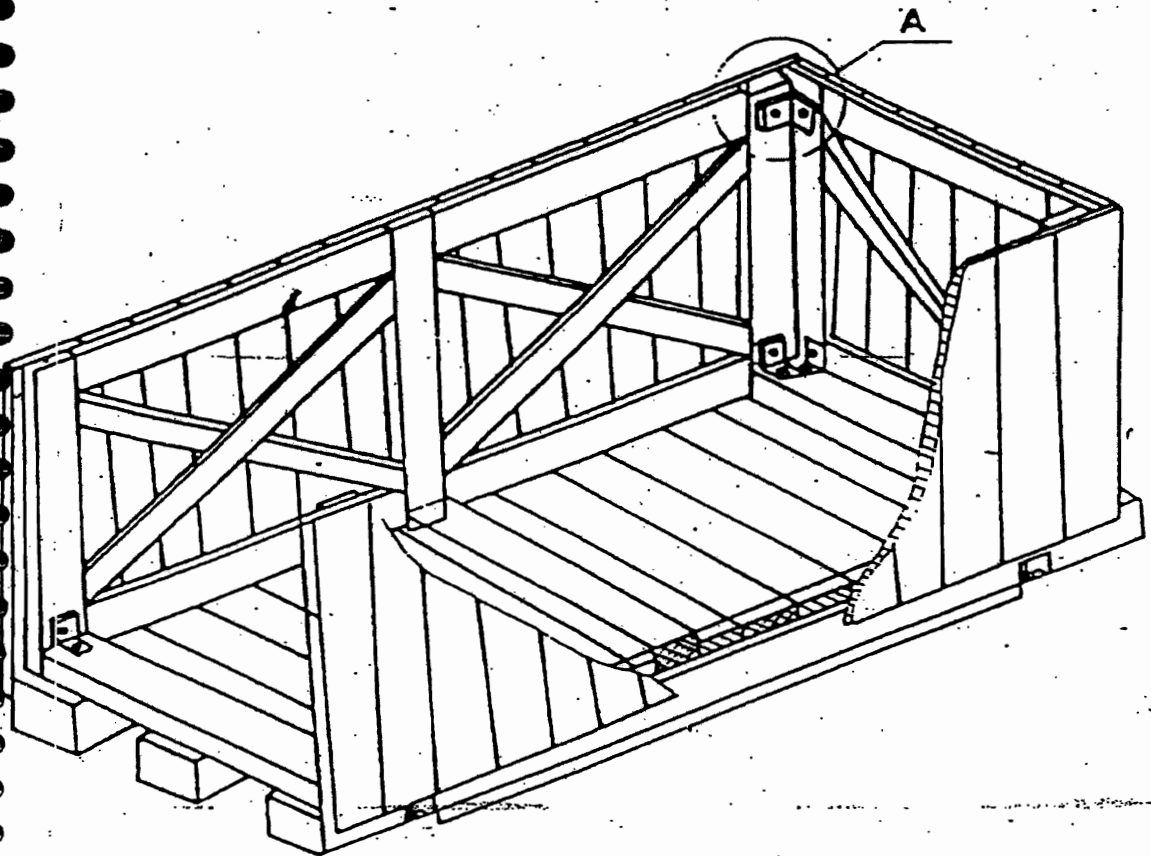
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ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

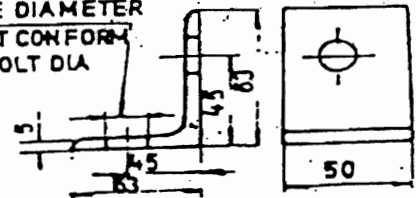


FIG:10

030

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

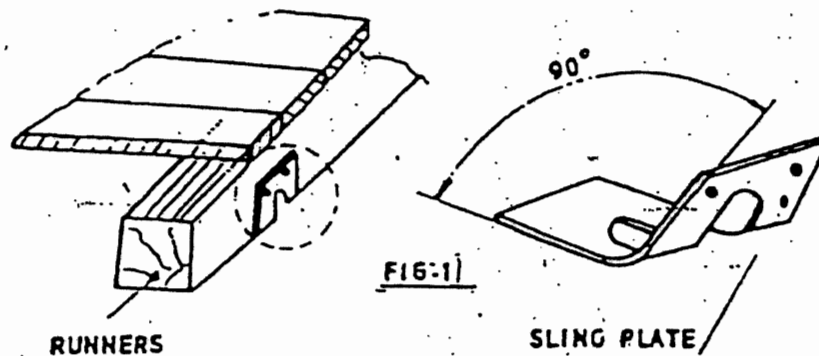
SPECIFICATION NO. PE-TS-888-100-A001

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**ARRANGEMENT OF SLING & PLATE ON
CASES**

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TABLE-1

LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c				c b		
500	50 X 100	50 X 100	50 X 100	50 X 100	75 X 100	75 X 100	100 X 100
800	50 X 100	50 X 100	75 X 100	75 X 100	75 X 100	75 X 100	100 X 100
1000	75 X 100	75 X 100	75 X 100	100 X 100	100 X 100	100 X 110	100 X 150
1500	75 X 100	75 X 100	100 X 100	100 X 100	100 X 100	100 X 150	100 X 150
2000	75 X 100	100 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150
2500	75 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150	150 X 150
3000	100 X 100	100 X 150	150 X 150	150 X 150	150 X 150	150 X 150	150 X 150

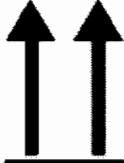
	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
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Table-2

End and side panels	Width of the panel "W"	Distance between longitudinal support (Dimension "D")						
		600	800	1000	1200	1400	1600	1800
		Cross section b x c				Item 1 to 7		
Fig- 5 to Fig-9	600 to 1200	30	30	30	30	30	30	30
		X	X	X	X	X	X	X
	1201 to 1600	100	100	100	130	130	130	130
		30	30	30	30	30	30	30
	1601 to 2000	X	X	X	X	X	X	X
		130	130	130	130	130	130	130
	2001 to 3000	30	30	30	30	30	30	40
		X	X	X	X	X	X	X
	3001 to 4000	130	130	130	130	130	130	150
		40	40	40	40	40	40	40
		X	X	X	X	X	X	X
		150	150	150	150	150	150	150

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INDICATION MARKS ON CASES/BOXES/CRATES

Designation	Symbol	Explanation
Fragile, Handle with care		The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.
Use no hooks		Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.
Top		The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.
Keep away from heat (solar radiation)		Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.
Protect from heat and radioactive sources		Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.
Sling here		The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side.
Keep dry		Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.

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Center of gravity		This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.
No hand truck here		The absence of this symbol on packages amounts to permission to use a hand truck on them.
Stacking limitation		The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.
Clamp here		Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.
Temperature limitations		According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note.
Do not use forklift truck here		This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.
Electrostatic sensitive device		Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.

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Do not destroy barrier		A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants".
Tear off here		This symbol is intended only for the receiver.

