

NTPC LIMITED

3X800 MW PVUNL PATRATU STP PHASE-I

**TECHNICAL SPECIFICATION FOR DOUBLE GIRDER
EOT CRANES UPTO 100T**

SPECIFICATION NO.: PE-TS-434-501-A401



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA (U.P.)
INDIA**

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TITLE

3X800 MW PATRATU STP

DOUBLE GIRDER EOT CRANES UPTO 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-434-501-A401

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SUB-SECTION IA
SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

**TITLE****3X800 MW PATRATU STP****DOUBLE GIRDER EOT CRANES UPTO 100T****SPECIFIC TECHNICAL REQUIREMENTS**

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SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

- 1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles fill of lubricants & consumables along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, trial run at site and carrying out performance guarantee/Functional/Demonstration tests at site (As applicable) & final handing over to end customer in flawless condition of crane(s) for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.
- 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 the contractor of the responsibility of providing such facilities to complete the supply, erection & commissioning and load testing of the cranes and its accessories.**
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his 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 specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 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 Section-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.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; 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/its cust

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1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, more stringent requirement 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 including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.

1.12 Apart from specific design requirement for crane, design of various systems/ Sub-systems and all equipment will also strictly meet the stipulations of Customer's Technical Specification.

Note:

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 (124.124.3) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (<http://dms-server.bhelpem.com/Wrench%20Web%20Access/Login.aspx>).

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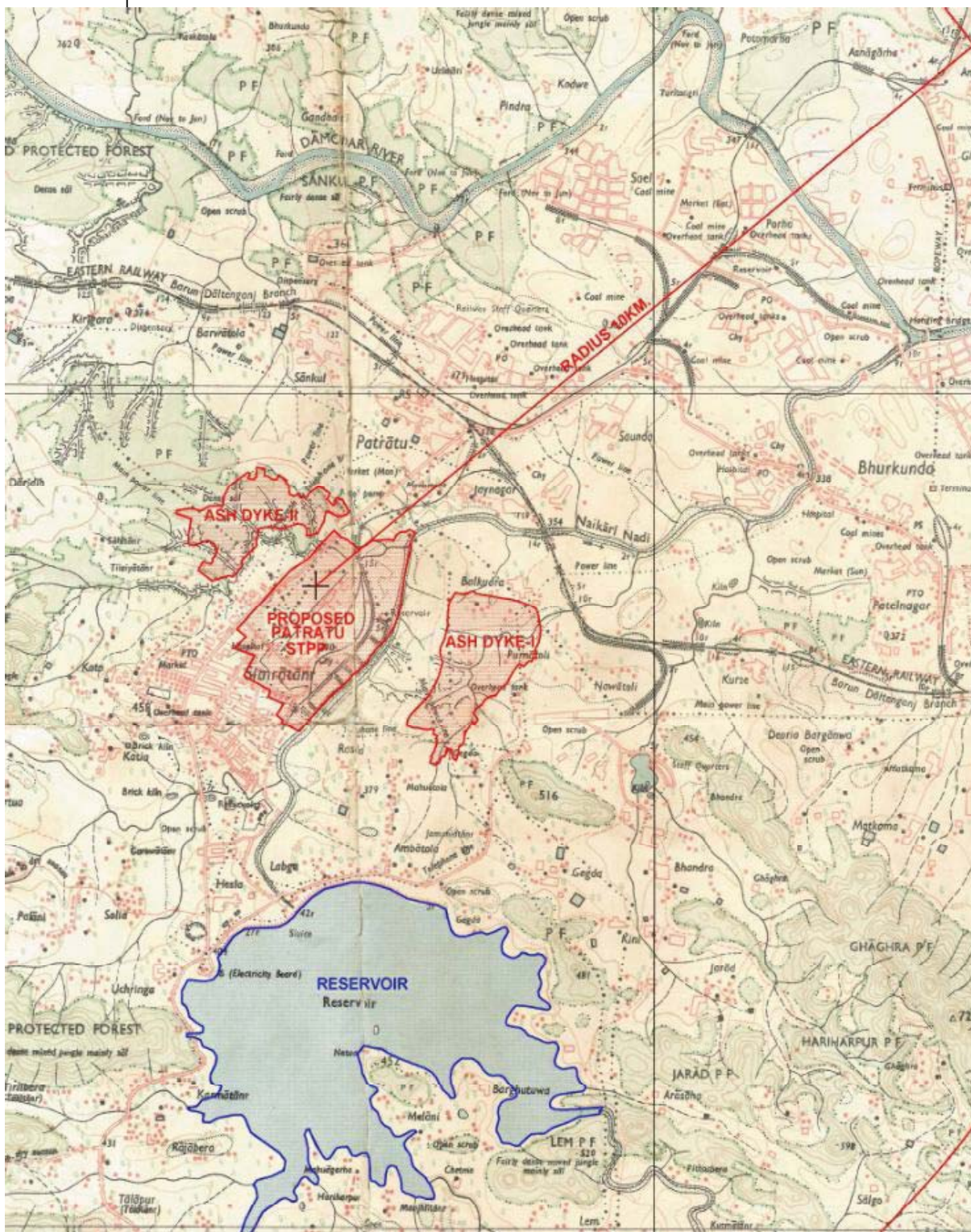
PROJECT INFORMATION

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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जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : रामगढ़
STATION : Ramgarh

मौसम की अवस्था		पवन		भू-रेख		दृश्यता	
दिनांक		पवन की गति (कि.मी. प्रति घंटा)		पवन की दिशा (डिग्री से)		पवन की शक्ति (कि.मी. प्रति घंटा)	
वर्ष	दिनांक	दिनांक	दिनांक	दिनांक	दिनांक	दिनांक	दिनांक
1971	01	1972	01	1973	01	1974	01
1975	01	1976	01	1977	01	1978	01
1979	01	1980	01	1981	01	1982	01
1983	01	1984	01	1985	01	1986	01
1987	01	1988	01	1989	01	1990	01
1991	01	1992	01	1993	01	1994	01
1995	01	1996	01	1997	01	1998	01
1999	01	2000	01	2001	01	2002	01
2003	01	2004	01	2005	01	2006	01
2007	01	2008	01	2009	01	2010	01
2011	01	2012	01	2013	01	2014	01
2015	01	2016	01	2017	01	2018	01
2019	01	2020	01	2021	01	2022	01
2023	01	2024	01	2025	01	2026	01
2027	01	2028	01	2029	01	2030	01
2031	01	2032	01	2033	01	2034	01
2035	01	2036	01	2037	01	2038	01
2039	01	2040	01	2041	01	2042	01
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2059	01	2060	01	2061	01	2062	01
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2067	01	2068	01	2069	01	2070	01
2071	01	2072	01	2073	01	2074	01
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2091	01	2092	01	2093	01	2094	01
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2099	01	2100	01	2101	01	2102	01
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2135	01	2136	01	2137	01	2138	01
2139	01	2140	01	2141	01	2142	01
2143	01	2144	01	2145	01	2146	01
2147	01	2148	01	2149	01	2150	01
2151	01	2152	01	2153	01	2154	01
2155	01	2156	01	2157	01	2158	01
2159	01	2160	01	2161	01	2162	01
2163	01	2164	01	2165	01	2166	01
2167	01	2168	01	2169	01	2170	01
2171	01	2172	01	2173	01	2174	01
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2211	01	2212	01	2213	01	2214	01
2215	01	2216	01	2217	01	2218	01
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2227	01	2228	01	2229	01	2230	01
2231	01	2232	01	2233	01	2234	01
2235	01	2236	01	2237	01	2238	01
2239	01	2240	01	2241	01	2242	01
2243	01	2244	01	2245	01	2246	01
2247	01	2248	01	2249	01	2250	01
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2259	01	2260	01	2261	01	2262	01
2263	01	2264	01	2265	01	2266	01
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2595	01	2596	01	2597	01	2598	01
2599	01	2600	01	2601	01	2602	01
2603	01	2604	01	2605	01	2606	01
2607	01	2608	01	2609	01	2610	01
2611	01	2612	01	2613	01	2614	01
2615	01	2616	01	2617	01	2618	01
2619	01	2620	01	2621	01	2622	01
2623	01	2624	01	2625	01	2626	01
2627	01	2628	01				

CLAUSE NO.	PROJECT INFORMATION			
	ANNEXURE-III			
	RAW WATER ANALYSIS			
	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	
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 9 OF 15

CLAUSE NO.	PROJECT INFORMATION			एन टी पी सी NTPC
	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
				PAGE 10 OF 15

CLAUSE NO.	PROJECT INFORMATION		एनडीपीसी NTPC																									
	ANNEXURE-IV-1																											
	LIGHT DIESEL OIL CHARACTERISTICS AS PER IS 15770-2008 <table><thead><tr><th>Characteristics</th><th>LDO</th></tr></thead><tbody><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></tbody></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					एनटीपीसी 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				एनटीपीसी 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="565 363 812 432">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 1130 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			एन टी पी सी 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

**TITLE****3X800 MW PATRATU STP PHASE-I****DOUBLE GIRDER EOT CRANES UPTO 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-434-501-A401

REV 00

Section IA

Date April'19

1.0.0. SCOPE OF WORK**1.1.0. SCOPE OF SUPPLY**

1.1.1. Equipment and services to be furnished by the bidder for the Three (3) nos. 40T capacity double girder EOT Cranes for BFP Handling, 1 No. 55T capacity double girder EOT Crane for Electrical Workshop, 1 No. 30T Capacity double girder EOT Crane for permanent store & 1 No. 10T capacity double girder EOT crane for Mechanical Workshop with accessories as per the details given in the technical specification and data sheet . . Any equipment / accessories not specified in the specification but required to make the EOT crane complete for efficient operation shall also be under the bidder's scope of work.

1.1.2. Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

1.1.3. Crane shall include but not be limited to the following: -

- a. Bridge girders
- b. End carriages with wheels
- c. Crab (trolley)
- d. Cross Travel & Long Travel drive arrangement
- e. All electrical equipment including cables, junction box, VVVF drive, pendant and panels etc. as per datasheet A.
- f. PVC insulated shrouded bus bar conductor type DSL
- g. Earthing arrangement
- h. Fill of lubricants till handing over.
- i. Painting of cranes and accessories including touch up painting at site.
- j. nos. 3.5 Core Power copper flexible cable (length- Half the bay length + 25m) of suitable size as per load calculation for commissioning, testing & operation of Crane till such time the DSL is charged.
- k. Rail including all accessories and end stopper
- l. Maintenance tools & Tackle
- m. Erection & Commissioning spares
- n. Mandatory Spares

**TITLE****3X800 MW PATRATU STP PHASE-I****DOUBLE GIRDER EOT CRANES UPTO 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-434-501-A401

REV 00

Section IA

Date April'19

- o. Main Isolating switch/Changeover in enclosure at operating floor for disconnecting supply to DSL. Termination of incoming cable (from BHEL) into isolating switch shall be in Vendor's scope.

1.1.4 Maintenance Tools and Tackles

As per Annexure III, section-IA of this specification

1.1.5 Mandatory Spares

A complete unused and new set of Mandatory Spare parts shall be supplied. Each part shall be stamped so as to be identified, easy for its use. The items supplied shall be of the best quality. The minimum requirement of mandatory spare parts is listed in Annexure –II section-IA of this specification.

1.1.6 Erection and Commissioning spares

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. Fill of lubricants; oil etc. till commissioning of the cranes shall also be supplied by the bidder.

1.1.7 Any supplies/services mentioned in GCC, SCC as relevant to the package**1.2.0 Services to be provided by the bidder****1.2.1. Packing, forwarding and transportation to site****1.2.2. Development of storage space including ward & watch of the equipment and handling at site.****1.2.3 Unloading, storage and handling at site.**

The Bidder shall provide means for all unloading and reloading for all consignments of plant; both during transport to Site and on the Site. Consignments shall be unloaded immediately on arrival at Site. The Bidder is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc. The following parts shall be stored inside enclosed warehouses:

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Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices attached, electric motors and excitation equipment, instruments, welding material and equipment, all small parts and all parts of the crane which already have been finally painted. If large parts are stored in the open air, they shall be provided with weather resistant and fire & resistant covers. Electrical parts, which are not packed in heavy duty polyethylene foil and those so packed, but whose packing has been damaged shall be kept in suitable places from the moment of storage to the moment of installation. All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity. All the equipment shall be stored as per standard storage and preservation instructions etc. of the suppliers.

1.2.4 Arranging test load at site

Collecting the test load at site within a radius of 1-2 KM from owner's storage to final testing bed of crane shall be under bidder's scope of work. Test load in the form of rolled steel, plates, girder, angle etc., as available at the site shall be made available by the purchaser. The test load shall be put back to the place from where it was lifted by the vendor, after the load testing. Load testing sling, cradles and any other item required by the vendor during the load testing shall be arranged by the vendor at no extra cost to the purchaser. Slings & cradles will be allowed to be taken back by the vendor, after completion of the test at site.

1.2.5 Erection and Commissioning & E-Learning Package (Annexure-IX)**1.2.6 Demonstration / Load test at bidder's Works and at site.****1.2.7 Obtaining clearance and acceptance certificate from the concerned competent**

Authority after site test and as and when required as per Government Norms /Statutory body till the time of final handing over to Customer. Necessary fees/expenditure as required shall be borne by the supplier.

1.2.9 Any service mentioned in GCC & SCC as relevant to the package.



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1.3.0. PAINTING & COLOUR SCHEME

As per Annexure IV, section-IA of this specification

2.0.0. Works Excluded

Supply feeder and cable from feeder / MCC to isolating switch.

Gantry girder

Dead load for load/ overload testing at site

Space for storage.

Exclusion, if any, mentioned in GCC, SCC.

3.0.0. Drawing and documents submission schedule along with number of prints.

Drawing and documents submission schedule along with number of prints / copies required for various drawing and documents are listed in Annexure –V, section-IA of this specification.

4.0.0. Deviations

If the offer submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the format of “Cost of withdrawal of deviation” attached in Section III and furnishing full particular of such deviations. Deviations are to be furnished with mention to specific clause number (reasons / explanations for such deviations shall be furnished). Notes / comments etc. is not acceptable. If there are no deviations from the tender document, bidder shall mention “**NO DEVIATION**” in cost of withdrawal of deviation format.

5.0.0. Makes of Sub - Vendor items

Makes of bought out items as per Annexure-I, section IA of the specification is for reference only. Sub vendor list shall be subject to customer approval and same shall not have any impact on manufacturing, delivery schedule and cost of the crane.

6.0.0 Parameter and tolerances for structural assembly including rail shall be as per the relevant standards.



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7.0.0. Performance Test requirement

EOT crane along with its drives, controls and other accessories shall be checked for the rated capacity against the rated speed of motions and for the service conditions specified.

The bidder shall have the full responsibility for the safe and efficient operation of the crane with associated accessories as a single unit. If the site performance tests indicate the failure of any of the components to achieve the desired performance, the deficiency shall be made good at bidder's cost.

Performance test shall be carried out each time after the rectification /modification is carried out.

Performance test of the crane shall include load tests and speeds in various motions at site.

7.1.0 Testing at site

Completely assembled crane at site shall be check for misalignment of gears, shafts and other items. Following minimum tests shall be conducted on the crane at the site

- i. Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.
- ii. Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated. Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177
- iii. All Other tests as per IS-3177.
- iv. Load & overload test along with deflection test of lifting beam in line with BHEL approved MQP for lifting beam (if applicable).
- v. Speed test at rated load for hoisting, CT and LT mechanism.
- vi. Brake test.
- vii. Any other test as per IS-3177

Note: The test shall be carried out with actual panel.

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8.0 Consumables

The Bidder's scope includes requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. till handing over. Consumption of all these consumables till handing over shall also be included in the scope of the Bidder. Bidder shall also supply a quantity of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilized till handing over. This additional quantity shall be supplied in separate Containers.

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QUALITY ASSURANCE AND INSPECTION REQUIREMENT



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1.1.0. Inspection and Testing

Bidder shall submit QAP based on the guidelines given in the specification & QAP enclosed therein.

1.1.1. Inspection and testing at Manufacturer's works

Copy of approved documents with stamp and signature (one set) shall be available at the place of Inspection which shall be ensured by supplier.

Shop inspection and tests will include but not limited to the following –

STAGE INSPECTION

Stage inspection of various components of crane shall be guided by the MQP approved during detail engineering. Indicative MQP is attached in the specification. However, following shall be ensured and read in conjunction with relevant clause of MQP w.r.t. stage inspection:

- i. All test certificates shall be in original and legible. Photocopies certified by Mill/ manufacturer of raw material used, are acceptable.
- ii. For tensile testing of hooks/ forgings, samples shall be drawn from the full cross section of the shank diameter of hooks/ forgings Samples forged to reduced cross section for testing purposes is not acceptable. **Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable.**
- iii Radiographs shall be inspected to a sensitivity of 2%.
- iv Ultrasonic test on forgings and casting of critical components like cross head (hook suspension block), Hooks, Shafts, Axles, Gears, Wheels, Pulleys etc. Ultrasonic test on forgings shall be carried out as per norms given below. UT shall be carried out in Proof machined condition (single diameter/ Flat surface without steps, keyways, teeth cutting or other profile machining which can create difficulty in ultrasonic testing). Components shall be identified with Heat number and serial number by punching). Hardening operation shall be carried out prior to Ultrasonic testing.

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps

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2. Defects giving indication larger than '4 (four) mm diameter equivalent flaw' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flaw.'
3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia. equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 40%.
4. Defects giving indication of 2 to 4 mm dia. equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws except for wheels for which Defects giving indication of 3 to 6 mm dia. Equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws Ultrasonic test on Castings shall be carried out as per ASTM E 609.

Wherever, the Quality plan calls for witness of Ultrasonic test by BHEL or BHEL's representative, the material shall be offered for UT in proof machined condition as stated above and hard stamping and subsequent stamp transferring by BHEL shall be followed at subsequent stages to ensure trace ability.

- v. Gear boxes shall be checked at No load for backlash, tooth contact, noise, temperature rise and vibration as per attached Procedure No. PEM (Q)/001.
- vi. Test certificates shall be furnished for verification of Type tests including environmental tests - for electrical and electro-mechanical items. If Type tests for items with similar / identical construction are not available, arrangement shall be made to conduct the same in the presence of BHEL/ Customer's representative (as required).
- vii.

FINAL INSPECTION- Testing At Works.

Cranes shall be completely assembled at manufacturer's works to check the misalignment of gears, shafts and other items. Gears shall be run idle for at least 4 (four) hours. Following minimum tests shall be conducted on the crane at the works of the manufacturer:

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- a) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.
- b) Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated.
- c) Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177
- d) All Other tests as per IS-3177.

Procedure for Load/Overload testing of EOT cranes at Manufacturer's Works & Site

Refer Testing requirement as mentioned at ANNEXURE-VII.



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Procedure No. PEM (Q)/001

SHOP TEST PROCEDURE FOR GEAR BOX

1.0.0	Scope: Acceptance Norms for Crane Gear Boxes
1.1.0	This procedure lays down the Acceptance norms for the Gear boxes for EOT crane. This standard also covers vertical gear boxes. Reduction Gears shall be tested for reduction ratio, backlash & contact pattern. Gear Box shall also be subjected to No load run test to check for oil leakage, temp. rise, noise and vibration.
2.0.0	The following dimensions shall be checked:
2.1.0	i. Diameter and keyway dimensions of input and output shafts. ii. Projection of input and output shafts beyond foundation holes and Centre lines of gear box. iii. Centre distance between input and output shafts. iv. Centre Height. v. Distance between foundation holes with respect to center line of the output shaft and distance of foundation holes from center line of the gearbox. vi. Overall dimensions
3.0.0	Backlash
3.1.0	The back lash shall be checked by dial gauge preferably (refer Figure –1). Lead wire may be also be used but final decision in case of dispute shall be taken by using dial gauge. The backlash shall be within the limits specified in the drawing. If the value of the backlash allowed is not specified in the drawing, the allowed backlash shall be a given in Table-1
4.0.0	Area of Contact:
4.1.0	Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2) For final stage of Hoist gearing: h / H shall be more than 30% $(a - c) / b$ shall be more than 40% For all other gears: h / H shall be more than 40% $(a - c) / b$ shall be more than 50%
5.0.0	Running Test
5.1.0	



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- i. All bolts at the joints remain tight
- ii. All gear mesh lines are getting enough lubrication
- iii. All bearings are getting enough lubrication
- iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour.
- v. Vibration : Maximum limit 125 microns (peak to peak)
- vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm.
- vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.

6.0.0

6.1.0



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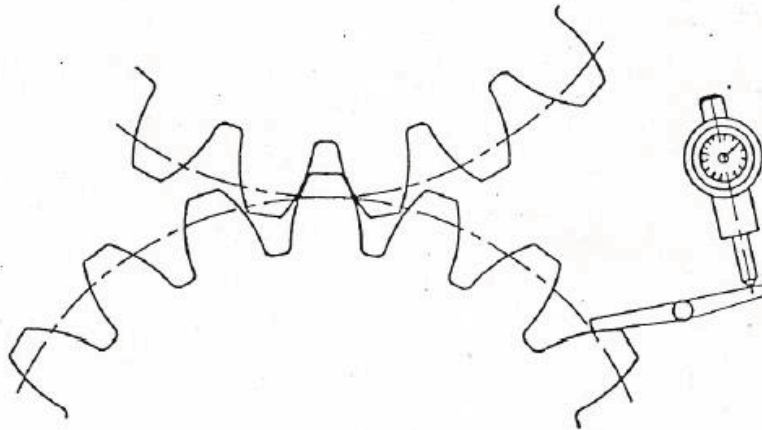


FIG.1 MEASUREMENT OF BACKLASH

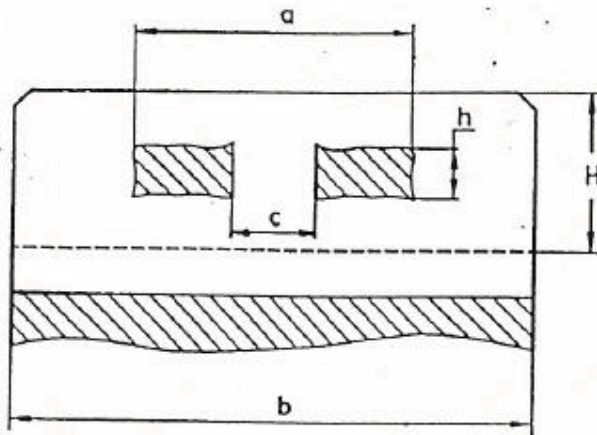


FIG.2 AREA OF CONTACT OF GEAR TEETH



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Table-1

Backlash for Gearing specified by module
(Clause 3.1.0)

Centre distance in mm		Tolerances in microns		
Above	Upto	Minimum	Maximum	
			For gears other than Drum gears	For Drum gears
			For all modules 1 to 50	For all modules 2.5 to 50
-	50	85	240	280
50	80	105	320	380
80	120	130	360	420
120	200	170	470	530
200	320	210	540	640
320	500	260	660	740
500	800	340	820	880
800	1250	420	970	1040
1250	2000	530	1200	1280
2000	3150	710	1500	1670
3150	5000	850	1810	1980



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	a) Suitable common lifting beam for lifting generator stator by means of two cranes operating in conjunction with suitable swiveling arrangement. b) A suitable indicating device to indicate the difference in the lifts of the two cranes, which shall be limited to 500 mm shall be provided on the lifting beam. The level difference indication shall be visible from ground level. c) A limit switch shall be provided to give alarm at both the cabins to enable the crane operators to control the level difference within 500mm. The bidder shall furnish the GA drawing of the beam showing all the dimensions, constructional details, details of crane hooks connection to the beam, lifting arrangement, level difference indicating devices, etc alongwith the bid.		
7.02.00	EOT CRANES		
7.02.01	One (1) no of Electrically operated travelling cranes for each unit with associated auxiliaries, alongwith electrical equipment, control & instrumentation as required and specified shall be provided in the BC bay for erection and maintenance of Boiler feed pump and their auxiliaries. The capacity of each crane shall be 10% over and above the heaviest component/equipment to be handled (including lifting beam and slings etc., if provided) or 25 Tonne whichever is higher.		
7.02.02	The EOT crane shall be pendent operated. The power shall be supplied from a single electrical power supply point at a suitable location on the operation floor of pump house.		
7.02.03	The design code for EOT crane shall be IS: 3177 latest edition.		
7.02.04	However, the speed for the various motions shall be as follows: Main hoist - 1.6 m/min Trolley Travel (Cross Travel) - 4.0 m/min Crane Travel (Long Travel) - 8.0 m/min		
7.02.05	Creep speed drives shall be provided for all the motions viz. bridge motion, trolley motion and hoist motion. This shall be 10% of the rated speeds. (Creep speed to be achieved through pony motor and planetary gear box or through variable voltage variable frequency (VVVF) system. Hoist brake shall not be used for this motion).		
7.02.06	The crane shall be electrically operated, overhead travelling type. Design and duty of crane structure, main hoist, cross travel. Long travel shall be in accordance with class M5 of IS:3177 (latest edition) and shall be suitable for indoor operation.		
7.02.07	The crane shall be complete with trolley and truck, wheels and axles, Drive mechanisms, Hoisting Drums, Brakes, Creep Speed Arrangement, Lifting tackles,		
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7.02.14	Each crane shall be controlled individually for all its motions from the control pendent panel.			
7.02.15	Each crane shall have a permanent inscription of English on each side, readily visible from the ground level, stating the safe working loads in tonnes for both the hooks, year of manufacture, crane serial number and manufacturer's name.			
7.02.16	The vertical deflection of crane girder shall not exceed 1/800 of the span. The girder shall be of box type and construction shall ensure non-accumulation of water/oil inside the box.			
7.03.00	Motors Three phase Squirrel Cage Induction motors to be operated from VFD system shall be suitable for speed range and torque without exceeding temperature rise limits as specified elsewhere in this specification. These motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for Inverter duty. Motors shall conform to latest revision of IS 325, IS 3177 and motor subsection of this specification.			
7.04.00	Controls i) Speed control of EOT crane shall be through Variable Voltage Variable Frequency System (VVVF) with minimum 6 (six) pulse design. ii) Necessary input & output devices to be provided to reduce harmonics, as per IEE519, at supply side of the drive at the switchgear. iii) All necessary protections e.g. Input Phase Loss, Earth Fault, Over Voltage, Output Short Circuit, Load Loss, Input Transient Protection, Overload etc to be provided. iv) VVVF system shall be capable of generating suitable starting torque (upto 400% typical) with / without encoder, however starting current shall not exceed 150% at rated torque. v) VVVF system shall be capable of withstanding upto 50 deg C ambient temp without derating vi) Provision for controlling the motion from operator cabin (in case of Turbine hall EOT crane) as well as remote control shall be available. vii). Squirrel cage Induction motor with VPI insulation shall be provided With VVVF system. viii) Master controller - Desk type having following features.			
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7.05.00	(i)Five speed control points in each direction of hoist motion. (ii)Four speed control points in each direction of bridge and trolley motion. (iii)Release of operator's hand from the controls shall stop motion and set brakes automatically.			
	ix)Protective Panel Provided with isolating switch, power contactor control and indication to switch ON/OFF power to starter panels, control and lighting transformer.			
	x)Starter Panel Separate VVVF system panels to be provided for CT, LT and hoist motion (main and auxiliary drives). a)Contactors : AC 4 duty for reversing application AC 3 duty for non reversing application b)Switches: AC 23 for motor application, AC 22 for other application. c)Fuses: HRC d)Overload relay : Temperature compensated, bimetallic with single phasing preventor.			
	xi)Panel shall be fabricated out of 1.6 mm thick rolled sheet steel. IP 52 degree of protection. Paint shade shall be RAL 9002 for front & rear and RAL 5012 for side covers. Space heaters to be provided.			
	Radio remote Control of EOT Crane:			
	i)The equipment should have facility to control EOT crane by radio frequency based wireless remote unit. The equipment should be supplied with transmitter unit, receiver unit, encoder unit, decoder unit, interface panel, coupling system, battery unit and any other control gear if required. ii)The equipment should be based upon the microprocessor based digital technology with almost nil hard wiring. iii)The remote unit should communicate up to the distance of approximately 100 meters.			
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7.06.00	iv)	The system has to integrate with the control system of crane, which operates at 110 V AC, Single phase.		
	v)	The remote unit should have transmitter which can be mounted on shoulder by suitable belt. Main controls can be of single joystick movement or double joystick movement type stepped control with spring return. The Micro control should be toggle switch type or push control type.		
	vi)	Frequency allotment for radio remote unit from Govt. of India, Deptt. of Telecommunication or any other agency shall be the responsibility of supplier.		
	vii)	The transmitter and receiver unit should have its own frequency and address code with each system having its own security code so that one particular set becomes unique and there is no interference from any other remote unit device. A microprocessor should check all security codes. The processor should have its own watchdog circuit. The receiver FM band should be sufficiently narrow to allow only passing of desired frequency and valid command. Any error should shut down the system immediately.		
	viii)	The remote unit should have safety key to prevent any unauthorized operation. All the crane operations should stop at once the communication break down occurs.		
	ix)	On local unit (receiver side), the system should be provided with one selector switch so that EOT crane can be operated either from Operator cabin or radio remote unit.		
	x)	In case tandem operation is envisaged, a suitable selector switch shall be provided in the cabin for selection of Tandem/normal operation.		
	xi)	The receiver unit along with I/O interface unit should be able to bear the vibrations and shocks encountered in normal usage of EOT crane.		
	xii)	The system should have very fast response time.		
	Power Supply			
(a)	Down shop Lead (DSL):			
	(i)	Shall conform to IS : 282 and shall be sized to		
	-	Cater to all cranes working simultaneously with 40% cyclic duration factor for load.		
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	- Limit voltage drop at motor terminals within 2% at extreme positions. (ii) DSL shall be sized with a margin of 10% over load requirement. (iii) Protective cover over DSL to be provided. (iv) Two (2) numbers isolating switches in enclosure shall be provided at extreme ends of operating floor for disconnecting supply to DSL while maintaining the crane. (v) DSL shall be located on 'A' -row side for Turbine hall EOT crane. (b) Transformers Dry type, with insulation class B or better. Following transformers shall be provided. (i) Control Transformers : 2x100%, 415V / 110V (ii) Lighting Transformers: One 415V/240V (iii) Hand lamp : One 415V/24V			
7.07.00	Illumination HPSV lamps under the bridge. Florescent lamp over the bridge and inside the cabin.			
7.08.00	CABLES (a) EPR insulated, copper conductor trailing cables, as per IS:9968, on the bridge. (b) Extruded PVC insulated, copper/Aluminium conductor,1100 Volt grade power cables. This shall include cable lengths between changeover switch & DSL and isolating switch & DSL. (c) Extruded PVC insulated, copper conductor 1100 volt grade control cables.			
7.09.00	Mechanical overload protection - to be provided for hoist mode.			
7.10.00	MAXIMUM SPAN/DEPTH RATIO FOR GIRDER: (a) Plate girders : 18 (b) Lattice girders : 12			
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7.11.00	Material (i) Structural steel plates : rolled section Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate (ii) Nuts & Bolts : As per IS:1363, IS:1364 and IS:1367. High Tension Friction grip bolts as per IS: 3757. High Tension Friction grip nuts as per IS: 6623. (iii) Electrodes : Radiography quality, covered electrodes with heavy covering as per IS : 814 and relevant requirements of ASME Sec. IX and IIC. Bare Electrodes as per IS:7280 and flux wire combination as per IS : 3613. (iv) Chequered plates : IS: 3502 (Minimum 6 mm thick O/P) (v) Hand rail pipes : 32 mm NB Medium class of IS : 1161 having top and bottom rail at height of 1050 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate(100 mm high and 6 mm thick). (vi) Crane Rails : As per IS : 3443.			
7.12.00	Minimum thickness of Structure Members: (a) Load Carrying members : 8 mm (b) Tubes with both ends sealed : 4.9 mm (6 SWG) (c) Tubes with unsealed ends : 8 mm (d) Chequered plate : 6 mm O/P			
8.00.00	PRECOMMISSIONING ACTIVITIES The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems are mentioned under respective equipments, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS- 9585-001-2	SUB SECTION-A-08 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 62 OF 67



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SECTION – IA
ANNEXURES



TITLE
3X800 MW PATRATU STP PHASE-I
DOUBLE GIRDER EOT CRANES UPTO 100T
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ANNEXURE-I
MAKES OF SUB-VENDOR ITEMS