FIG-12

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BHEL-PEM-DEWHI-INDIA	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	MO. NO.
DESPATCH ADVICE NOTE NO.	CASE NO.
DIMENSIONS(MM) LXBXH	NET WT -KGS
	GROSS WT -KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE -- KEEP DRY DO NOT DROP -- DO NOT TILT

FIG-13: MARKING PLATE



TITLE

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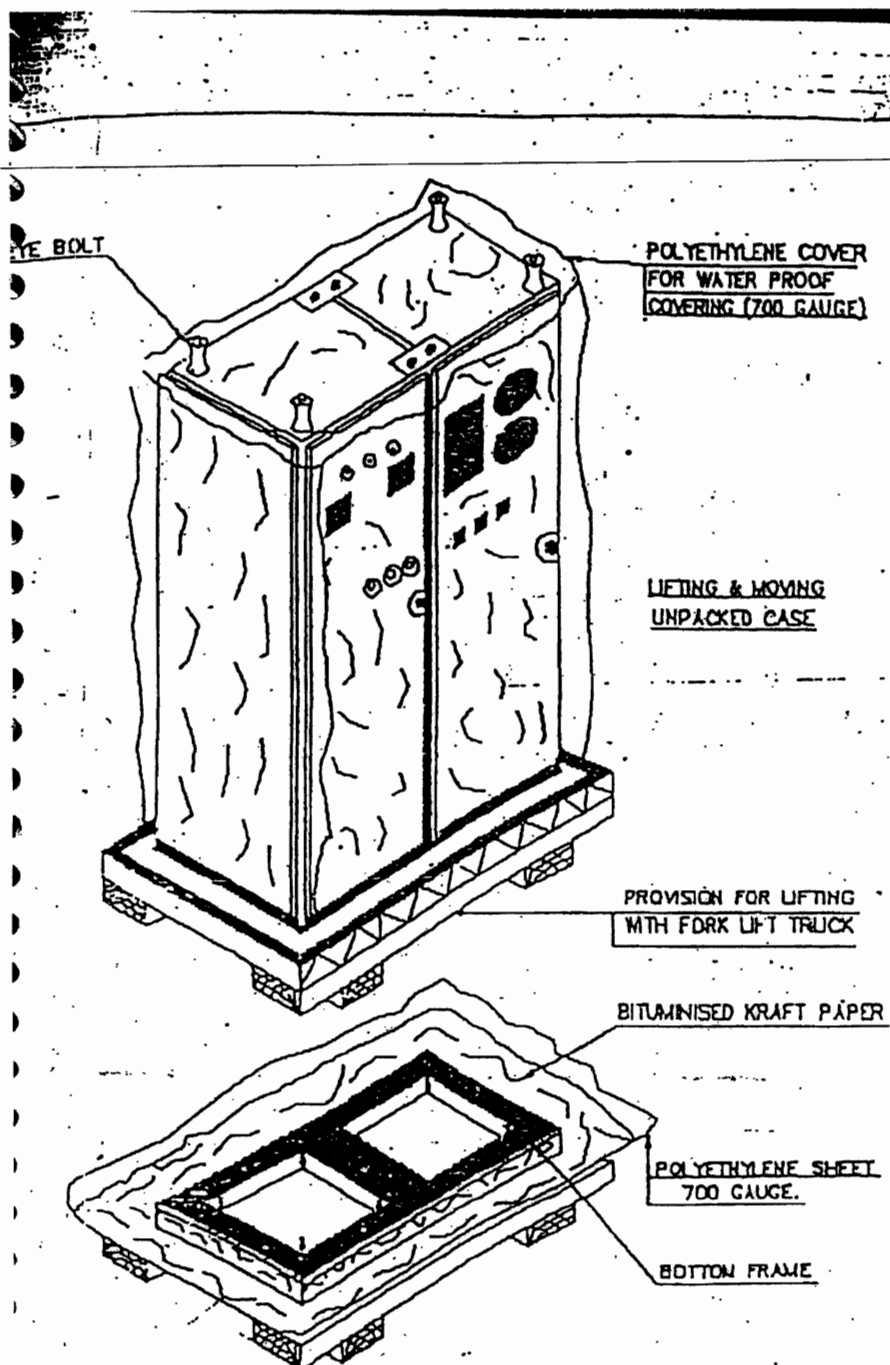


FIGURE-14



TITLE

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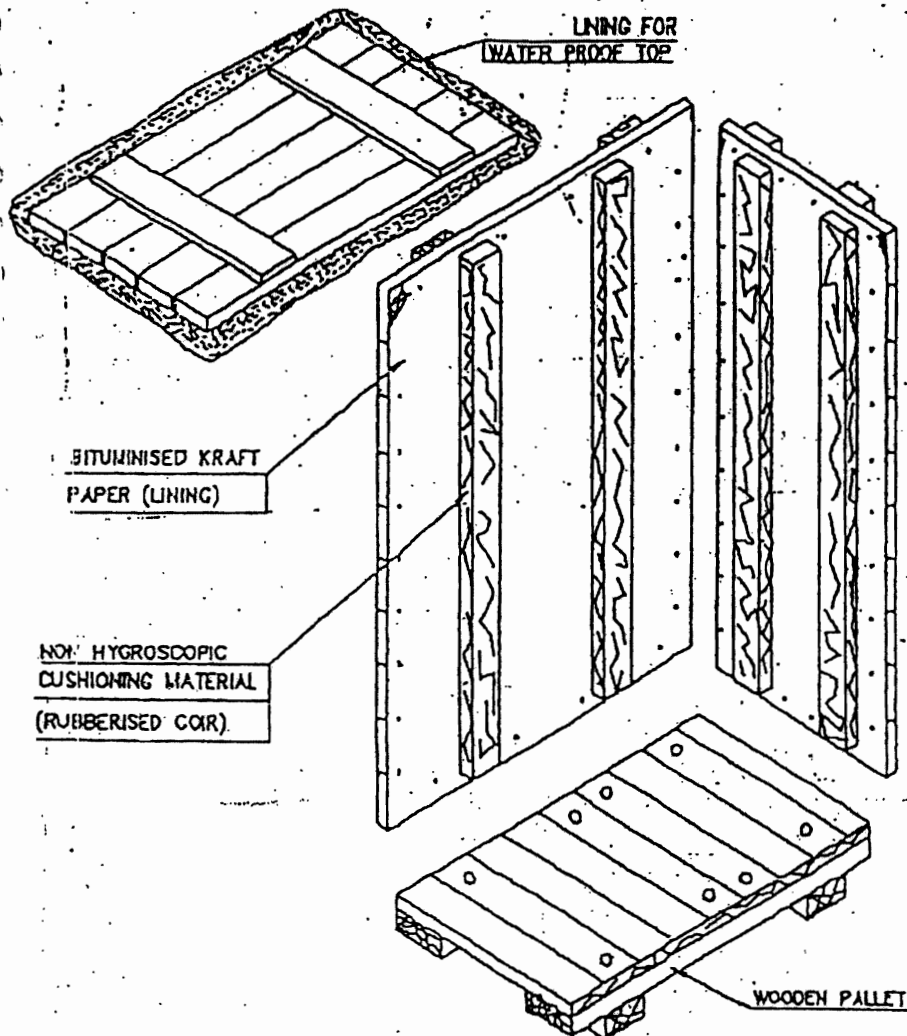
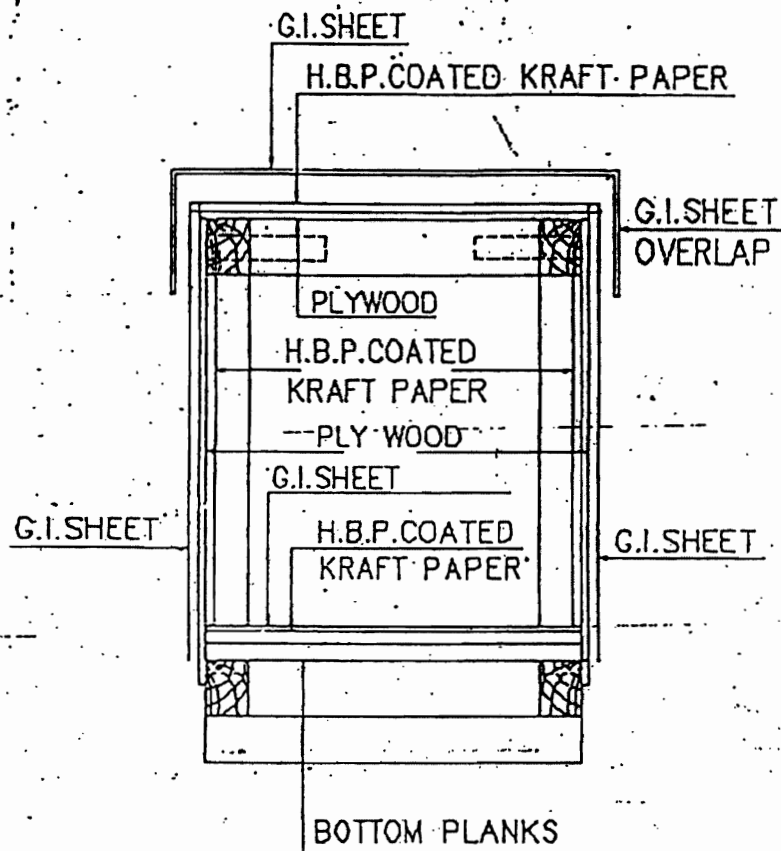


FIGURE-15

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**FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET
SHOWING LAYERS OF PACKING MATERIALS.**

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10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

- a) Project Name
- b) Purchase Order No.
- c) Sl. No. of package
- d) Size of mattress (Thickness x Length x Width)
- e) Density
- f) Wire netting material and size
- g) Weight of the package

10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

10.2.1 Type of construction for Eye to Sky packaging

- a. Strapping of coil with polyester strap around circumference at one place.
- b. Putting paper I. D. Edge protector.
- c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
- d. Wrapping the coil with HDPE film.
- e. Covering the coil including its build up & bore with masonite / particle board.
- f. Putting metallic I. D on coil.
- g. Putting O.D edge protector (paper) on coil.

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- h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
- i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.
- j. Coil is to be tilted to eye-to-sky position.
- k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.
- l. Fixing the coil with wooden blocks at 4 corners.
- m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

10.2.2 Type of construction for Eye to Eye packaging

- a. Strapping of coil with polyester strap around circumference at one place.
 - b. Putting paper I. D. Edge protector.
 - c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
 - d. Wrapping the coil with HDPE film.
 - e. Covering the coil including its build up & bore with masonite / particle board.
 - f. Putting metallic I. D on coil.
 - g. Putting O.D edge protector (paper) on coil.
 - h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
 - i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.
 - j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.
- Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

10.3 Packing Procedure for Online Tube Cleaning System and accessories

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

10.3.1 Packing details:

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

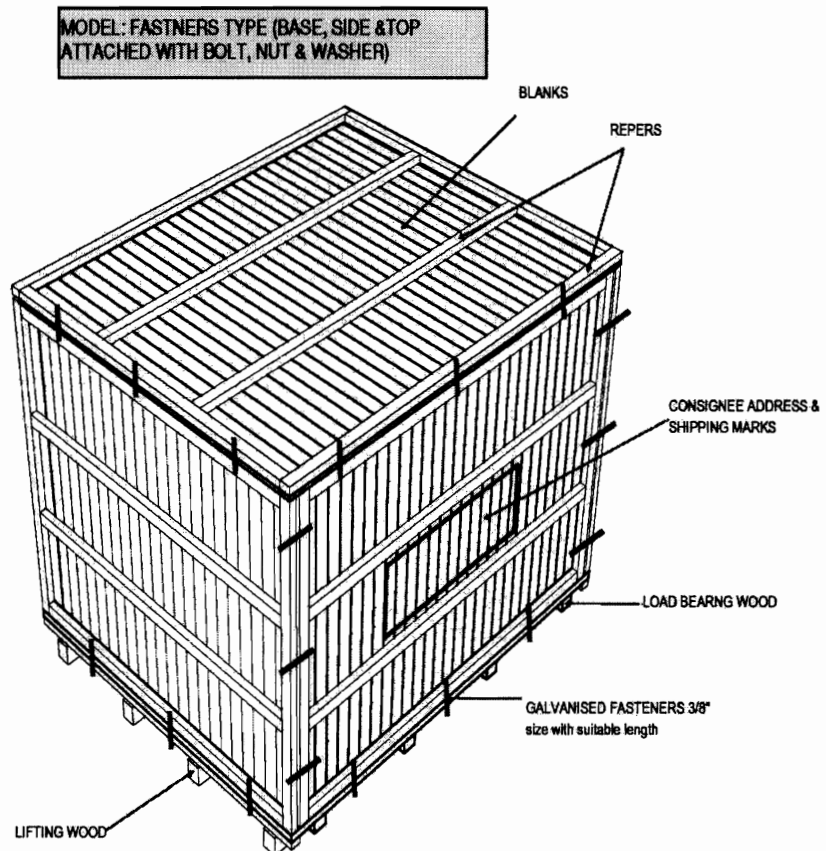
	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
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- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.

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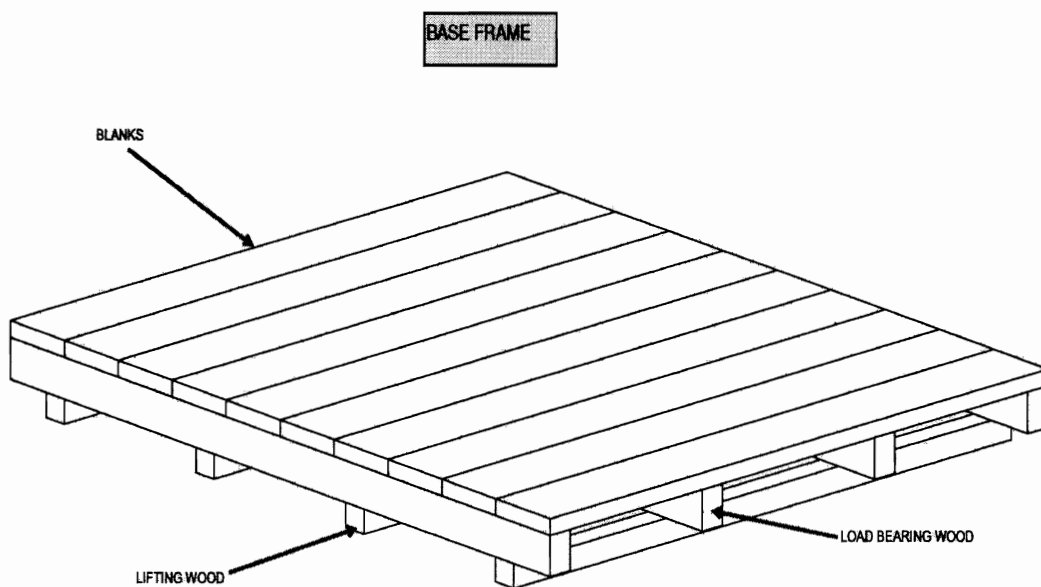
This Type of case to be used for following items:

1. BALL SEPERATOR
2. BALL COLECTOR SKID



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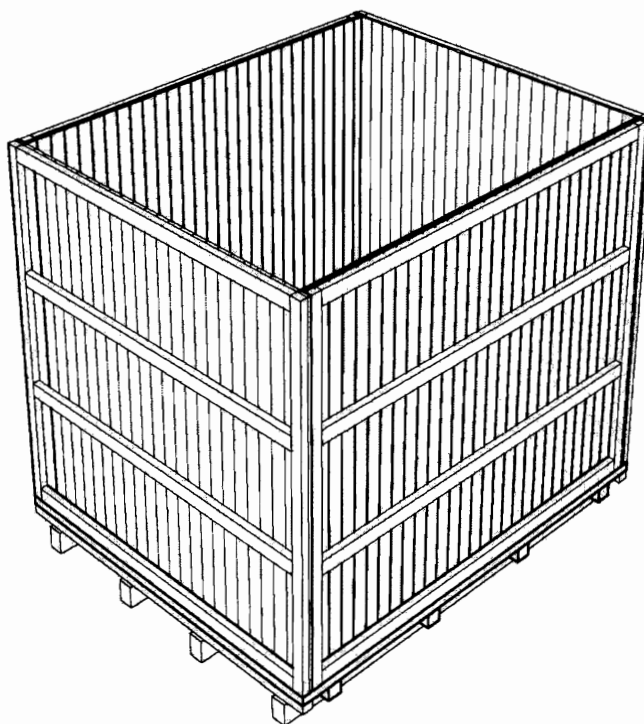
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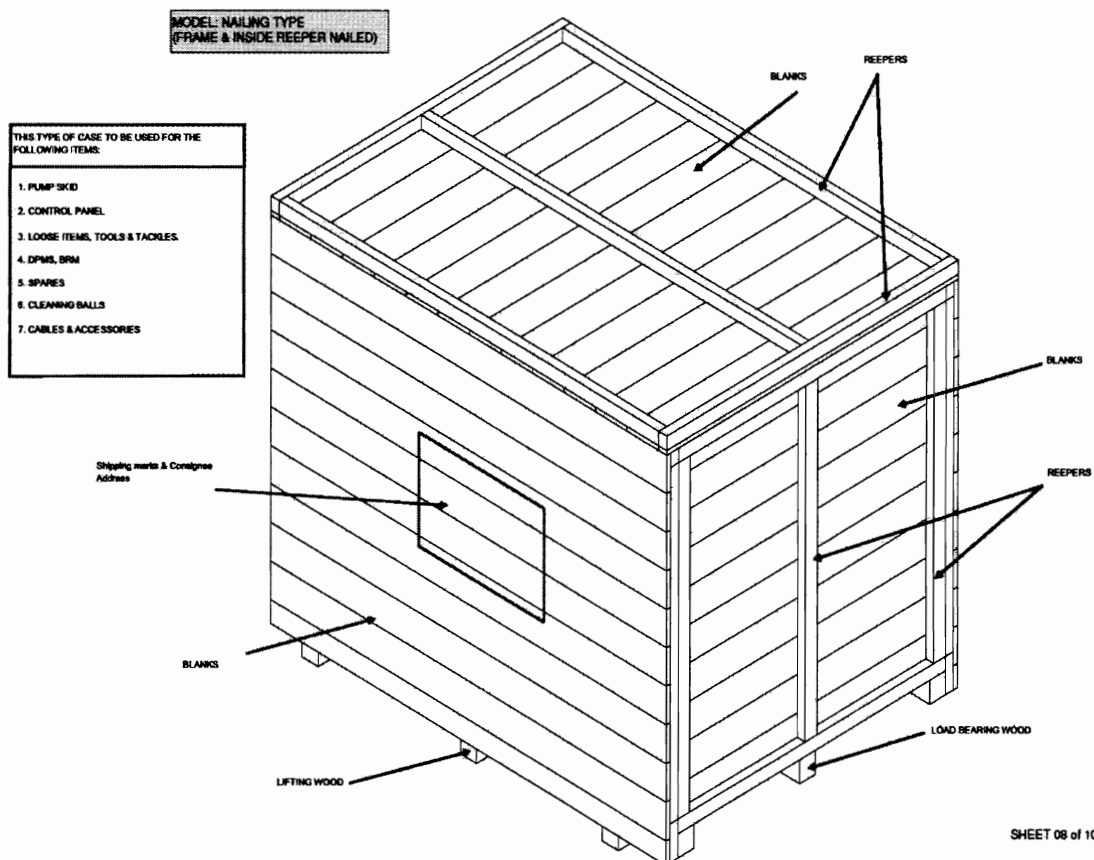
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MODEL: FASTNERS TYPE - WITHOUT TOP