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	STEEL	SAIL		
		TISCO		
		JINDAL		
		ESSAR		
2.	HOOKS	STEEL FORGING & ENGG. CO.,	KOLKATA	
		SIMRITI FORGING		
		KARACHIWALA		UP TO 25T CAPACITY
3.	GEAR COUPLINGS	ALLIANCE		
		FLEX-TRANS (formerly known as HICLIFF)		
		SAHARA		
		NUTECH		
		OEM		
4.	WIRE ROPE	USHA MARTIN		
		FORT WILLIAMS		
		BHARAT WIRE ROPES		
5.	BEARINGS	SKF		
		FAG		
		TATA		
		NBC		
6.	MOTORS	SIEMENS		
		NGEF (up to 15KW)		
		CROMPTON		
		KIRLOSKAR		
		BHARAT BIJLI		
		MARATHON		
7.	BRAKES	ABB		
		ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DCEM BRAKES ONLY
		KAKKU		
8.	CONTACTOR	PATHE		
		SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
9.	OVER LOAD RELAYS	BCH		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
11.	ISOLATING SWITCH	ABB		
		SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
		SIEMENS		
13.	TIME DELAY RELAYS	L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
		SIEMENS		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS		
		BAJAJ		
		CROMPTON		
16.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
17.	HOOTERS	BEACON		
		OSC		
		TARGET		
		KHERAJ		
18.	LIGHTING SWITCHES	ANCHOR		
		ELLORA		
		BAJAJ		
		PHILIPS		
19.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
20.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DELTON CABLES LTD	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		ELKAY TELELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
21.	TRAILING CABLES	UNIVERSAL CABLES LTD	SATNA	
		NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
22.	XLPE POWER CABLES	SUYOG ELECTRICALS LTD	VADODARA	
		APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATI	MUMBAI	

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
23.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
24.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
25.	PUSH BUTTONS	DOWELL		
		SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
26.	LIMIT SWITCHES	SPEED-O-CONTROL ELECTROMAG		
27.	MASTER CONTROLLER	SPEED-O-CONTROL ELECTROMAG		
28.	SAFETY SWITCHES	ALSTOM L&T SIEMENS		
29.	PENDENT PUSH BUTTON STATION	OEM		
30.	INDICATING LAMPS	TECKNIC BCH SIEMENS		
31.	MCB	STANDARD MDS INDO COPP STANDARD SIEMENS L&T ABB SCHNEIDER		
32.	PANELS	OEM RITTAL PYROTECH		
33.	RESISTANCE BOXES	ENAPROS OEM		
34.	FIRE EXTINGUISHERS	ASKA EQUIPMENTS LTD. ASHOKA ENGINEERING COMPANY KANADIA FYR FYTER PVT. LTD NITIN FIRE PROTECTION INDUSTRIES LTD NEW ENGINEERING CORPORATION SAFEX FIRE SERVICES LTD UNITED FIRE EQUIPMENTS PVT. LTD ZENITH FIRE SERVICES (INDIA) PVT LTD		
35.	VVVF	YASKAWA ABB SIEMENS SCHNIEDER FUJI ELECTRIC MITSUBISHI ELE		



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
36.	SHROUDED DSL	SUSHEEL STROMAG		
37.	ANTI COLLISION DEVICE	ELECTRONIC SWITCHES INDIA		
38.	LOAD CELL	IPA SARTORIUS		
39.	RRC	ACROPOLIS ENGINEERING SNT CONTROLS	- -	
40.	GEAR BOX	OEM ELECON ENGINEERS SHANTI GEARS PBL* NAW* NORD* SEW* BONGFILIOLI*		* = Applicable for Geared Motors only
41.	RAIL	JSPL SAIL		

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND NTPC APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL
2. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ NTPC.

ANNEXURE-II

MANDATORY SPARES (APPLICABLE ONLY FOR BFP CRANE)

Sl. No.	DESCRIPTION	QUANTITY
Mechanical		
1	Bearings for long travel wheels	1 Set (Requirement for one Crane)
2	Bearings for cross travel wheels	1 Set(Requirement for one Crane)
3	Bearings for Gear Boxes for each type of Hoist & travel (Main and aux hoist, LT and CT travel)	1 Set(Requirement for one Crane)
4	Brake Liner for all the brakes (main and aux hoist ,LT and CT travel)	2 Sets (Requirement for two Crane)
5	Hydraulic thruster for all Brakes (Main and aux hoist, CT and LT travel)	1 Set (Requirement for one Crane)
6	Oil Seals (both main and aux hoist , CT and LT motion)	2 Sets(Requirement for two Crane)
7	Brake springs for all brakes (both main and aux hoist, LT and CT travel)	1 Set(Requirement for one Crane)
8	Wire Rope	1 No each
Electrical		
1	Solenoid Coils for Brakes	2 sets
2	MCBs/MCCBS/Fuse links for the whole crane	1 set
3	Contactors and overload Relays for Motors of the EOT	1 set of each type, size & rating
4	Motors of EOT	1 set of each type, size & rating
5	Timers of each type, size & rating	1 set
6	Limit Switches for	
	Main Hoist	1 set
	Aux. Hoist	1 set
	Cross Travel	1 set
	Long Travel	1 set
	Carbon brushes & brush holders	1 set
7	Master Controller	1 set each
8	Resistance Box	1 No of each type.
9	Drive for MH,AH,CT&L	1 no. of each type& rating
NOTES		
1	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. One (1) set means 100% requirement for one crane.	
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 is 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	Interchangeability and Packings:	
	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 to 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 preprogrammed 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	Identification:	
	Each spare shall be clearly marked and labeled 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, containers and other packages must be suitably marked and numbered for the purpose of identification.	
8	Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification, same shall be deemed to have been covered in bidders scope of supply.	

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ANNEXURE III - TOOLS & TACKLES

A complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied for each crane. Each tool and wrench shall be stamped so as to be identified, easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and minimum the following shall be provided

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Min. 6 Nos., Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5	Wrench spanner	1 No.
6.	Grease Gun	1 No.
7.	Oil Gun.	1 No.
8.	Hand Lamp.	1 No.
9	Line tester	1 No.

Note: - One set of tool and tackles with O&M manual in the toolbox shall be supplied. Further in addition to above mentioned items, if any other items is required for maintenance of cranes, the same shall also be included as a part of maintenance tools by the bidder.



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ANNEXURE IV PAINTING SPECIFICATION

1. Painting specification for steel structures:-

Surface preparation: De greasing and Mechanical cleaning with wire brush or blasting according to SIS 055900, Grade 2 ½ .

Primer : Epoxy based Zinc Phosphate. - 1 coat, DFT 35 µm per coat.

Intermediate : Epoxy base Tio2 pigmented coat - 1 coat, DFT 35 µm per coat

Finish Coat : Epoxy base paint - 2 coats, DFT 40 µm per coat.

Total DFT : 150µ

2. Painting specification for Indoor components such as motors, electrical parts etc:-

Epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat.

3. Color Shade:

SL. No	Item Description	Color Shade	Remarks
1	Crane Structure	Golden Yellow shade 356 as per IS-5	Colour band-Black
2	Trolley and hook	Golden Yellow shade 356 as per IS-5	
3	Motors	Light Gray shade 631 as per IS-5	
4	Control Panels	Light Gray (Powder coated) as per IS-5	

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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 RID DOC NO. CS-9585-001-2	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 1 of 9

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1.06.04	as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats. 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.			
1.06.05	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-Deoxaluminate 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 RIN DOC NO. CS-9585-001-2	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 2 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
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 RID DOC NO. CS-9585-001-2	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 3 of 9 59 of 335

1.06.11 Primer/Painting Schedule

Sl. No	Description	Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painting DFT (Microns)	Colour Shade	
			Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)			
A) Power Cycle Piping														
1.	All insulated Piping, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	As per NTPC Colour shade/ coding scheme	
2.	All un-insulated Piping, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3	35	155		
		SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40		
		SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40		
3	Constant Load Hanger (CLH) and Variable Load Hanger (VLH)	SP4*	PS19	1	40	-	-	-	PS17	1	30	70		

4	Piping hangers/ supports (other than (3) above. (un-insulated)	SP4 (SP6 - for cleaning of weld joints after erection.)	PS 5	1	40	PS 4	1	40	PS 17	1	40	120
	Valves											
5.	Cast/Forge d	Design temperature < or equal to 60 degC	PS4/PS9	1	40	Polyamide Epoxy	1	100	PS17	1	40	180
		Design temperature above 60 degC and up to 200 degC	PS 9*	1	20	-	-	-	PS9*	1	20	40
		Design temperature above 200 degC	PS9*	1	20	-	-	-	PS9*	1	20	40
6.	All auxiliary Structural Steel components for pipe supports	Outside TG building and in SG envelope	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	75	a))Epoxy coat b)Final coat of paint PS17	2 1	35 30	250

		Within building	TG	SP4*	-do-	1	35	PS18	1	35	a)) Epoxy coat	2	25	150
											b) Final coat of paint PS17	1	30	
7.	Weld Edges			SP6 (Hand cleaning by wire brushing)	PS13 (Weldable primer)	1	25	-	-	-	-	-	-	25
1. \$ The first 2 finished coats (total min. DFT of 70 microns) shall be done at shop and the 3rd finish coat (min. DFT 35 Microns) shall be applied at site. 2. For valves below 65NB and temperature upto and including 540 DegC, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint. 3. For corrosion protection of threaded hanger rods and variable spring cages, electro galvanizing in full compliance to minimum Corrosion category C3 as per EN ISO12944 is also acceptable. 4. For spring cages, 2 coats of 30 µm (min) zinc-rich epoxy resin primer with zinc content > 80 weight% in dry film followed by 2 coats of 30 µm (min) top coat of Acrylic resin Co-polymerisate with a total combined minimum DFT of 120µm is also acceptable in lieu of above specified paint scheme. 5. For corrosion protection for all inner parts of the hangers shall be at least in full compliance to Corrosion category C3 as per EN ISO12944.														
B) Steam Generator & Auxiliaries:														
1	All surfaces with temperature 95°C or less and which are insulated	SP3/SP4	PS 5	2	30	-	-	-	-	-	PS 4	2	20	100
2	All surfaces with temperature above 95°C and which are insulated	SP3/SP4	PS9*	1	20	-	-	-	-	-	PS9*	1	20	40

Note: 1) 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.
2) For valves below 65NB and temperature upto & including 545 Deg.C, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint.

C) LOW PRESSURE PIPING

1	All Pipes, components, fittings / valves, Equipments etc.	SP3/SP5	PS3/ PS5	2	25	PS 4	1	30	PS 4	2	35	150	As per NTPC Colour shade/ coding scheme
2	Stainless steel surface, Galvanized steel surface and gun metal surface.	No Painting											
3	On the internal surface for pipes 1000 Nb and above	A coat of primer followed by hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.											

D) Fire Detection & Protection System, Compressed air system, Hydrogen generation plant and Air-conditioning & Ventilation System

For Fire Detection & Protection System, Surface preparation and painting of Fire Water Storage Tanks, all Steel Surfaces (external) exposed to atmosphere (outdoor & indoor installation), Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc. should be as per the Part-B, Sub Section-A-18, Fire Detection & Protection System

For Air Conditioning System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Air Conditioning System.

For Ventilation System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-30, Ventilation System.

For compressed air system, Surface preparation and painting of all the steel surfaces should be as per the Part-B, Sub Section-A-16 compressed air system.

For hydrogen generation plant, Surface preparation and painting should be as per the Part-B, Sub-Section-A-19 hydrogen generation plant.

E) ESP

1	All surfaces with surface temperature 95°C or less (with insulation)	SP3/SP4	PS3/ PS5	1		25	-	-	-	PS 4	1	30	55
2	All surfaces with surface temperature above 95°C (with or without insulation)	SP3/SP4	PS5	2		30	-	-	-	-	-	-	60

General Notes (Applicable for all above points A to E)

- i) Painting specification for all surfaces with surface temperature 95°C or less (un-insulated) that are not covered above shall be same as that given in Civil Sub-section, Part-B, Section-VI for corrosion protection of steel structures.



- 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.

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3X800 MW PATRATU STP PHASE-I
DOUBLE GIRDER EOT CRANES UPTO 100T
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-434-501-A401
REV 00
Section IA **Date** April'19

ANNEXURE-V

DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

S.N	BHEL drawing No.	Title	Approval category	Schedule date of submission from date of LOI.
1	PE-V0-434-501-A401	Manufacturing Quality Plan with sub vendor list For BFP Handling Crane	A	2
2	PE-V0-434-501-A403	Data sheet of motors for BFP Handling Crane	I	5
3	PE-V0-434-501-A404	Mechanism Sizing Calculation for BFP Handling Crane	A	2
4	PE-V0-434-501-A405	General arrangement for BFP Handling Crane with CT DSL details	A	2
5	PE-V0-434-501-A406	Crab sub assembly for BFP Handling crane with CT wheel assembly	I	3
6	PE-V0-434-501-A408	General arrangement for PVC shrouded DSL for BFP handling Crane	I	3
7	PE-V0-434-501-A409	Main hook block assembly with details of hook, nut and check plate For BFP handling Crane	I	2
8	PE-V0-434-501-A410	Long travel Machinery Assembly with LT wheel assembly For BFP Handling Crane	I	4
9	PE-V0-434-501-A412	Structural calculations For BFP Handling Crane	A	3
10	PE-V0-434-501-A414	O & M Manual For BFP Handling Crane	I	9
11	PE-V0-434-501-A417	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Cross Traverse & BOM d) Long Traverse & BOM Including earthing diagram and operational write up For BFP Handling Crane"	A	5
12	PE-V0-434-501-A418	"General Arrangement of a) Protective panel b) Main hoist panel c) Cross Travel panel d) Long Traverse travel panel. e) Pendent For BFP Handling Crane"	I	5
13	PE-V0-434-501-A419	Cable Sizing and cable schedule For BFP Handling Crane	A	6
14	PE-V0-434-501-A425	Erection procedure For All Cranes	I	8
15	PE-V0-434-501-A427	Data sheet of BFP handling Crane with painting details	A	3
16	PE-V0-434-501-A432	Gantry Rail installation for BFP Handling Crane	I	3
17	PE-V0-434-501-A430	Crane lubrication drawing For BFP handling Crane	I	6



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18	PE-V0-434-501-A451	Manufacturing Quality Plan with sub vendor list For Permanent Store Crane	A	2
19	PE-V0-434-501-A453	Data sheet of motors for Permanent Store Crane	I	5
20	PE-V0-434-501-A454	Mechanism Sizing Calculation for Permanent Store Crane	A	2
21	PE-V0-434-501-A455	General arrangement for Permanent Store Crane with CT DSL details	A	2
22	PE-V0-434-501-A456	Crab sub assembly for Permanent Store crane with LT & CT wheel assembly	I	3
23	PE-V0-434-501-A459	Main hook block assembly with details of hook, nut and check plate For Permanent Store Crane	I	2
24	PE-V0-434-501-A460	Structural calculations For Permanent Store Crane	A	3
25	PE-V0-434-501-A461	O & M Manual For Permanent Store Crane	I	9
26	PE-V0-434-501-A467	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Cross Traverse & BOM d) Long Traverse & BOM Including earthing diagram, GA of DSL and operational write up For Permanent Store Crane"	A	5
27	PE-V0-434-501-A468	"General Arrangement of a) Protective panel b) Main hoist panel c) Cross Travel panel d) Long Traverse travel panel. e) Pendent For Permanent Store Crane"	I	5
28	PE-V0-434-501-A469	Cable Sizing and cable schedule For Permanent Store Crane	A	6
29	PE-V0-434-501-A477	Data sheet of Permanent store Crane with painting details	A	3
30	PE-V0-434-501-A472	Gantry Rail installation for Permanent Store Crane	I	3
31	PE-V0-434-501-A470	Crane lubrication drawing For Permanent Store Crane	I	6
32	PE-V1-434-501-A451	Manufacturing Quality Plan with sub vendor list For Electrical Workshop Crane	A	2
33	PE-V1-434-501-A453	Data sheet of motors for Electrical Workshop Crane	I	5
34	PE-V1-434-501-A454	Mechanism Sizing Calculation for Electrical Workshop Crane	A	2
35	PE-V1-434-501-A455	General arrangement for Electrical Workshop Crane with CT DSL details	A	2
36	PE-V1-434-501-A456	Crab sub assembly with LT & CT wheel assembly for Electrical Workshop Crane	I	3
37	PE-V1-434-501-A459	Main hook block assembly with details of hook, nut and check plate For Electrical Workshop Crane	I	2
38	PE-V1-434-501-A460	Structural calculations For Electrical Workshop Crane	A	3
39	PE-V1-434-501-A461	O & M Man	al Workshop Crane	I



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40	PE-V1-434-501-A467	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Cross Traverse & BOM d) Long Traverse & BOM Including earthing diagram, GA of DSL and operational write up For Electrical Workshop Crane"	A	5
41	PE-V1-434-501-A468	"General Arrangement of a) Protective panel b) Main hoist panel c) Cross Travel panel d) Long Traverse travel panel. e) Pendent For Electrical Workshop Crane"	I	5
42	PE-V1-434-501-A469	Cable Sizing and cable schedule For Electrical Workshop Crane	A	6
43	PE-V1-434-501-A477	Data sheet of Electrical Workshop Crane with painting details	A	3
44	PE-V1-434-501-A472	Gantry Rail installation for Electrical Workshop Crane	I	3
45	PE-V1-434-501-A470	Crane lubrication drawing For Electrical Workshop Crane	I	6
46	PE-V1-434-501-A401	Manufacturing Quality Plan with sub vendor list For Mechanical Workshop Crane	A	2
47	PE-V1-434-501-A403	Data sheet of motors for Mechanical Workshop Crane	I	5
48	PE-V1-434-501-A404	Mechanism Sizing Calculation for Mechanical Workshop Crane	A	2
49	PE-V1-434-501-A405	General arrangement for Mechanical Workshop Crane with CT DSL details	A	2
50	PE-V1-434-501-A406	Crab sub assembly for Mechanical Workshop crane with LT & CT wheel assembly	I	3
51	PE-V1-434-501-A409	Main hook block assembly with details of hook, nut and check plate For Mechanical Workshop Crane	I	2
52	PE-V1-434-501-A410	Structural calculations For Mechanical Workshop Crane	A	3
53	PE-V1-434-501-A417	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Cross Traverse & BOM d) Long Traverse & BOM Including earthing diagram, GA of DSL and operational write up For Mechanical workshop Crane"	A	5
54	PE-V1-434-501-A418	"General Arrangement of a) Protective panel b) Main hoist panel c) Cross Travel panel d) Long Traverse travel panel. e) Pendent For Mechanical Workshop Crane"	I	5
55	PE-V1-434-501-A419	Cable Sizing and cable schedule For Mechanical Workshop Crane	A	6
56	PE-V1-434-501-A417	Data sheet of Mechanical Workshop Crane with painting details	A	3
57	PE-V1-434-501-A422	Gantry Rail installation for Mechanical Workshop Crane	I	3



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58	PE-V1-434-501-A420	Crane lubrication drawing For Mechanical Workshop Crane	I	6
LEGENDS				
A= Approval category				
I= Information category				

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.
5. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-
 - a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.
 - f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
 - g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No. Technical parameters, dimensions, hardness,

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machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

- h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.
- i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- j) Bidder to follow the following the drawing submission schedule:
 - i. 1st submission of drawings from date of LOI as per the submission schedule.
 - ii. Every revised submission incorporating comments – within 7 days.
- k) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

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ANNEXURE VI – PACKING PROCEDURE**Packing and Marking**

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement.

Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

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ANNEXURE-VII**Procedure for Load & Overload testing of Double Girder EOT
Cranes at Manufacturer's Works**

Objective: To demonstrate final NO load, Load, Overload, Deflection & Functional tests of assembled crane/s for the purpose of acceptance.

Basic Assumptions / Inputs for testing at Works:

- Actual job hook shall be used for load & overload tests for hoisting.
- Actual ropes shall be used for load & overload testing.
- Shop cables can be used for temporary connection for the purpose of showing various functional tests at shop.
- Interlock and limit switch operation check will be shown with load for hoisting and CT motion.

Procedure for Load / Overload testing:

The cranes shall be tested for no load, load test & overload test at works generally in conformance with the IS – 3177 (latest edition). Specifically with respect to the load / overload testing of crane, the following tests as per the outlined procedures shall be done at works.

- Deflection of the girder will be measured at SWL when the trolley with load is at the middle of the girder.
- No load and full load current of the motors will be measured to verify whether it is as per the approved data sheet of the motor. Resistors in the circuit will be checked for any overheating of the element.
- Overload relays will be checked for proper functioning.

Hoisting & Cross Travel motions:

The load will be gradually raised to 125 percent of the rated capacity (SWL) with actual hook. The load will be lifted upward to about 1 meter height above its support and stop again. Check for any undue drift in the load. If load drifts, check the adjustment of brakes and repeat the above procedure. Then lower the load to rest on support/ground.

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For checking the cross travel, raise the load up to one (1) meter height above supports and then move the trolley with load about one (1) meter in either direction of the bridge. Then lower the load to rest on support/ ground.

Creep speed motions shall be checked over a distance of about 500 mm.

Note: Complete No load, load & over load tests in line with IS-3177 (latest edition) shall also be done after erection of EOT crane at site.

ANNEXURE - VIII

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

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

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				

6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				

ANNEXURE-IX

e-Learning Package:

e-learning packages shall be supplied for the equipment / system for the following Steam Turbine Generator & auxiliaries and Steam Generator & auxiliaries along with associated electrical and C&I system.

Steam Turbine Generator & Auxiliaries

Steam Turbine including stop valves, control valves, overload valves and cross over piping. Steam Turbine Auxiliary Systems including Quick Closing and Ordinary NRVs, Turbine gland sealing system, Lubricating oil system and its purification system, Centralised oil storage and its purification system, Control fluid and its purification system, governing and protection system, exhaust hood spray cooling system, drainage and vent system, turbine preservation system, HP/LP Bypass system.

Generator and Auxiliary System including Generator, complete hydrogen cooling, carbon dioxide and nitrogen gas systems as applicable, complete seal oil system, complete water cooling system where applicable and complete excitation system.

Condensing Plant including Condenser, Condenser air evacuation system and Condenser on load tube cleaning system as applicable.

Drip Pump along with all accessories as applicable, Condensate Extraction Pumps along with all accessories, Deaerator level Control Station, Feed Water Heating Plant including Drain Cooler, low pressure heaters, deaerator and feed storage tank, high pressure heaters and associated accessories, Boiler Feed Pumps along with all accessories, Drive Turbine for Boiler Feed Pump along with all accessories, Feed regulating station, Make up system to Condenser, Gland Steam Condenser Recirculation System, Turbine Hall EOT Cranes and EOT Crane for Boiler Feed Pump as applicable.

Steam Generator & Auxiliaries

Furnace/evaporator, separator & drain collection vessel, superheater, reheater, economiser, startup recirculation & drain system, desuperheating spray system, safety valves, soot blowing system, draft plant including FD & ID fans, PA fan, air preheaters, SCAPH, coal preparation and firing system including raw coal feeder and pulverisers, coal burners, fuel oil system and oil burners, Electrostatic precipitator, NOx control system and Flue gas desulphurisation system, Aux. PRDS system.

These packages shall be installed on the Learning Management Server (LMS) of Power Management Institute (PMI) , NTPC located at Noida . The Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI.

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

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

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

4. e-Learning course broad requirements:

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

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

Notes:

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

**TITLE**

3X800 MW PATRATU STP PHASE-I
DOUBLE GIRDER EOT CRANES UPTO 100T
SPECIFIC TECHNICAL REQUIREMENTS

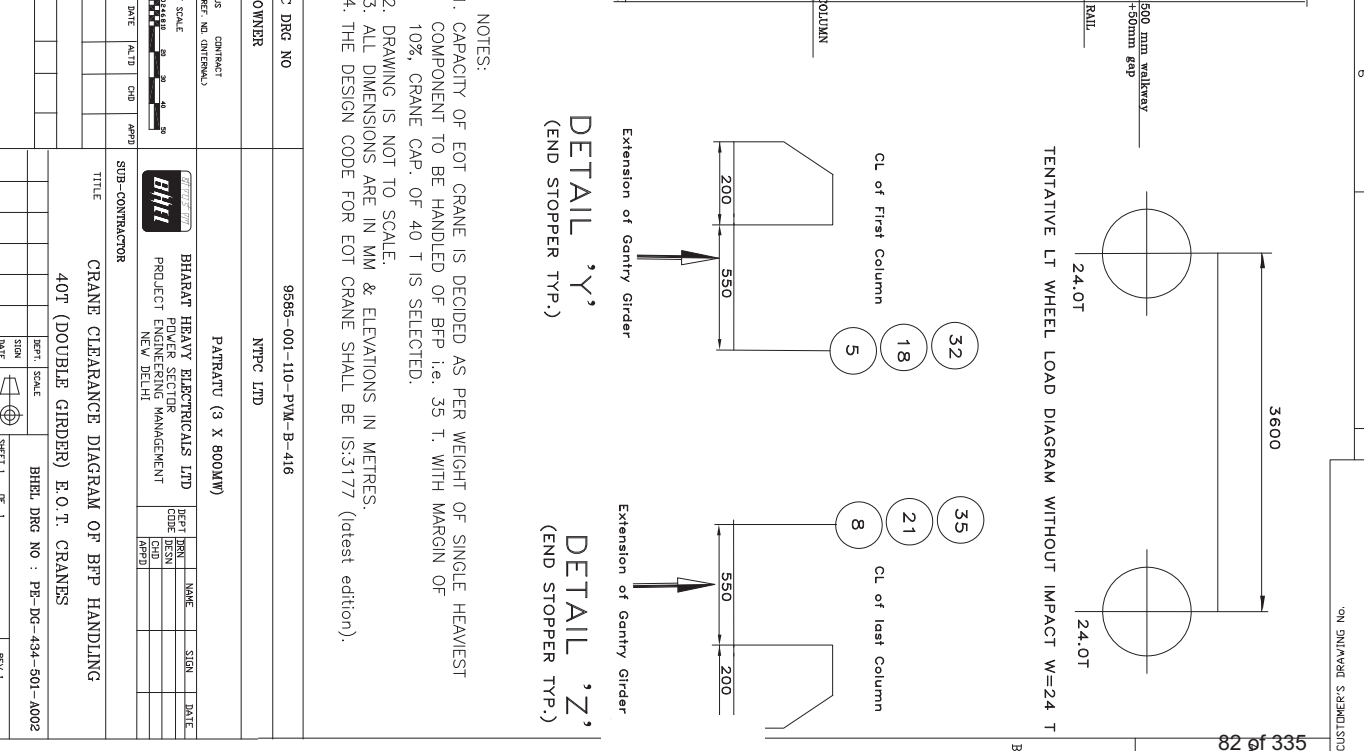
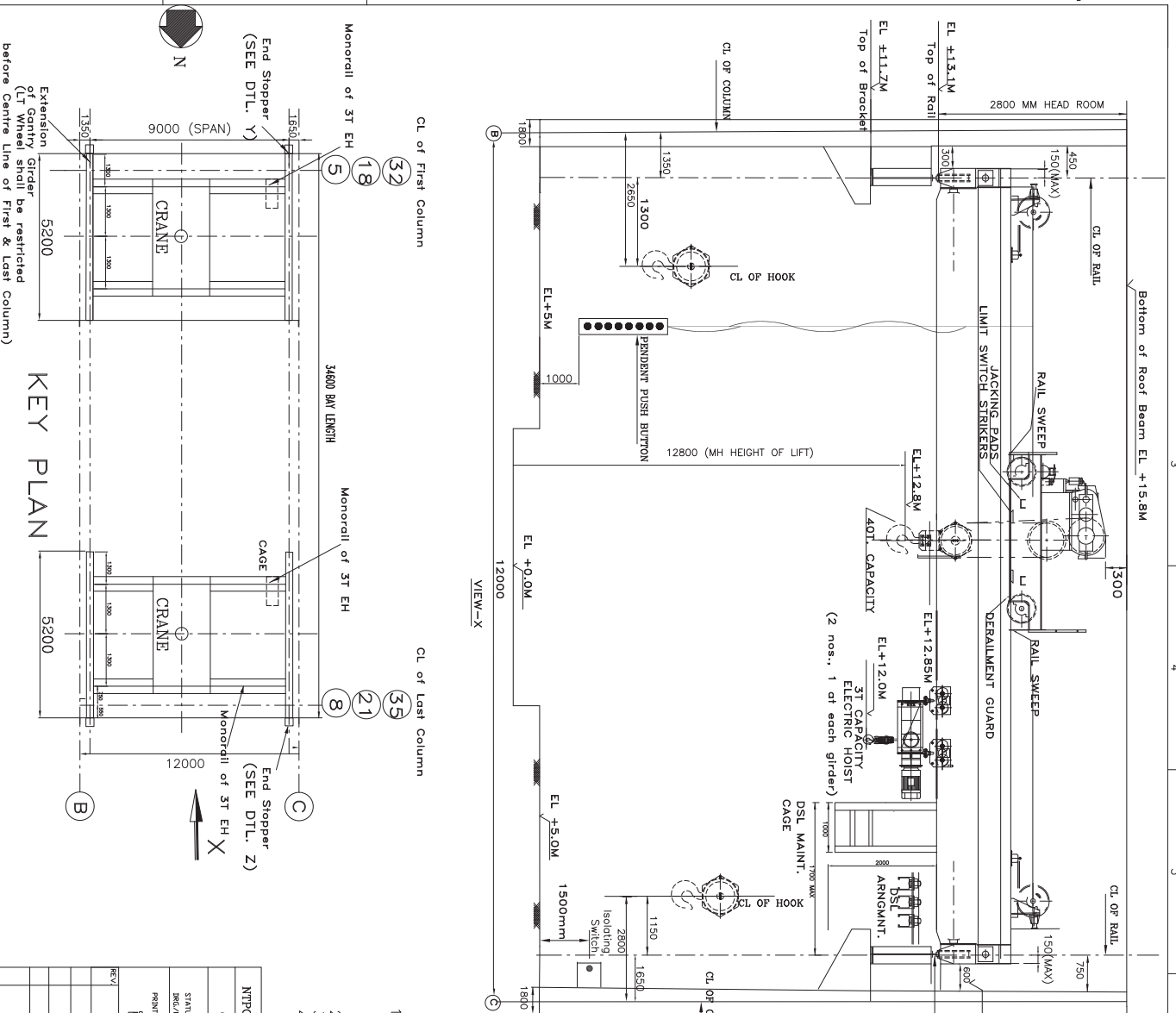
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REV 00

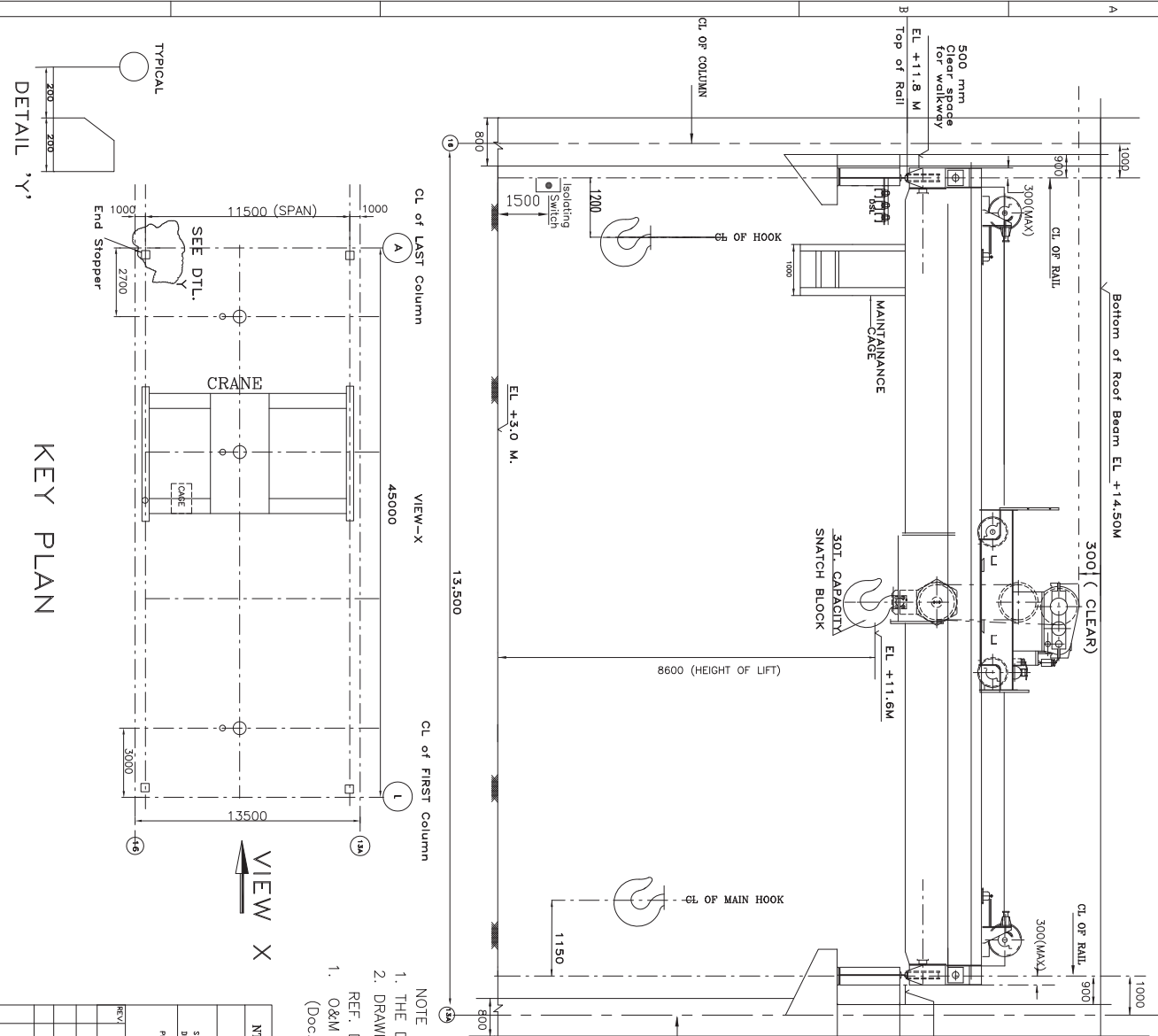
Section IA Date APRIL'19

Page

SECTION – IA
CRANE CLEARANCE DIAGRAM



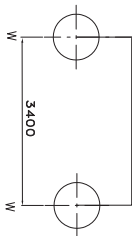
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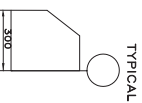
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DATE		NEW DELHI			
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TITLE		30T (DOUBLE GIRDER) E.O.T. CRANES			
REV		BHEL DRG NO : PE-DG-434-501-A003			
DATE		SHEET 1 OF 1			
REV		SIZE-A2			