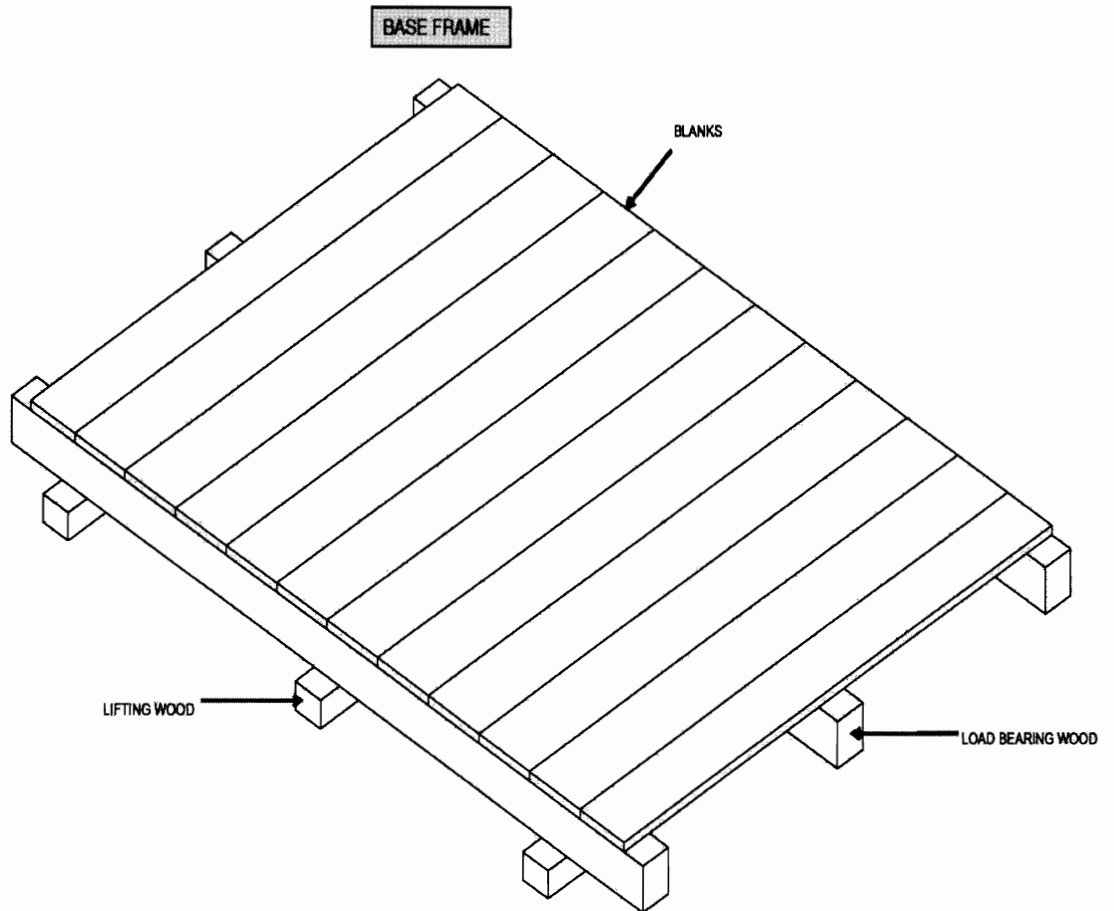
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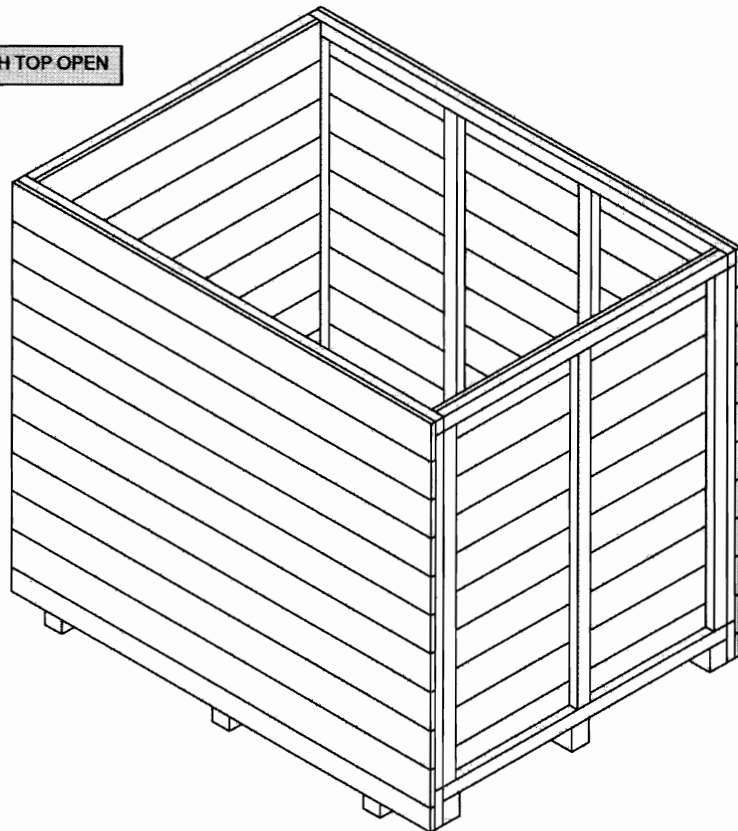


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10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.

11.0 PACKING OF ELECTRICAL ITEMS

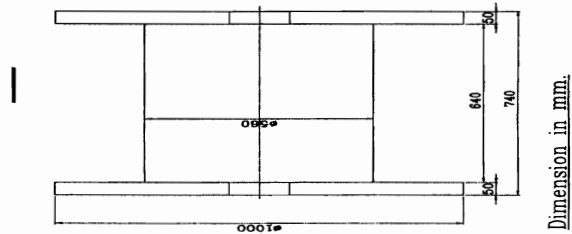
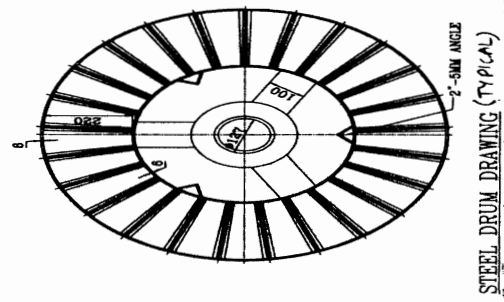
11.1 CABLES

11.1.1 Type of Equipment
All type of cables..

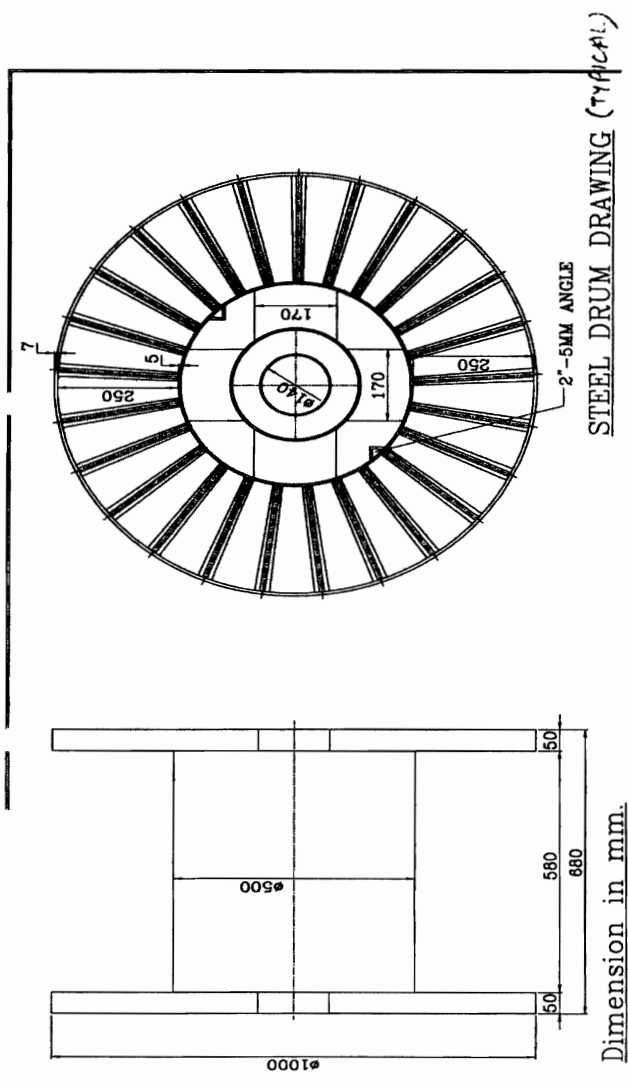
11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).

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11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

- 1) All Dimensions are in "mm" unless otherwise stated.
- 2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
- 3) Finish of Packing Box Shall be Galvanized.
- 4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
- 5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

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- 6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.
- 7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes
- 8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.
- 9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.
- 10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

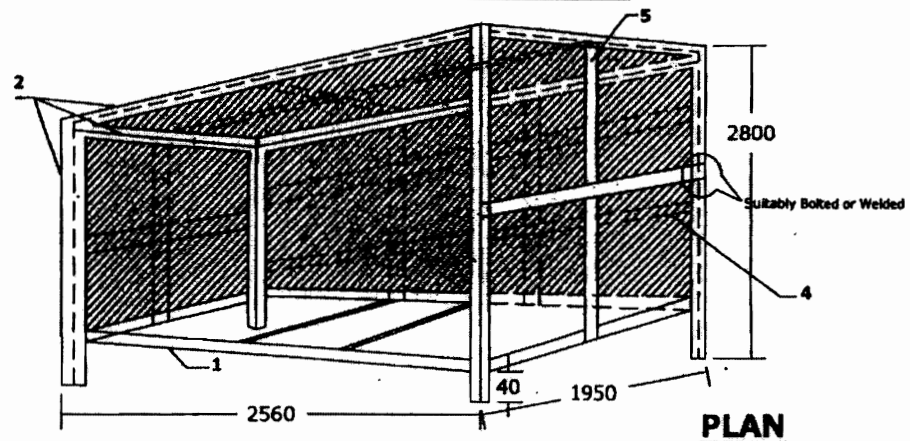
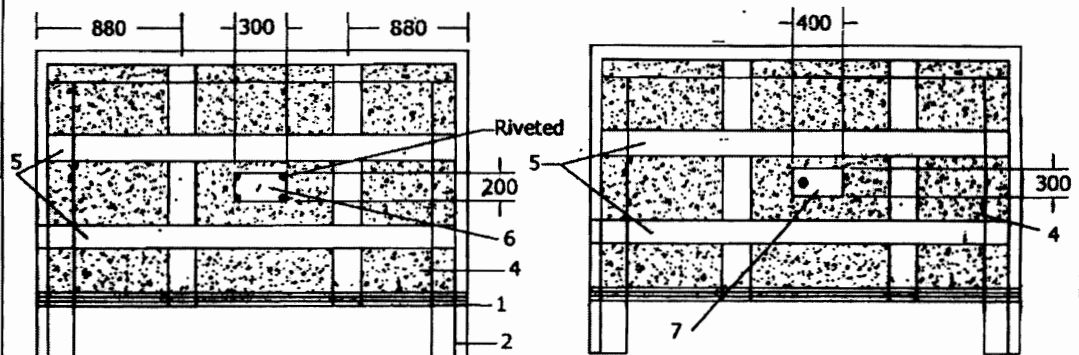
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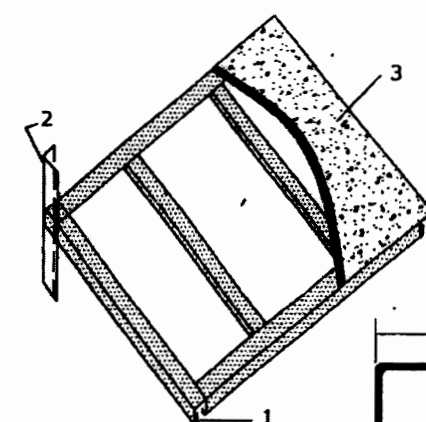
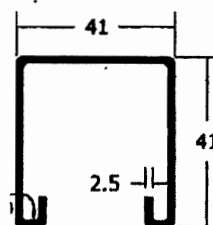
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STEEL PACKING (TYPICAL DETAILS)**PLAN****FRONT SIDE OF BOX****BACK SIDE OF BOX****Note:**

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Aluminium Plate for Marking.
7. Hinged Inspection Window.

**BOTTOM FRAME ARRANGEMENT****DETAILS OF "C" CHANNEL**

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11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

- Construction of packing case for LIGHTING DISTRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.
- Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

- The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.
- Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMISSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMABLES

- Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
- Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.

11.3.3 For CONDUIT PIPE

As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

- Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- Then bundle will be wrapped with bitumen coated hessian craft paper.
- Bundle shall be strapped with steel straps.
- An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

11.3.4 For POLES

Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

11.3.5 For STRUCTURAL STEEL

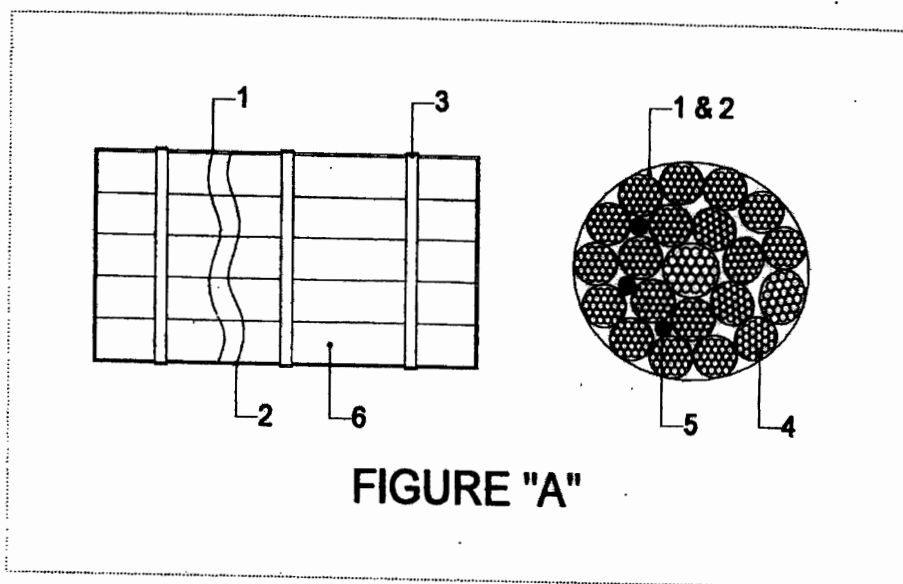
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Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

- a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- b) Then bundle will be wrapped with bitumen coated hessian craft paper.
- c) Bundle shall be strapped with steel straps.
- d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

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PACKING PROCEDURE FOR CONDUIT PIPE



- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) CONDUIT PIPES.
- 5) SILICA GEL POUCHES.
- 6) BUNDLES OF CONDUIT PIPES.

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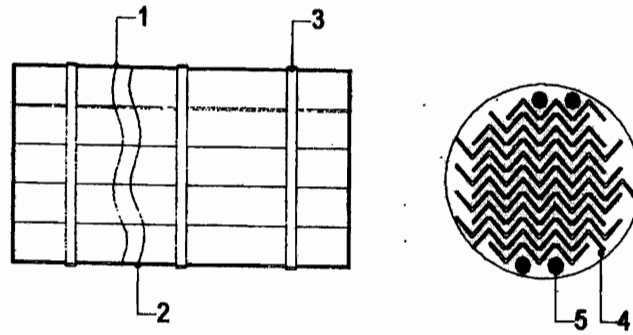
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PACKING PROCEDURE FOR STRUCTURAL STEEL**FIGURE "B"**

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) STRUCTURAL STEEL.
- 5) SILICA GEL POUCHES.