- NOTE
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 2. DRAWING IS NOT TO SCALE.
- REF. DRG.
1. O&M PERMANENT STORE HEAVY MATERIAL STORE:DETAILS GANTRY GIRDER (Doc. No. 9585-001-315-PVC-C-1175)

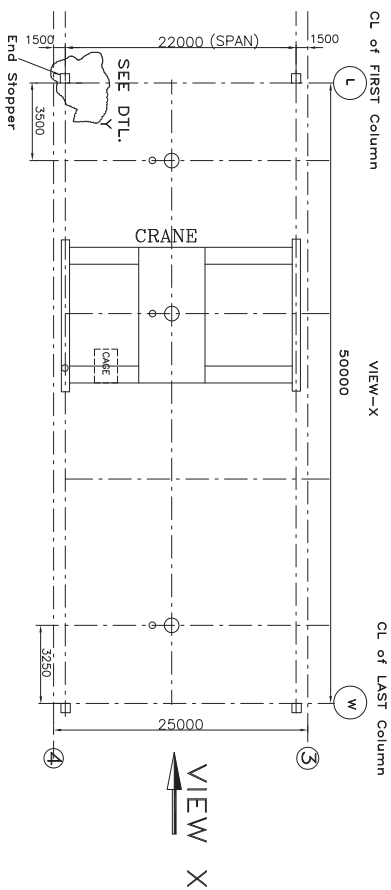
TENTATIVE LT WHEEL LOAD DIAGRAM WITHOUT IMPACT W=20T



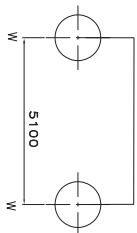
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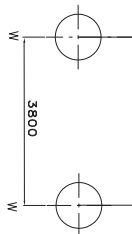
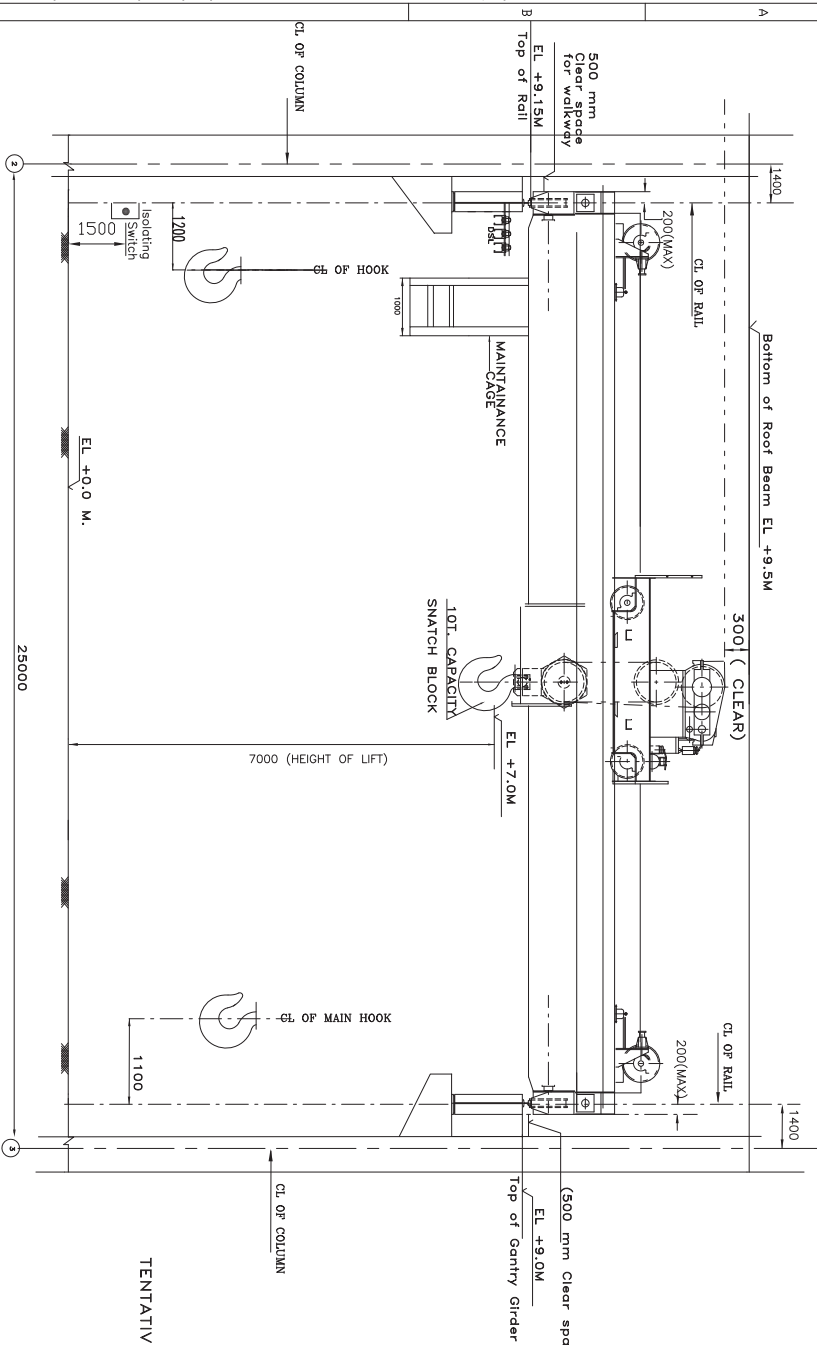
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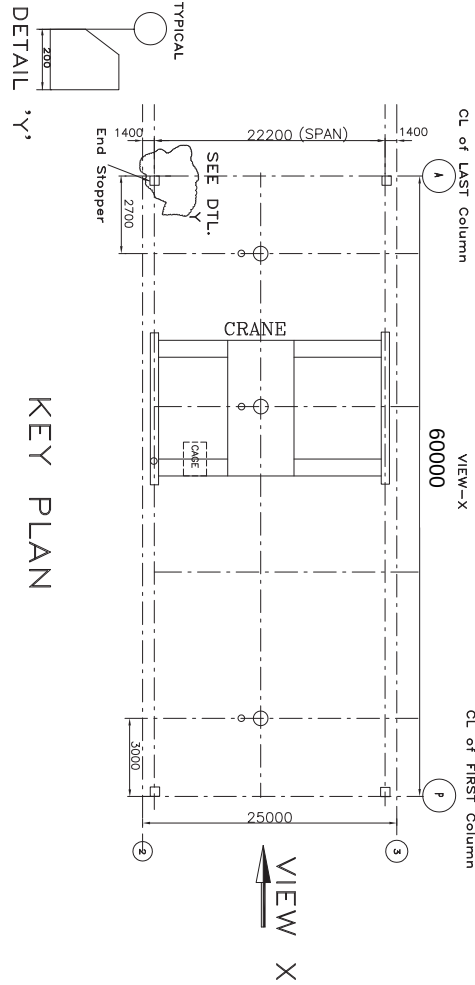
- NOTE
1. THE DESIGN CODE FOR EOT CRANE SHALL BE IS:3177 (latest edition).
 2. DRAWING IS NOT TO SCALE.

TENTATIVE LT WHEEL LOAD DIAGRAM WITHOUT IMPACT $W=40T$ 

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DATE		A.M.D			
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PROJECT		ENGINEERING MANAGEMENT		ENGINEERING MANAGEMENT	
NEW DELHI		NEW DELHI			
TITLE		CRANE CLEARANCE DIAGRAM OF ELECTRICAL WORKSHOP			
55 T (DOUBLE GIRDER) E.O.T. CRANES		BHRL DRG NO : PE-DC-434-501-A005			
SHEET 1 OF 1		REV 0			



- NOTE
1. THE DESIGN CODE FOR EOT CRANE SHALL BE IS:3177 (latest edition).
 2. DRAWING IS NOT TO SCALE.



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ALTD		NEW DELHI			
DATE		SUB-CONTRACTOR			
DATE		CRANE CLEARANCE DIAGRAM OF MECHANICAL WORKSHOP			
DATE		10T (DOUBLE GIRDER) E.O.T. CRANES			
DATE		BHHL DRG NO :			
DATE		PE-DG-434-501-A004			
DATE		SHEET 1 OF 1			
DATE		SIZE-A2			



TITLE

3X800 MW PATRATU STP

DOUBLE GIRDER EOT CRANES UPTO 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-434-501-A401

REV 00

Section

IA

Date APRIL'19

Page

SECTION – IA

STANDARD QUALITY PLAN

MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 3X800 MW PATRATU STP PACKAGE : DOUBLE GIRDER CRANES						
				ITEM:			QP NO :							CONTRACT NO :					
								REV :	0					CONTRACTOR :					
								DATE :						VENDOR'S QAP No. :					
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS			AGENCY			REMARKS					
											M	C	N						
1	4	3	4	DPT	100%	ASME Sec-V	ASME Sec-VIII, Div-I, Appen - 8	DP Report	✓	P	W	V	DP test of fillet weld for rope drum to be conducted. After final machining random witness by BHEL	11					
d	fillet welds	Size and surface defects	Major	Visual	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	✓	P	V	V							
		NDT	Major	DPT	10% RANDOM	ASME Sec-V	ASME Sec-VIII, Div-I, Appen - 8	Vendor inspection Report	✓	P	W	V							
e	final insecton of fabricated components listed in Sr.1 above	Dimensions for Girder, end carriage rope drum etc. Camber, Verticality, bend etc	Major	Dimensional Measurement	100%	Vendor Mfg. Drg.	Vendor Mfg. Drg.	Vendor inspection report	✓	P	V	V							
f	Heat treatment of rope drum	Stress relieving	Major	Review of SR chart	100%	Approved drawing/relevant standard	Approved drawing/ relevant standard	SR Chart	✓	P	V	V	If fabricated from M.S Plate						
3	Gear box casing																		
a	Material	Surface condition	Major	Visual	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	✓	P	V	V	Refer note 1						
		Chemical & mech	Major	Measurement Correlation with T.C. Check test in absesnce of T.C. Correlation	100%	Manufacturing drawing/ IS: 2062	Manufacturing drawing/ IS: 2062	T.C. & I.R.	✓	P	V	V							

MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 3X800 MW PATRATU STP PACKAGE : DOUBLE GIRDER CRANES					
						ITEM:		QP NO :						CONTRACT NO :				
								REV : 0						CONTRACTOR :				
								DATE :						VENDOR'S QAP No.:				
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS						
									M	C	N							
1	b	Dimensional conformity	4	5	6	7	8	9	D**	10						11		
			Major	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report		P								
c	Heat treatment	stress relieving	Major	Review of SR chart	100%	Approved drawing/relevant standard	Approved drawing/relevant standard	SR Chart	✓	P	V	V						
4	PLATFORMS	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	✓	P	V	V	Refer note: 1					
5	L.T.FRAMES	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	✓	P	V	V						
6	HAND RAILINGS	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	✓	P	V	V						
7	CABIN	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	✓	P	V	V						
8	Current collector arms	Dimensional conformity	Minor	Measurement	100%	Mfr. Catalog	Mfr. Catalog	Vendor inspection Report	✓	P	V	V						
9	DSL Guard	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	✓	P	V	V						
10	Rails	Dimensional conformity	Minor	Measurement	100%	G.A.drg./IS : 3443 Vendore T.C./Appd.Data Sheet	G.A.drg./IS : 3443 Vendor T.C./Appd.Data Sheet	Vendor inspection Report	✓	P	V	V						
		Chemical , tensile & hardness	Major	Chemical & hardness	100%	IS-3443	IS:3443	Manufacturer TC	✓	P	V	V						
11	MECHANICAL COMPONENTS																	
A	a)	wheels																

MANUFACTURER'S NAME & ADDRESS				STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 3X800 MW PATRATU STP PACKAGE : DOUBLE GIRDER CRANES			
								ITEM:	QP NO :					CONTRACT NO :			
									REV : 0					CONTRACTOR :			
									DATE :					VENDOR'S QAP No :			
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS							
1	i) raw material	3	4	5	6	7	8	9	D**	10	11						
		Chemicals composition and Mechanical Properties.	Major	Correlation with Mfr's TC	100%	Mfg drg./IS:1570 / BS - 970	Mfg.drg./IS:1570 / BS - 970	Test Certificate	V	P	V	V	Refer Note:1				
	ii) Machined	a) Dimensions	Major	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report		P	V	V					
		b) Hardness		Mechanical	100%	Approved Data Sheet / Mfg. Drg.	Approved Data Sheet / Mfg. Drg.	Vendor inspection Report	V	P	V	V					
		c) UT		NDT	100%	ASTM A 388	ASTM A 388	Vendor inspection Report	V	P	V	V	Refer UT procedure				
		d) DPT		NDT	100%	ASME Sec-VIII-App-8	ASME Sec-VIII-App-8	Vendor inspection Report	V	P	W	V					
	b) Raw material for Gears , Pinions, Shafts,Axles etc	i) Chemicals Composition & heat treatment, Physical Properties.	Major	Correlation with Mfr's TC/ Check test in absence of TC	100%	Manufacturing drawing, BS : 970 / IS : 1570 / Approved Data Sheet	Manufacturing drawing, BS : 970 / IS : 1570 / Approved Data Sheet	Mfr's T.C/ Check Test Report	V	P	V	V					
		ii) UT (after machining)	Major	check for UT (above)	100%	ASME Sec-V	Refer UT procedure	Vendor inspection Report	V	P	V	V					
		iii) Hardness	Major	check for Hardness	100%	drg. & Approved Data Sheet	Mfg. drg. & Approved Data Sheet	Vendor inspection Report	V	P	W	V	Hardness witnessing by BHEL before teeth cutting.				
		iv) Dimensions	Major	Measurement	100%	Mfg. Drawing	Mfg. Drawing	Vendor inspection Report	V	P	V	V					
		V) D.P.Test on teeth	Major	NDT	100%	ASTME-165	No linear indication	Vendor inspection Report	V	P	V	V					
	c) Casting for Gears and pinions, if applicable	Chemical and Physical	Major	Chemical and Physical	100%	Approved drg/ data sheet	Approved drg/ data sheet	Mfr's T.C	V	P	V	V					
		NDT	Major	U.T.	100%	ASTM A 388	ASTM A 388	Vendor inspection	V	P	V	V	Refer UT procedure				
B	Pulleys, Brake drums, coupling & other major steel castings & forging																
	i) Materials	Physical/Chemical/Hardness	Major	Correlation with mfr's TC	100%	Mfg. Drawing	Mfg. Drawing	Mfr's T.C.	V	P	V	V					

MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 3X800 MW PATRATU STP PACKAGE : DOUBLE GIRDER CRANES			
			ITEM:	QIP NO :									CONTRACT NO :			
				REV : 0									CONTRACTOR :			
				DATE :									VENDOR'S QAP No :			
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS						
1	4	3	4	5	6	7	8	9	D**	10	11					
14	Assembly of cranes															
a)	Bridge with LT	Dimesions, wheel level alignment	Major	Measurement	100%	GA drg/IS:3177	GA drg/IS:3177	Insp. Report	V	P	W	V				
b)	Crab assembly	Dimesions, wheel level alignment	Major	Measurement/ Vis	100%	GA drg/IS:3177	GA drg/IS:3177	Insp. Report	V	P	W	V				
c)	Final Inspection (at works) with actual panel and pendent	Overall dimension: Span, Diagonal dimension check, Wheel base & gauge, overhang, LT Stopper, headroom, lift , Eqp. Layout on bridge platform,, elevations /levels etc	Major	Measurement	100%	Approved drgs./IS :3177	Approved drgs./IS: 3177	Insp. Report	V	P	W	W				
		No Load & Load Tests														
		a) No load: Hoists,CT & current measurement, No Load running of LT machinery for direction and speed with VVVF	Major	Measurement	100%	Approved drgs	Approved drgs	Insp. Report	V	P	W	W				
		b) SWL: Hoists, CT speed, current & Deflection measurement	Major	Operational Check & Measurement	100%	GA drg/ IS:3177/ Approved Drawing	GA drg/ IS:3177/ Approved Drawing	Insp. Report	V	P	W	W				
		c) Overload: Hoisting, CT movement & current measurement (at 125% SWL)	Major	Operational Check & Measurement	100%	GA drg/ IS:3177/ Approved Drawing	GA drg/ IS:3177/ Approved Drawing	Insp. Report	V	P	W	W				
		d) Operation check of brakes and limit switches .	Major	Operational Check	100%	GA drg/ IS:3177/ Approved Drawing	GA drg/ IS:3177/ Approved Drawing	Insp. Report	V	P	W	W				
15	Painting	Surface preparation & Painting: DFT	Major	Visual	100%	Approved drgs/doc	Approved drgs/doc	Vendor's Report	P	V						
Note 1 : Original TCs / Photocopies certified in original by mill shall be furnished for review. Test In absence of correlated TCs Check test to be witnessed by BHEL shall be carried out from each plate/ bar for above 10 mm thk., certificates shall be offered for review at the time of stage inspection of components / assembly. Supplier shall ensure that pitted material is not used.																
Note 2 : X-Ray to be taken for thickness upto 19 mm and Gamma Ray for thickness above 19 mm. If Gamma Ray is used for lower thickness slow speed film like D2 or equivalent which gives enough readable and interpretable film quality to be used for clarity. All NDT shall be carried out by Qualified Level II personnel.																

MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 3X800 MW PATRATU STP PACKAGE : DOUBLE GIRDER CRANES	
		ITEM:		QP NO :		CONTRACT NO :							
				REV : 0		CONTRACTOR :							
				DATE :		VENDOR'S QAP No :							
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS			
	4	3	4	5	6	7	8	9	M C N				
1								D*	10	11			
Note 3 : LT motors shall be of type tested quality. For each type & rating of LT motors rated above 30 KW, the bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last ten years from the date of bid opening. These reports should be for the tests 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. In case the Bidder is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval. 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 30 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 10. Test for degree of protection and 11. Over speed test. LESS THAN 30KW: 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 CUSTOMER 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. 30 KW TO BELOW 50 KW:ACCEPTANCE OF MOTOR RATING BETWEEN 30 KW & 50 KW IS BASED ON NTPC REVIEW OF ROUTINE TEST INSPECTION REPORT AS PER IS 325 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.													
Note 4 : Performance of electrical & control devices along with the interlocks, protection & sequence to be checked during crane assembly and parked at works.													
Note 5 : All material of construction shall be as per approved drg. / data sheet / specifications													
LEGEND :													
D: RECORDS IDENTIFIED WITH 'TICK'(V) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION													
M : MANUFACTURER/SUBCONTRACTOR													
C: BHEL-CQS/THIRD PARTY													
N : CUSTOMER													
INDICATE "p" PERFORM "w" WITNESS AND "v" DOCUMENT REVIEW													

ULTRASONIC TEST PROCEDURE

1. Specification Applicable : **(I) ASTM A – 388**
2. Test Purpose : This test conducted on Round Bar, Forging Blank & Hook material (Before Forming) to detect Internal Defect.
3. Condition of material : As rolled/ Normalized Surface shall be prepared as Necessary for conducting the ultrasonic test.
4. Method : Contact method using with pulse-back echo.
5. Equipment details : Modsonic Instrument/ EEC- PX-10
6. Scanning Area : Scanning shall be done in 100% area direction all Along the length and width scanning shall be done at ± 6 db. Evaluation shall be done at reference level.
7. Couplant : Oil/Water
8. Calibration block : The ultrasonic flow detector shall be calibrated by Using standard calibration block IIW V1, V2.
9. Probe used : Probe dia 24mm, 2MHz, 4MHz (NB)
Probe dia 10mm x 4MHz, 24 mm Dia x 2MHz (NB)
(For Hook)
10. Calibration : By choosing proper depth range and gain, the back Wall echo from a defect free area shall be brought To **100 %** full screen height (FSH). This shall be The reference level.
11. Acceptance Norms : Loss of back echo: More than 20% not acceptable.
Defect echo more than 20% not acceptable.
Any indication characterized as cracks, lamination, Or any linear defect is not acceptable.
12. Personnel Qualification : The ultrasonic test shall be carried out and results are Evaluated by a person qualified to ISNT/ASNT LEVEL-II.

 PSR-QUALITY		SUPPLIER'S NAME & ADDRESS		SYSTEM : EOT Crane				QP NO. : QIP/BOP/001 REV. No. : 00 PAGE No. : 2 of 4			
CHARACTERISTICS / ITEM		TYPE OF CHECK		INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS		
SL.NO.											

STANDARD FIELD QUALITY PLAN

3	Check for Alignment of Rails	Measurement	Piano Wire/ Twine	B	100%	Drawings/Erection Manual	Protocol	Tolerance as per Spec/IS
	a. Straightness of gantry rails	Measurement	Water level/ Measuring Tape	A	100%	Drawings/Erection Manual	Protocol	
	b. Level and Elevation of Gantry rails (top level of girder)	Measurement	Measuring Tape	A	100%	Drawings/Erection Manual	Protocol	
	Distance between rails(every 5 M) including diagonal of gantry rails (Tolerance±. 5 mm)	Measurement	Torque wrench	C	100%	Drawings	Protocol	
	d. Bolting of rails and tightening	Physical	-	A	100%	Drawing	Protocol	
5	e. End Stopper Arrangement	Visual	-	B	100%	Drawing Appd. QAP	Report	
	WELDING & RAIL JOINING (FUSION / THERMIT WELDING)	Visual	-	A	100%	Drawing		
	a. Scrapping and grinding after weld	Visual		A	100%	AppdDrawing		
	b. Structural qualification of PQR,WPS & WQT for arc welding	RT/DPT		C	100%			
	c. Typ. Butt joint of rail to be welded by fusion/thermit welding	Physical	-	B	100%	Tech. Spec.	Protocol	
	d. Weld joint Soundness	Physical	-	B	100%	Drawings/Tech. Spec.	Protocol	
	ERECTION CHECK FOR							
	a. Joining of Girders i.e. splice joints							
	b. Placement of girder assembly on the gantry.							

LEGEND : CLASS #:: A = CRITICAL, B = MAJOR, C = MINOR "A" SHALL BE WITNESSED BY BHEL & CUSTOMER/ CLIENT "B" SHALL BE WITNESSED BY BHEL "C" SHALL BE WITNESSED BY ERECTION ENGINEER		FOR BHEL USE		FOR BHEL USE		FOR CUSTOMER USE	
TYPE @ : V = VISUAL, R = RECORD VERIFICATION, M= MEASUREMENT, P = PHYSICAL & T-TEST		PREPARED BY		REVIEWED AND APPROVED BY		APPROEVD BY	

SUPPLIER'S NAME & ADDRESS		SYSTEM : EOT Crane		STANDARD FIELD QUALITY PLAN						
PSR-QUALITY		CHARACTERISTICS / ITEM		TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMAR KS
AREA :		QP NO. : QIP/BOP/001 REV.No. : 00 PAGE No. : 3 of 4								
SL.NO.										
5	c. Movement of wheels	Physical	-	B	100%	Drawings/Tech. Spec.	Protocol			
	d. Placement and positioning of electrical panel & trolley.	Physical	-	B	100%	Drawings/Tech. Spec.	Protocol			
	e. Movement of crab trolley on the crane girder	Physical	-	B	100%	Drawings/Tech. Spec.	Protocol			
	f. Deviation in the crane rail level at any point from true level tolerance $\pm$. 10 mm	Measurement	Piano Wire / Twince	A	100%	Drawings/ Erection Manual	Protocol			
	D.S.L.	Visual	-	C	100%	Drawing	Protocol			
6 7 8 9	a. Fixing arrangement	Measurement	Measuring Tape	B	100%	Drawing	Protocol			
	b. Location with respect to gantry rail, spacing & alignment.	Measurement	Measuring Tape	B	100%	Drawing	Protocol			
	c. Continuity check & insulation Resistance	Measurement	Megger	A	100%	Minimum 5 Mega Ohms	Protocol			
	Cable laying connections	Physical	-	B	100%	Drawing	Protocol			
	Crab Clearances	Visual & Measurement	Measuring Tape	B	100%	Drawing	Protocol			
	a. Headroom, end clearance, hook approaches and height of lift and record.	Measurement	Dip stick	B	100%	Drawing	Site log Book			
	Gear Box	Visual	-	B	100%	Drawing	Protocol			
	a.Check oil level	Visual	-	B	100%	Drawing	Protocol			
	LT Machinery, Platform, cabin, Electrical equipment, other structural components, limit switch & Mechanical stopper.	Visual	-	B	100%	Drawing	Protocol			
	a. Fit up	Visual	-	B	100%	Drawing	Protocol			
	b. Alignment	Visual	-	B	100%	Drawing	Protocol			
		Visual	-	B	100%	Drawing	Protocol			
	LEGEND : CLASS #:: A = CRITICAL, B = MAJOR, C = MINOR			FOR BHEL USE		FOR CUSTOMER USE				
	"A" SHALL BE WITNESSED BY BHEL & CUSTOMER/ CLIENT									
	"B" SHALL BE WITNESSED BY BHEL									
"C" SHALL BE WITNESSED BY ERECTION ENGINEER										
TYPE @ : V = VISUAL, R = RECORD VERIFICATION, M= MEASUREMENT, P = PHYSICAL & T-TEST			PREPARED BY		REVIEWED AND APPROVED BY		APPROEVD BY			

 PSR-QUALITY		SUPPLIER'S NAME & ADDRESS		SYSTEM : EOT Crane				QP NO. : QIP/BOP/001 REV. No. : 00 PAGE No. : 4 of 4									
SL.NO.		CHARACTERISTICS / ITEM		TYPE OF CHECK		INSTRUMENT		CLASS		QUANTUM / FREQUENCY OF CHECK		REFERENCE DOCUMENT/ ACCEPTANCE STANDARD		FORMAT OF RECORD		REMARKS	
10	Storm braker arrangement	Physical		-	A	100%	Drawing	Protocol									
11	COMMISSIONING CHECKS	Visual		Megger	A	100%	Min 5 Mega Ohms	Protocol									
	a. Power & control cable connections Insulation Resistance	Measurement Physical		Megger	A	100%	Min 5 Mega Ohms	Protocol									
	b. Control panel earthing	Measurement		-	B	100%	Min 5 Mega Ohms	Protocol									
	c. resistance Function & sequential operation	Measurement		-	B	100%	Drawing	Protocol									
	d. Operation of Brakes (Hoist motion, L.T. Motion & C.T. motion)	Physical		-	A	100%	O&M Manual	Protocol									
	e. Operation of limit Switch (Hoist & traveling motion brakes)	Physical		-	A	100%	O&M Manual	Protocol									
	f. Motors. IR value	Measurement		-	B	100%	Min 5 Mega Ohms	Protocol									
	g. At no load check	Measurement		-	A	100%	As per procedure	Protocol									
	h. At full load check / Load testing of crane (SWL):	Measurement		-	A	100%	As per procedure	Protocol									
	i. At 25% Overload	Measurement		-	A	100%	As per procedure	Protocol									
	j. Storm braker arrangement	Physical & operation		-	A	100%	Drawing	Protocol									
	k. Touch Up Painting.	Visual		-	C		As per approved shade	Records									
LEGEND : CLASS #:: A = CRITICAL, B = MAJOR, C = MINOR		FOR BHEL USE		FOR BHEL USE		FOR CUSTOMER USE											
"A" SHALL BE WITNESSED BY BHEL & CUSTOMER/ CLIENT																	
"B" SHALL BE WITNESSED BY BHEL																	
"C" SHALL BE WITNESSED BY ERECTION ENGINEER																	
TYPE @ : V = VISUAL, R = RECORD VERIFICATION, M= MEASUREMENT, P = PHYSICAL & T-TEST		PREPARED BY		REVIEWED AND APPROVED BY		APPROVED BY											

CLAUSE NO.	QUALITY ASSURANCE			
1.02.05	Coal Feeders (a) Any welds in the casing/ pulley fabrication shall be checked with MPI. (b) Type tests including degree of protection and routine tests shall be done as per relevant Indian Standards or equivalent International Standards. (c) All major items like plates for casings, head pulley, tail pulley, Pulley shaft and major castings shall be procured with respective material test certificates. (d) Leak tightness test shall be done on individual feeder casing. Functional test for load cell shall be carried out. (e) Test for weighing accuracy, calibration and repeatability shall be carried out at various speeds by a coal flow on one feeder. (f) Calibration check shall be carried out on all feeder cabinet/ assemblies prior to dispatch.			
1.02.06	Fuel Oil Pumps (a) Bar stock/forging above 40 mm diameter shall be subjected to UT. Impeller and rotor shall be dynamically balanced. (b) Pump assemblies shall be subjected to hydraulic test. (c) All pumps including spare cartridges shall be subjected to performance test at the manufacturer's works under as near site conditions as possible and strip down examination after the test.			
1.02.07	EOT CRANES 1.0 HOOKS 1.01 All Tests including Proof Load Test as per relevant IS shall be carried out. 1.02 MPI/DPT shall be carried out after proof load test. 2.0 STEEL CASTING 2.01 DPT on machined surface shall be carried out. 3.0 GIRDERS, END CARRIAGE,CRAB, GEAR BOX AND ROPE DRUM 3.01 The plates of thickness 25mm and above shall be ultrasonically tested. 3.02 NDT requirements on weldments shall be as follows: (a) BUTT WELDS IN TENSION :- 100% RT AND 100% DPT (b) BUTT WELDS IN COMPRESSION :- 10% RT AND 100% DPT (c) BUTT WELDS IN ROPE DRUM :- 100% RT AND 100% DPT (d) FILLET WELDS :- RANDOM 10% DPT 4.0 FORGINGS (wheel, gears, pinions, axle, hooks & hook trunnion)			
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-01 STEAM GENERATOR AND AUXILIARIES	Page 9 of 13

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC		
	4.01 All forgings greater than or equal to 50 mm diameter or thickness shall be subjected to Ultrasonic test. 4.02 DPT/MPI shall be done after hard-facing and machining. 5.0 Wire rope shall be tested as per relevant standard. 6.0 Reduction gears shall be tested for reduction ratio, backlash & contact pattern. Gear box shall be subjected to no load run test to check for oil leakage, temperature rise, noise and vibration. 7.0 The cranes shall be completely assembled at shop for final testing. All tests for dimension, deflection, load, overload, hoisting motion, cross travel etc. as per IS-3177 shall be carried out at shop. 8.0 All electric hoists shall be tested as per IS-3938 and chain pulley blocks shall be tested as per IS-3832.			
1.02.08	Lube Oil systems/ Hydraulic Power Pack Lube Oil system/ hydraulic power packs shall be tested for performance.			
1.02.09	Fans & pumps which are not mentioned in other clauses above shall be dynamically balanced and functionally tested at Manufacturer's works. Complete performance tests shall be carried out on first pump/fan of each type and capacity to verify its output against total head, power input, efficiency, vibration and noise level. Head/volume, efficiency and power input curves corrected for site conditions shall be furnished.			
1.02.10	Dampers (a) All the dampers shall be subjected to operational test/checks. (b) Leak tightness of test of Dampers / Gates shall be carried out as given in respective subsection of Technical Requirements of Steam Generator & Auxiliaries. (c) All dampers shall be checked for sealing dimensions to establish guaranteed tightness.			
1.02.11	Steel Structure of Boiler, Mill Bunker building including Coal bunkers, Coal transfer points. Coal conveyor galleries and supporting trestles, Ducts, Hoppers, etc. (a) Only material which has been identified against mill sheet or test certificates shall be used for construction. All plates above 40mm thickness shall be 100% ultrasonically tested. (b) Visual inspection of all welds shall be performed in accordance with AWS D.1.1. (c) NDT requirements of structural steel welds (other than Coal Bunkers) shall be as under:- (i) 100% RT/UT on butt-welds of plate thickness ≥ 32 mm. (ii) For plates of 25mm < thickness < 32mm - 10% RT/UT and 100% MPI (iii) For plates of thickness < 25mm - 10% MPI/LPI. (iv) All fillet welds of built up plate girders shall be inspected 100% by MPI.			
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-01 STEAM GENERATOR AND AUXILIARIES	Page 10 of 13