TITLE

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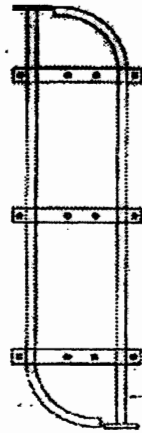
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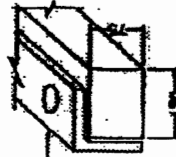
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packing procedure for poles



POLES WRAPPED WITH POLYTHENE SHEET &
EXTRUDED COATED HESSIAN CLOTH



TOP WOODEN BATTEN TO BE
FIXED WITH L90x80x6 MM ON TOP
OF IT FOR TIEING THE ROD
25 MM DIA



BOTTOM WOODEN BATTEN TO BE
FIXED ON L90x80x6 MM ANGLE

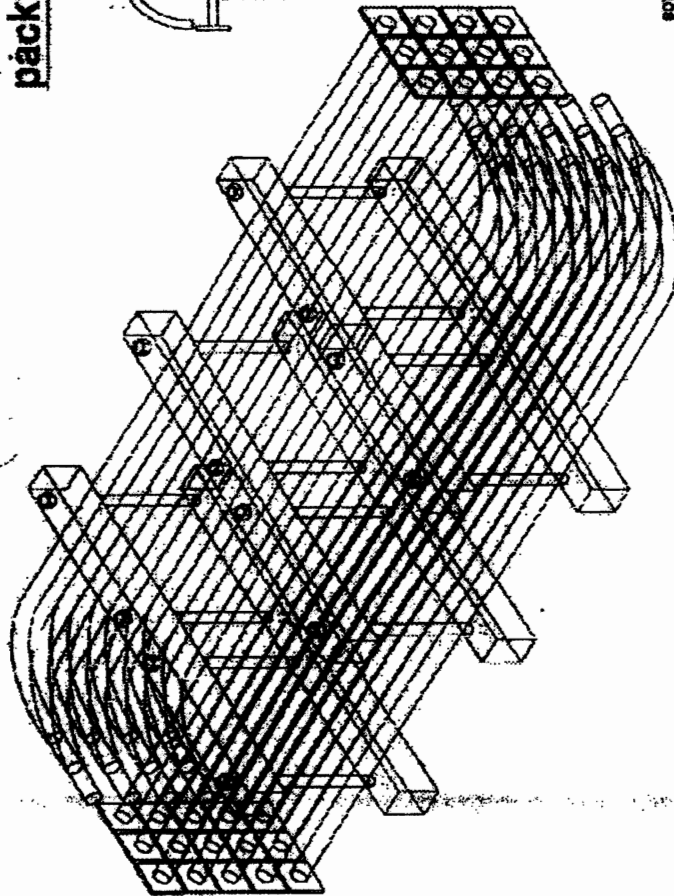


FIGURE "C"

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11.4 PACKING FOR DC BATTERY

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

- a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).
- b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.
- c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)
- d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.
- e) The battery accessories shall be packed with suitable precautions as follows:
 - i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.
 - ii) Hardware items shall be packed in polyethylene bags (Thickness $\geq 0.175\text{mm}$) with item slip
 - iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet
 - iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.
 - f) Galvanized Steel straps are provided for binding the packing box sides.
 - g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.5.01 PACKING DETAILS :

- a) Items shall be packed in case / crates as per the shipping list.
- b) All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".
- c) Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

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- d small / delicate items such as glass thermometer, door keys shall be packed in separate box.
- d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.
- e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.
- f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.
- g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.
- h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box
- i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.
- j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.
- k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.
- l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.
- m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

12.0 Containerization

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).

The maximum inside dimensions of containers are to be considered:

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- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
-

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

12.2 Mechanical Constraints

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

Note:

It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.

13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS. VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.

The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming

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useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.



**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION : II

REV 00

DATE: DEC 2019

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SECTION-II

ANNEXURES

	PATRATU STPP FGD PACKAGE TECHNICAL SPECIFICATION FOR AGITATORS LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-434-571-18000-A001	
		SECTION : II	
		ANNEXURE-1	
		REV: 00	DATE: DEC 2019
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BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

1. Compliance cum confirmation certificate (refer annexure-2 of section-II)
2. Pre-bid clarification schedule as per format given under Section-II (Annexure-3), in case of any clarifications.
3. Deviation schedule as per format given under Section-II (Annexure-4), in case of any deviations by bidder.
4. Guaranteed power consumption format (In the format attached in the price schedule) declaring guaranteed power consumption value in KW.
5. Un priced format for main package (mentioning quoted against each item)
6. Un priced format for mandatory spare (mentioning quoted against each item)
7. Un priced format for Tools and Tackles (mentioning quoted against each item)
8. Un priced format for Commissioning spare (mentioning quoted against each item)
9. List of makes of sub vendor items (refer annexure-6 of section-II)
10. Agitator Schedule filled up by the bidder (refer annexure-8 of section-II)
11. GA drawing, Exploded view with Material of construction, total weight of all Agitators models offered
12. Agitator and Motor Sizing Calculation
13. List of makes of sub-vendor items (refer annexure-6 of section-II)
14. Electrical Load data filled up by the bidder (refer annexure-5 of section-II)
15. Documents for meeting the Pre-Qualification Requirement (3K format has to be submitted along with supporting documents)
16. Schedule of guarantees(refer annexure-10 of section-II)
17. Documents for meeting the Pre-Qualification Requirement (3K format has to be submitted along with supporting documents)
18. Priced offer



**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No:PE-TS-434-571-18000-A001

SECTION : II

ANNEXURE-2

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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account



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TECHNICAL SPECIFICATION FOR
AGITATORS
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

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ANNEXURE-2

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- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
- m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.



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AGITATOR**

SPECIFICATION NO. PE-TS-434-571-18000-A001

SECTION-II

ANNEXURE-3

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PRE-BID CLARIFICATION SCHEDULE

S.No.	Section/Clause/ Page No.	Statement of the referred clause	Clarification required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL



**PATRATU STPP FGD PACKAGE
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SECTION-II

ANNEXURE-4

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ANNEXURE-4
**SCHEDULE OF TECHNICAL
DEVIATION**

DEVIATION SHEET (COST OF WITHDRAWAL)



PROJECT:-PATRATU STPP FGD PACKAGE

PACKAGE:- AGITATOR

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE	
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NOTES:

- For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
- Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOS				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ANNEXURE-IV																		
Filtrate Water Tank Agitator				1	0				C									
Secondary Waste Water Hydro-cyclone Feed Tank Agitator				1	0				C									
Waste Water Tank Agitator				1	0				C									
Limestone Slurry Storage Tank Agitator				1	1				C									
Absorber Area Drain Sump Agitator-1				1	0				C									
Absorber Area Drain Sump Agitator-2				1	0				C									
Absorber Area Drain Sump Agitator-3				1	0				C									
Auxiliary Absorbent Tank Agitator				3	0				C									
Gypsum Area Drain Sump Agitator				1	0				C									
Limestone Area Drain Sump Agitator				1	0				C									
NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER 2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTOR CONTROLLED)																		
ANNEXURE-5 LOAD DATA (ELECTRICAL)	JOB NO.		434		ORIGINATING AGENCY		PEM (ELECTRICAL)											
	PROJECT TITLE		3x800MW PATRATU STPP		NAME		DATA FILLED UP ON											
	SYSTEM		AGITATOR		SIGN.		DATA ENTERED ON											
	DEPTT. / SECTION		MAUX		SHEET 1 OF 1		REV. 00											
				DE'S SIGN. & DATE		Page 344												



3x800 MW PATRATU TPS

**AGITATORS
TECHNICAL SPECIFICATION**

SUB-VENDOR LIST

SPECIFICATION NO. PE-TS-434-571-18000-A001

SECTION : II

ANNEXURE : 6

REV 00

SHEET 1 OF 1

LIST OF MAKES OF ITEMS

<u>S.N.</u>	<u>ITEM NAME</u>	<u>MANUFACTURER</u>	<u>LOCATION</u>



**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION NO. PE-TS-434-571-18000-A001

SECTION : II

ANNEXURE-7

REV 00

DATE: DEC 2019

SHEET: 1 OF 1

ANNEXURE-7
LIST OF TOOLS & TACKLES



**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION NO. PE-TS-434-571-18000-A001

SECTION : II

ANNEXURE-7

REV 00

DATE: DEC 2019

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Bidder shall supply a set of special tools and tackles required either for erection or operation or maintenance of the agitator units. A list of such tools and tackles shall be submitted along with the offer.