CLAUSE NO.	QUALITY ASSURANCE		
	Shop Test for EOT Cranes, Other Cranes & Hoist		
1.0	HOOKS		
1.01	ALL TESTS INCLUDING PROOF LOAD TEST AS PER RELEVANT IS/BS/DIN SHALL BE CARRIED OUT.		
1.02	MPI/DPT SHALL BE CARRIED OUT AFTER PROOF LOAD TEST.		
2.0	STEEL CASTING		
2.01	DPT ON MACHINED SURFACE SHALL BE CARRIED OUT.		
3.0	GIRDERS, END CARRIAGE,CRAB, GEAR BOX AND ROPE DRUM		
3.01	THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED.		
3.02	NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS:		
	a) BUTT WELDS IN TENSION:-	100% RT AND 100% DPT	
	b) BUTT WELDS IN COMPRESSION:-	10% RT AND 100% DPT	
	c) BUTT WELDS IN ROPE DRUM:-	100% RT AND 100% DPT	
	d) FILLET WELDS:-	RANDOM 10% DPT	
4.0	FORGING (WHEEL, GEARS, PINIONS, AXLE, HOOKS & HOOK TRUNION)		
4.01	ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE SUBJECTED TO ULTRASONIC TESTING.		
4.02	DPT/MPI SHALL BE DONE AFTER HARDFACING AND MACHINING.		
5.0	WIRE ROPE SHALL BE TESTED AS PER RELEVANT STANDARD.		
6.0	REDUCTION GEARS SHALL BE TESTED FOR REDUCTION RATIO, BACKLASH & CONTACT PATTERN. GEAR BOX SHALL BE SUBJECTED TO NO-LOAD RUN TEST TO CHECK FOR OIL LEAKAGE, TEMPERATURE RISE, NOISE AND VIBRATION.		
7.0	THE CRANES SHALL BE COMPLETELY ASSEMBLED AT SHOP FOR FINAL TESTING. ALL TESTS FOR DIMENSION, DEFLECTION, LOAD, OVERLOAD, HOISTING MOTION, CROSS TRAVEL ETC. AS PER IS-3177 SHALL BE CARRIED OUT AT SHOP.		
8.0	ALL ELECTRIC HOISTS SHALL BE TESTED AS PER IS-3938 AND CHAIN PULLEY BLOCKS SHALL BE TESTED AS PER IS-3832.		
9.0	LIFTING BEAM:		
9.01	THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED.		
9.02	NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS:		
	a) BUTT WELDS IN TENSION:-	100% RT AND 100% DPT	
	b) BUTT WELDS IN COMPRESSION:-	10% RT AND 100% DPT	
	c) FILLET WELDS:-	RANDOM 10% DPT	
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-16 EOT CRANES AND HOISTS
			Page 1 of 2

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC	
9.03	ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE SUBJECTED TO ULTRASONIC TESTING.		
9.04	DPT/MPI SHALL BE DONE AFTER MACHINING.		
9.05	~~Lifting Beam will be subjected to overload testing at @1.25 X SWL of Lifting Beam at manufacturer works.~~		
		</	

**TITLE****3X800 MW PATRATU STP PHASE-I****DOUBLE GIRDER EOT CRANES UPTO 100T****SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-434-501-A401

REV 00

Section

I B

Date April'19

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SUB-SECTION IB
SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)

ELECTRICAL EQUIPMENT SPECIFICATION FOR DG EOT CRANE 3X800MW PATRATU STPP	SPECIFICATION NO.
	VOLUME NO. : II-B
	SECTION : C
	REV NO. : 00 DATE : 04.05.18
	SHEET :

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) Erection and Commissioning spares.
- e) Erection & Maintenance tools & tackles.
- f) Electrical load requirement for SCS system.
- g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- h) 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
- i) 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.
- j) Motor shall meet minimum requirement of motor specification.
- k) LT power & control cables shall meet minimum requirement of LT power & control cables specification.
- l) Cabling, earthing & lightning protection shall meet minimum requirement of cabling, earthing & lightning protection specification.

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 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:
 - a) A copy of this sheet ”Electrical equipment Specification for DG EOT CRANE and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement
- 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.

	ELECTRICAL EQUIPMENT SPECIFICATION FOR DG EOT CRANE 3X800MW PATRATU STPP	SPECIFICATION NO.
		VOLUME NO. : II-B
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- 4.0 List of enclosures :
- Electrical scope between BHEL & vendor.
 - Technical specification, datasheets & quality plans for 415V Electric motors.
 - Technical Specification, datasheets & quality plans for LT power & control cables.
 - Technical Specification, datasheets & quality plans for cabling, earthing & lightning protection.
 - Electrical Load data format.
 - Cable Listing Format

Note: The requirements mentioned in Customer Motor Spec for Motors shall prevail in case of conflict between the same and the corresponding requirements mentioned in the Section C/ Section D/ Datasheet A

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

PACKAGE: DOUBLE GRIDER EOT CRANES

SCOPE OF VENDOR: SUPPLY , ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT :

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 4W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

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

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

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

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

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

3.3.3 The following frequency of starts shall apply

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

3.4 Running Requirements

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

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

3.5 Stress During bus Transfer

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

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

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

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

4.0 CONSTRUCTIONAL FEATURES

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

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

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

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

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

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		VOLUME NO. : II-B
		SECTION :
		REV NO. : 00 DATE : MAY 18
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

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			
	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				
7.03.00	(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)	
	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.	
7.04.00	(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	
	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	PAGE 4 OF 10

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
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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) Below 110KW	:	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			
10.01.05	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. 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. LIST OF TYPE TESTS TO BE CONDUCTED The following type tests shall be conducted on each type and rating of HT motor (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test (subject to test bed constraint) (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.			
10.01.06	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of HT motor (a) Degree of protection test for the enclosure followed by IR, HV and no load run test. (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only. (c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15			
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 7 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																				
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	<table><tr><td>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2</td><td>SUB-SECTION-B-07 MOTORS</td><td>PAGE 9 OF 10</td></tr></table>	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2	SUB-SECTION-B-07 MOTORS	PAGE 9 OF 10																	
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
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SUB-SECTION – B-20

LT POWER CABLES

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 		
1.00.00 1.01.00	CODES & STANDARDS All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes: IS :1554 - I PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V. IS : 3961 Recommended current ratings for cables IS : 3975 Low carbon galvanised steel wires, formed wires and tapes for armouring of cables. IS : 5831 PVC insulation and sheath of electrical cables. IS:7098 (Part -I) Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V. IS : 8130 Conductors for insulated electrical cables and flexible cords. IS : 10418 Specification for drums for electric cables. IS : 10810 Methods of tests for cables. ASTM-D -2843 Standard test method for density of smoke from the burning or decomposition of plastics. IEC-754 (Part-I) Tests on gases evolved during combustion of electric cables. IEC-332 Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).		
2.00.00 2.01.00	TECHNICAL REQUIREMENTS The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.		
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-B-20 LT POWER CABLES	PAGE 1 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS																
2.02.00	All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.																
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.																
2.04.00	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.																
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.																
2.06.00	For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows : <table><tr><th>Calculated nominal dia. of cable under armour</th><th>Size and Type of armour</th></tr><tr><td>Upto 13 mm</td><td>1.4mm dia GS wire</td></tr><tr><td>Above 13 & upto 25mm</td><td>0.8 mm thick GS formed wire / 1.6 mm dia GS wire</td></tr><tr><td>Above 25 & upto 40 mm</td><td>0.8mm thick GS formed wire / 2.0mm dia GS wire</td></tr><tr><td>Above 40 & upto 55mm</td><td>1.4 mm thick GS formed wire /2.5mm dia GS wire</td></tr><tr><td>Above 55 & upto 70 mm</td><td>1.4mm thick GS formed wire / 3.15mm dia GS wire</td></tr><tr><td>Above 70mm</td><td>1.4 mm thick GS formed wire / 4.0 mm dia GS wire</td></tr></table>			Calculated nominal dia. of cable under armour	Size and Type of armour	Upto 13 mm	1.4mm dia GS wire	Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire	Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire
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Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire																
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire																
2.06.01	The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm ² per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.																
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.																
2.07.00	Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29 (as per IS 10810 Part-58). (b.) Acid gas emission of max. 20% (as per IEC-754-I).																
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-B-20 LT POWER CABLES	PAGE 2 OF 6													

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.08.00	(c.) Smoke density rating shall not be more than 60 % (as per ASTM-D-2843).			
	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:			
	1 core -	Red, Black, Yellow or Blue		
	2 core -	Red & Black		
	3 core -	Red, Yellow & Blue		
	4 core -	Red, Yellow, Blue and Black		
2.09.00	For reduced neutral conductors, the core shall be black.			
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.			
	(a.) Cable size and voltage grade - To be embossed			
	(b.) Word 'FRLS' at every 5 metre - To be embossed			
	(c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed			
	The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.			
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.			
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum, over the declared value in the technical data sheets.			
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.			
2.14.00	Cable selection & sizing			
2.14.01	Cables shall be sized based on the following considerations:			
	(a) Rated current of the equipment			
	(b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage			
	(c) Short circuit withstand capability			
	This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.			
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-B-20 LT POWER CABLES
PAGE 3 OF 6				

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	9. Resistance test 10(a) Mass of zinc coating test For GS Formed wires/wires only 10(b) Uniformity of zinc coating For GS Formed wires /wires only 11. Adhesion test For GS Formed wires/wires only For PVC/XLPE insulation & PVC Sheath 12. Test for thickness 13. Tensile strength & elongation tests before ageing and after ageing 14. Ageing in air oven 15. Loss of mass test For PVC insulation and sheath only 16. Hot deformation test For PVC insulation and sheath only 17. Heat shock test For PVC insulation and sheath only 18. Shrinkage test 19. Thermal stability test For PVC insulation and sheath only 20. Hot set test For XLPE insulation only 21. Water absorption test For XLPE insulation only 22. Oxygen index test For outer sheath only 23. Smoke density test For outer sheath only 24. Acid gas generation test For outer sheath only For completed cables 25. Insulation resistance test (Volume resistivity method) 26. High voltage test 27. Flammability test as per IEC-332 Part-3 (Category-B) Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of LT power cables enclosed.		
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-B-20 LT POWER CABLES	PAGE 6 OF 6

SUB-SECTION – B-21

LT CONTROL CABLES

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			एन टी पी सी NTPC
1.00.00	CODES & STANDARDS			
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes: IS :1554 - I PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V. IS : 3961 Recommended current ratings for cables IS : 3975 Low carbon galvanised steel wires, formed wires and tapes for armouring of cables. IS : 5831 PVC insulation and sheath of electrical cables. IS : 8130 Conductors for insulated electrical cables and flexible cords. IS : 10418 Specification for drums for electric cables. IS : 10810 Methods of tests for cables. ASTM-D –2843 Standard test method for density of smoke from the burning or decomposition of plastics. IEC-754 (Part-I) Tests on gases evolved during combustion of electric cables. IEC-332 Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).			
2.00.00	TECHNICAL REQUIREMENTS			
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.			
2.02.00	All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.			
2.03.00	Conductor of control cables shall be made of stranded, plain annealed copper.			
2.04.00	PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.			
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.			
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-B-21 LT CONTROL CABLES	PAGE 1 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC										
	be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.													
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath: (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed. The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.													
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.													
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.													
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.													
2.14.00	Cable selection & sizing Control cables shall be sized based on the following considerations: (a) The minimum conductor cross-section shall be 1.5 sq.mm. (b) The minimum number of spare cores in control cables shall be as follows: <table><tr><td>No. of cores in cable</td><td>Min. No. of spare cores</td></tr><tr><td>2C, 3C</td><td>NIL</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-12C</td><td>2</td></tr><tr><td>14C & above</td><td>3</td></tr></table>				No. of cores in cable	Min. No. of spare cores	2C, 3C	NIL	5C	1	7C-12C	2	14C & above	3
No. of cores in cable	Min. No. of spare cores													
2C, 3C	NIL													
5C	1													
7C-12C	2													
14C & above	3													
2.14.01	Cable lengths shall be considered in such a way that straight through cable joints are avoided.													
2.14.02	Cables shall be armoured type if laid in switchyard area, CHP area or directly buried.													
3.00.00	CONSTRUCTIONAL FEATURES													
3.01.00	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).													
3.02.00	1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit,													
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-B-21 LT CONTROL CABLES	PAGE 3 OF 6										

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	S. No.	Type Test	Remarks	
		For Conductor		
	1.	Resistance test		
		For Armour Wires / Formed Wires (If applicable)		
	2.	Measurement of Dimensions		
	3.	Tensile Test		
	4.	Elongation test		
	5.	Torsion test	For round wire only	
	6.	Wrapping test	For aluminium wires / formed wires only.	
	7.	Resistance test		
	8(a).	Mass of zinc Coating test	For GS wires/formed wires only	
	8(b).	Uniformity of zinc coating	For GS wires/formed wires only	
	9.	Adhesion test	For GS wires/formed wires only	
		For PVC insulation & PVC Sheath		
	10.	Test for thickness		
	11.	Tensile strength and elongation test	before ageing and after ageing	
	12.	Ageing in air oven		
	13.	Loss of mass test	For PVC insulation and sheath only	
	14.	Hot deformation test	For PVC insulation and sheath only	
	15.	Heat shock test	For PVC insulation and sheath only	
	16.	Shrinkage test		
	17.	Thermal stability test	For PVC insulation and sheath only	
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-B-21 LT CONTROL CABLES
				PAGE 5 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
5.02.00	S. No.	Type Test	Remarks	
	18.	Oxygen index test	For outer sheath only	
	19.	Smoke density test	For outer sheath only	
	20.	Acid gas generation test	For outer sheath only	
	For completed cables			
	21.	Insulation resistance test(Volume resistivity method)		
	22.	High voltage test		
	23.	Flammability test as per IEC-332 Part-3 (Category-B)		
	Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.			
	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-B-21 LT CONTROL CABLES

	3X800MW PATRATU STPP EPC PACKAGE TECHNICAL SPECIFICATION FOR CABLE TRAYS & ACCESSORIES	SPECIFICATION NO. PE-TS-434-507-E021	
		VOLUME II B	
		SECTION	
		REVISION 0	DATE: MAY 18
		SHEET	1 of 2

DATASHEET-A

1.0 APPLICABLE STANDARDS

a)	IS: 1079	For hot rolled carbon steel sheet and strip.
b)	IS: 1730	For dimensions for steel sheet and strip.
c)	IS: 1363	Hexagon head bolts, screws and nuts.
d)	IS: 2629	For hot dip galvanising of steel & surface pre treatment.
e)	IS: 2633	For testing of zinc coating.
f)	IS: 6745	For determining of mass of zinc coating.
g)	IS: 1367	Galvanised Coating on threaded Fasteners. (Part-XIII)
h)	IS: 1852	For Rolling and Cutting Tolerances of hot rolled steel products.
i)	IS: 9595	For thickness of welding of carbon & carbon manganese steels

2.0 CABLE TRAYS & ACCESSORIES

2.1	Material	:	Hot Rolled Mild Steel
2.2	Type	:	Ladder Type Perforated Type Cable trough
2.3	Standard Length of Straight Length of Cable Trays	:	2.5 meters
2.4	Standard Width (mm)	:	Cable Trays : 600 300 150 Cable Trough: 75 50
2.5	Construction	:	Conforming to enclosed drawing [PE-DG-405-507-E005]
2.6	Bending Radius of Accessories(in mm)	:	600 mm
2.7	Tolerance in length/width / height	:	+ /- 2 mm

3.0 FITTINGS

End connections	:	Through Coupler plates (Side Coupler Plates shall be provided as part of cable tray & accessories supply with bolts, nuts, washers etc)

4.0 SHEET THICKNESS

a) For cable trays & Accessories	:	min 2.0 mm
b) For Coupler plate	:	min 3.0 mm
c) Tolerance in Thickness :		(+ 0.2 mm) (NO NEGATIVE TOLERANCE IS PERMITTED)

	3X800MW PATRATU STPP EPC PACKAGE TECHNICAL SPECIFICATION FOR CABLE TRAYS & ACCESSORIES	SPECIFICATION NO. PE-TS-434-507-E021	
		VOLUME II B	
		SECTION	
		REVISION 0	DATE: MAY 18
		SHEET	2 of 2

6.0 SURFACE TREATMENT

- a) Pre-treatment : IS 2629 before galvanisation
- b) Type : Hot dip galvanisation
- c) Applicable Standard : IS 2629
- d) Minimum thickness : 75 microns (minimum)
- e) Min. weight of Zinc deposit : 610 grams per square meter
- f) Tests for galvanizing : (i) Weight of Zinc Coating as per IS 6745.
(ii) Thickness of Zinc Coating as per IS 4759.
(iii) Uniformity of Zinc Coating as per IS 2633.
(iv) Adhesion Test as per IS 2629.