TITLE:
PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION-II, ANNEXURE-8

REV. 00

DATE: DEC 2019

SHEET : 1 OF 1

AGITATOR SCHEDULE

AGITATOR SCHEDULE (To be submmitted with the offer by Bidder)										
Sl.no.	Description	Primary Hydrocyclone feed tank Agitator	Filtrate water tank Agitator	Secondary Hydrocyclone feed tank Agitator	Waste water Tank Agitator	Limestone Slurry Storage tank Agitator	Auxiliary Absorbent Tank Agitator	Absorber Area Drain Pit Agitator	Gypsum Dewatering Area Drain Pits Agitator	Ball Mill Area Drain Pit Agitator
1	Agitator Sl No.	1	2	3	4	5	6	7	8	9
2	Type	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Marine Propeller – Horizontal Type (Side Entry),	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)
3	Medium to be handled	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry
4	Seal Type	Not required	Not required	Not required	Not required	Not required	Mechanical Seal (Flushless)	Not required	Not required	Not required
5	Duty	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
6	Agitator Location	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
7	Operation	Continuous	Continuous	Continuous	Continuous	Continuous	Whenever FGD is under maintenance	Continuous	Continuous	Continuous
8	Tank details									
a)	Tank Shape	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Rectangular	Rectangular	Rectangular
b)	Tank name	Primary Hydrocyclone feed tank	Filtrate water tank	Secondary Hydrocyclone feed tank	Waste water Tank	Limestone Slurry Storage tank	Auxiliary Absorbent Tank	Absorber Area Drain Pit	Gypsum Dewatering Area Drain Pits	Ball Mill Area Drain Pit
c)	Capacity of Slurry (in m3)	840.4	422.2	623.4	1481.6	4305.5	4714.4	56.0	56.0	56.0
	Dimension (in m)									
d)	Diameter	10.0	8.0	9.0	12.0	17.5	17.5	-	-	-
e)	Length	-	-	-	-	-	-	4	4	4
f)	Breadth	-	-	-	-	-	-	4	4	4
g)	Height	11.2	8.9	10.3	13.6	19.8	20.4	4	4	4
9	MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L
10	Quantity of Agitator per tank	1	1	1	1	1	3 (Refer note-2)	1	1	1
11	Total quantity of agitators (for three units)	1	1	1	1	2	3 (Refer note-2)	3	1	1
12	Slurry Analysis									
a)	Slurry to be handled	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry
b)	Maximum solid particle size	200 mesh (75 µ)	200 mesh (75 µ)	200 mesh (75 µ)	200 mesh (75 µ)	200 mesh (75 µ)	200 mesh (75 µ)	6-7 mm	6-7 mm	6-7 mm
c)	Normal solid particle size, d50	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	6-7 mm	6-7 mm	6-7 mm
d)	Solid to be handled	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	Limestone + impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	Limestone + impurities
e)	Chloride concentration	max 30000 ppm	max 30000 ppm	max 30000 ppm	max 30000 ppm	max 1000 ppm	max 30000 ppm	max 30000 ppm	max 30000 ppm	max 1000 ppm
f)	Hardness of particle	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale
g)	Slurry concentration, wt%	25 wt%	14%	16.60%	3%	30 wt%	25%	25%	25%	30 wt%
h)	Sp. Gravity of slurry	1.177	1.098	1.114	1.025	1.218	1.177	1.177	1.177	1.218
i)	Sp. Gravity of Lime Stone & Gypsum	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)
j)	Viscosity of Slurry	10 cP	4 cP	4 cP	3 cP	30 cP	10 cP	10 cP	10 cP	30 cP
k)	pH	4 to 8	4 to 8	4 to 8	4 to 8	5 to 8	4 to 8	4 to 8	4 to 8	5 to 8
l)	SiO ₂ Content	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l
m)	Temperature	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.
13	Motor									
a)	Total Power consumed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	Motor Rating	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Motor Explosion Proof Class	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof
d)	Motor Protection Class	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor
e)	Motor Efficiency Class	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3
14	Minimum Liquid level In the tank	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
15	Impeller									
a)	Type of impeller	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	No. of impeller per agitator	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Impeller diameter	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
d)	Impeller tip speed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
e)	Operating speed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
f)	Agitator Pumping Capacity	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
g)	Volume/Agitator	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
16	Baffle Plates (not in bidder's scope)									
a)	No. & size of baffle plates	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Thickness of baffle plates (mm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
d)	Distance from Bottom of the tank	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
17	Nozzle (not in bidder's scope)									
a)	Size of the nozzle on which agitator frame is mounted	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	NA	NA	NA
18	Loads									
a)	Static Load	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	Dynamic load	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Torsional Moment (Nm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
d)	Bending Moment (Nm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
Notes										
1	There shall be complete re-suspension of all solids after a 24 hour outage. Accumulation of solids shall not prevent agitator restart.									
2	Agitation shall be provided to prevent settlement of slurry by side entry agitators with emergency flush start system. Sufficient number of agitators shall be provided in the tank by the contractor to prevent the solids from settling down.									
3	Tank low level trip requirement shall be provided by the bidder									
4	Maximum Sound Pressure Level at a height of 1.5 m above floor level in elevation, and at a distance of 1.0 m horizontally shall be 85 dBA.									



**PATRATU STPP FGD PACKAGE
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-434-571-18000-A001

SECTION : II

ANNEXURE-9

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**ANNEXURE-9
LIST OF COMMISSIONING SPARES**

Break up price for COMMISSIONING SPARES

Total (Rs)	
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1) Bidder shall furnish unit price of commissioning spares in above format alongwith the Bid. Any part even though not mentioned in list furnished but required at later date shall be supplied free of cost.



**PATRATU STPP FGD PACKAGE
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ANNEXURE-10

REV 00

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Annexure-IV-Schedule of Guarantees (TO BE FILLED FOR EACH AGITATOR)

Project:

Enquiry No:

Sl. No.	Description	Unit	Data
1	Rated Input Power at Motor Terminal at Normal water level and at Normal voltage and Frequency (*)	KW	
2	Possible Rate of deposit of solid particles at tank bottom of total solid particle inflow/outflow	%	
2	Noise level at a distance of 1.0 meter from the equipment at site	dB(A)	85
3	Maximum vibration velocity (at site) (RMS)	mm/sec	
4	Life of Agitator components parts from the date of Commissioning for continuous operation		24 months
5	Anti-friction Bearing		25000 hrs.

BIDDER SIGN : _____

DESIGNATION : _____

DATE : _____