7.0 NUMBER OF COUPLER PLATES, BOLTS, WASHERS & NUTS REQUIRED FOR EACH CABLE TRAY SECTION (2.5 MTRS)

Sl. No.	NAME OF ITEM	COUPLER PLATE (nos.)	NUTS (nos.)	WASHERS (nos.)	BOLTS (nos.)
1	Cable tray of standard length 2.5 meters	4	16	32	16

NOTE: - Based on above table, no. of coupler plates, bolts, washers & nuts shall be calculated for the offered lot. Over & above the calculated quantity, additional 5% coupler plates & 10% bolts, washers & nuts shall be supplied by the bidder.

	PATRATU STPP (3 00MW) EPC PACKAGE		SPECIFICATION NO. PE-TS-434-507-E013	
			VOLUME II B	
			SECTION	
			REVISION 0	DATE: MAY 18
	TECHNICAL SPECIFICATION FOR CABLE TRAY SUPPORT SYSTEM (BOLTABLE TYPE)		SHEET 1 OF 1	

DATASHEET A
(SPECIFIC TECHNICAL REQUIREMENTS)

1.0 APPLICABLE STANDARDS:

- a) IS: 2062 For structural steel.
- b) IS: 1079 For hot rolled carbon steel sheet and strip.
- c) IS: 513 For cold rolled low carbon steel sheet & strips
- d) IS: 1730 For dimensions for steel sheet and strip.
- e) IS: 1363 Hexagon head bolts, screws and nuts.
- f) IS: 5 For colours of paint.
- g) IS: 2629 For hot dip galvanising of steel & surface pre-treatment.
- h) IS: 2633 For testing of zinc coating.
- i) IS: 6745 For determining of mass of zinc coating.
- j) IS: 1852 For rolling and cutting tolerances of hot rolled steel products.

2.0 CABLE TRAY SUPPORT

- a) Tray support type: Bolttable type
- b) Material: **Hot/ Cold** Rolled MS sheet steel for channel SC1/ DC1 and channel portion of cantilever arms
- c) Thickness: 2.5 mm
- d) Length: Standard length of 6 meters
- e) Fabrication : At works
- f) Construction: Conforming to enclosed drawings [PE-DG-405-507-E013]

3.0 SURFACE TREATMENT:

Galvanizing:

- a) Pre-treatment: As per IS 2629 prior to galvanisation
- b) Type: Hot dip galvanization
- c) Applicable Standard: IS 2629
- d) Minimum thickness: 75 microns (minimum)
- e) Min. weight of Zinc deposit: 610 gms. per square meter
- f) Tests for galvanizing:
 - i) Weight of zinc coating as per IS : 6745
 - ii) Thickness of zinc coating as per IS : 4759
 - iii) Uniformity of zinc coating as per IS : 2633
 - iv) Adhesion as per IS: 2629

	TITLE	LV MOTORS DATA SHEET-A	SPECIFICATION NO.	
			VOLUME	II B
			SECTION	D
			REV NO. 00	DATE 01/10/2012
			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		
	o 110kW & Above (Breaker controlled)	:	50 kA for 1 sec
	o Below 110kW (SFU+ Contactor controlled)	:	50 KA for 0.20 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B. (Refer clause 5.00.00 of Motors)
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	As per Customer Motor Spec (enclosed)
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
13.0	Tests	:	As per 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 spec.
- The requirements mentioned in Customer Motor Spec for Motors shall prevail in case of conflict between the same and the corresponding requirements mentioned in the Section C/ Section D/ Datasheet A

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CUSTOMER :				PROJECT TITLE		SPECIFICATION : NUMBER :						
QUALITY PLAN				BIDDER/ VENDOR		SPECIFICATION : TITLE						
SHEET 1 OF 9				SYSTEM		NUMBER PED-506-00-Q-007, REV-03						
COMPONENT/OPERATION		CHARACTERISTIC CHECK		CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	VOLUME III	
SL. NO.										AGENCY	REMARKS	
										P	W	V
1	2	3	4	5	6	7	8	9	10	11		
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL				PARTICULARS		BIDDER/VENDOR						
				NAME								
				SIGNATURE								
				DATE								
								BIDDERS/VENDORS COMPANY SEAL				

CUSTOMER :			PROJECT		SPECIFICATION :	
TITLE			TITLE		NUMBER :	
BIDDER/ VENDOR			QUALITY PLAN		SPECIFICATION :	
SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		TITLE	
CAT.			REFERENCE DOCUMENT		SECTION	
TYPE/ METHOD OF CHECK			ACCEPTANCE NORM		AGENCY	
EXTENT OF CHECK			FORMAT OF RECORD		P W V	
1			2		3	
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7			8		9	
10			11		12	
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			CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :						
QUALITY PLAN			BIDDER/ VENDOR :		QUALITY PLAN		SPECIFICATION : TITLE						
			SHEET 5 OF 9		NUMBER PED-506-00-Q-007. REV-03		SECTION VOLUME III						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	SYSTEM CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10	11			
2.0	IN PROCESS												
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-		
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-		
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-		
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-		
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1		
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC./BHEL SPEC./ RELEVANT STAND	BHEL SPEC./ SAME AS COL.7	LOG BOOK	2	-	-		
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-		
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-		
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-		
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE										
							BIDDER'S/VENDORS COMPANY SEAL						

			CUSTOMER :		PROJECT		SPECIFICATION :					
QUALITY PLAN			BIDDER/ VENDOR		TITLE		NUMBER :					
SHEET 6 OF 9			SYSTEM		QUALITY PLAN		TITLE					
COMPONENT/OPERATION			CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	VOLUME III		
SL. NO.	CHARACTERISTIC CHECK								AGENCY	REMARKS		
									P	W	V	
1	2	3	4	5	6	7	8	9	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	-	-	FOR MV MOTOR
		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	THREE DIPS TO BE GIVEN
		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	
BHEL		1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACUUM	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							BIDDER'S/VENDORS COMPANY SEAL
			NAME									
			SIGNATURE									
			DATE									

			CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :				
QUALITY PLAN			BIDDER/ VENDOR :		QUALITY PLAN		SPECIFICATION : TITLE				
SHEET 7 OF 9			SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
									P	W	
1	2	3	4	5	6	7	8	9	10		11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2	1	1
2.9	COMPLETE ROTOR ASSEMBLY	3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	1	1
		1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2	1	VERIFICATION FOR MV MOTOR ONLY
2.10	ASSEMBLY	2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2	1	
		1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1
		4.DIMENSIONS	MA	-DO-	-DO-	MFG DRG./ MFG SPEC.	MFG DRG/ RELEVANT IS	Log Book	2	-	-
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	1	
BHEL			PARTICULARS		BIDDER/VENDOR						
			NAME								
			SIGNATURE								
			DATE								
					BIDDER/SVENDORS COMPANY SEAL						

		CUSTOMER :			PROJECT			SPECIFICATION :		
		BIDDER/ VENDOR			TITLE			NUMBER :		
		QUALITY PLAN			NUMBER PED-506-00-Q-007, REV-03			TITLE		
		SHEET 8 OF 9			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT. SYSTEM	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 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-	2 1\$ 1	\$ NOTE - 2
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-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								
					BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03 ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SPECIFICATION : TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	SHEET 9 OF 9	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	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											

CUSTOMER :			PROJECT		SPECIFICATION :							
			TITLE									
BIDDER/ :			QUALITY PLAN		SPECIFICATION							
VENDOR			NUMBER PED-506-00-Q-006, REV-01		TITLE							
SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION VOLUME III							
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUF'R'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									

		QUALITY PLAN		CUSTOMER : BIDDER/ : VENDOR : SYSTEM :		PROJECT TITLE QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01 ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SPECIFICATION : NUMBER : SPECIFICATION : TITLE :			
										SHEET 2 OF 2	
										COMPONENT/OPERATION	
										CHARACTERISTICS CHECK	
SL. NO.	2	3	4	5	6	7	8	9	10	11	
1		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.											
Legends for Inspection agency 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					

CLAUSE NO.		QUALITY ASSURANCE													एनटीपीसी NTPC		
QUALITY ASSURANCE & INSPECTION															MODULE NO. SQE-16		
CABLING, EARTHING, LIGHTNING PROTECTION																	
ATTRIBUTES / CHARACTERISTICS		Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per NTPC		
ITEMS/COMPONENTS / SUB SYSTEMS																	
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)		Y	Y	Y	Y		Y		Y		Y	Y	Y	Y	Y		
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745)		Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y		
Cable glands(BS-6121)		Y													Y		
Cable lug		Y													Y		
Lighting wire (IS-694)		Y											Y				
Flexible conduits		Y											Y		Y		
Conduits (Galvanise & Epoxy) IS-9537 & IS-2629, 2633, 6745		Y		Y						Y			Y		Y		
RCC Hume Pipe (IS-458)													Y				
Cable termination & straight through joint (IS 13573)		Y											Y		Y		
Cable Trays, bends, tees, crosses, Flexible supports system & accessories IS-513, 2629,2633,6745		Y		Y		Y	Y	Y		Y			Y	Y	Y		
Trefoil clamp		Y													Y		
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)		Y		Y						Y			Y		Y		
GI wire (IS-280)		Y											Y				
Fire Sealing System (BS –476)													Y	Y	Y		
.Note:1.This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2.* Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the NTPC technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot. This test is not applicable on bends, tees & crosses. 3. Make of all items will be subject to NTPC approval.																	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)					TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-9585-001-2					SUB-SECTION-E-35 CABLING, EARTHING, LIGHTNING AND PROTECTION					Page 1 of 1		

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, antifricition 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-I	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		

QUALITY ASSURANCE		LT Power Cables															
Attributes / Characteristics	Item / Components / Sub System Assembly	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on wooden	Constructional requirements feature as per NTPC specification	Routine & Acceptance Tests as per relevant standard & NTPC	FRLS Tests
	Aluminum (IS-8130)	Y	Y	Y	Y	Y	Y										
	XLPE Compound (IS-7098)	Y	Y	Y		Y	Y	Y				Y					
	PVC insulation Compound (IS: 5831)	Y	Y	Y		Y						Y	Y				
	FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1)	Y	Y	Y								Y	Y				Y
	Extrusion & curing /Manufacturing of Core (PVC / XLPE)		Y			Y		Y					Y				
	Core Laying								Y								
	Armour wire/strip	Y	Y	Y													
	Inner sheath	Y	Y														
	Armouring		Y	Y					Y								
	Outer Sheathing		Y									Y					
	Power Cable (Finished) (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1, IEC 60332 part III cat B)									Y	Y	Y	Y	Y	Y	Y	Y
	Wooden drum(IS-10418) /Steel Drum		Y												Y	Y	

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Make of all major Bought out items will be subject to NTPC approval.

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-9585-001-2		SUB-SECTION-E-48 L.T. POWER CABLE		Page 1 of 4

QUALITY ASSURANCE		Page 2 of 4	
CLAUSe NO.	PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		
ROUTINE TESTS		Following routine tests shall be carried out on each drum of finished cables for all types (PVC / XLPE insulated) & sizes.	
1)	Conductor Resistance test		
2)	High voltage test		
ACCEPTANCE TESTS		Following Acceptance tests shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in the offered lot.	
A) For Conductor (as per sampling plan mentioned in IS: 1554 / 7098)			
	1)	Annealing test (Copper)	
	2)	Tensile Test (Aluminum)	
	3)	Wrapping Test (Aluminum)	
	4)	Resistance test	
B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IS: 1554 / 7098)			
	1.	Measurement of Dimensions	
	2.	Tensile Tests	
	3.	Elongation Test	
	4.	Torsion Test For Round wires only	
	5.	Wrapping Test	
	6.	Resistance Test	
	7.	Mass of Zinc coating test For G S wires / Formed wires only	
	8.	Uniformity of Zinc coating For G S wires / Formed wires only	
	9.	Adhesion test For G S wires / Formed wires only	
	10.	Freedom from surface defects	
C) For PVC / XLPE insulation & PVC Sheath (as per sampling plan mentioned in IS: 1554 / 7098)			
	1)	Test for thickness	
	2)	Tensile strength & Elongation before ageing (for tests after ageing see "D")	
	3)	Hot set test (For XLPE insulation)	
D) Ageing test:			

QUALITY ASSURANCE				
				
Criteria	Condition	Test Requirements	Remarks	
PVC insulation & outer sheath: Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). Tensile & elongation testing shall preferably be done with a computerized machine. The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).	All sizes which meet the criteria	The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C+/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test then all sizes (which had met the criteria) will be put on ageing test as per IS.	
XLPE insulation Samples as per relevant IS, from each size of cables in the offered lot, will be put on ageing test as per IS.	Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----	
E) Following tests will be carried out on completed cables as per IS on each size of each type (PVC / XLPE insulated)				
	1)	Insulation resistance test (Volume resistivity method)		
	2)	High voltage test		
F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)				
	1)	Thermal stability test on PVC insulation and outer sheath		
	2)	Oxygen index test on outer sheath		
	3)	Smoke density rating test on outer sheath		
	4)	Acid gas generation test on outer sheath		
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-48 L.T. POWER CABLE	Page 3 of 4

CLAUSE NO.	QUALITY ASSURANCE		
			
		G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cables as per following sampling plan:	
		This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured PVC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched together, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall be covered. For one particular type, cables with OD less than or equal to 30 mm shall be clubbed together in touching formation while cables with OD greater than 30 mm shall be clubbed together leaving a gap equal to OD of cable having least diameter. Cable OD shall be taken as nominal overall diameter as per NTPC approved datasheet.	
		H) Following tests shall be carried on one length of each type (PVC / XLPE insulated) of offered lot:	
		1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch)number marking on sheath
		2)	Measurement of Eccentricity & Ovality
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-48 L.T. POWER CABLE	Page 4 of 4

	TITLE	SPECIFICATION NO.
		VOLUME II B
		SECTION
		REV NO. 00 DATE MAY 18
		SHEET 1 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
		VOLUME II B
		SECTION
		REV NO. 00 DATE MAY 18
		SHEET 2 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

**TITLE**

3X800 MW PATRATU STPP
DOUBLE GIRDER EOT CRANES
(UP TO 100T)
DATA SHEET

SPECIFICATION NO. PE-TS-434-501-A401

VOLUME: II

REV 00

Section I C

April 2019

VOLUME - II

SECTION – I C

DATA SHEET



TITLE
3X800 MW PATRATU STPP
DOUBLE GIRDER EOT CRANES
(UP TO 100T)
DATA SHEET

SPECIFICATION NO. PE-TS-434-501-A401
VOLUME: II
REV 00
Section I C April 2019

DATA SHEET FOR DOUB E G RDER EOT CRA E TH F DR ES

**** marked information are to be furnished by bidder during detai**

S.N.	Description	Technical Particulars			
1.0.0	General				
1.1.0	Name of manufacturer	*			
a.	EOT Crane	*			
b.	Crane motors	*			
c.	Runway conductors	*			
1.2.0	Weight of equipment				
a.	Bridge assembly	*			
b.	Trolley assembly	*			
c.	Total crane weight	*			
d.	Total weight of the gantry rail	*			
e.	Total weight of DSL	*			
f.	Total weight of all the equipment under this specification	*			
1.3.0	Design, fabrication and testing of the crane confirm to standard / code number	Mechanical and Electrical as per IS: 3177-2006 & Structure design in accordance to IS 807:2006 for EOT cranes. As per IS: 3938 for Electric Hoists.			
1.4.0	Number of crane/s	3 nos. for BC bay crane for BFP handling, 1 no. for Electrical workshop, 1 No. for Mechanical Workshop and 1 no. for Permanent O&M Store.			
1.5.0	Crane classification	M5 (Mechanical and Electrical) as per IS: 807-2006 and 13834 (part-5)-1993			
1.6.0	Suitable for outdoor or indoor duty	Indoor			
1.7.0	Capacity (T)	BFP handling Crane	Electrical Workshop crane	Mechanical Workshop Crane	Permanent store Crane



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1.7.1	Main hoist				
	Rated SWL – tones	40T	55 T	10 T	30T
	Test load SWL – tones	Rated SWL and over load test : 125% of SWL			
1.7.2	Monorail Electric Hoists				
	Rated SWL – tones	2nos.at each crane of 3 T cap. As per CCD attached. Reeving arrangement should be 4/2 type with vertical lift.	NA	NA	NA
	Test load SWL – tones	Rated SWC and over load test : 125% of SWL			
1.8.0	Span	As per attached crane clearance diagram			
1.9.0	Operation from	Pendent push buttons.	Pendent push buttons		
2.0.0	CRANE PERFORMANCE				
2.1.0	Crane speed with full load (mtrs/min.)	BFP handling Crane (m/min)	Electrical Workshop crane (m/min)	Mechanical Workshop Crane (m/min)	Permanent store Crane (m/min)
	Main Hoist	1.6	1.6	1.6	1.6
	Monorail Electric hoists	3.0	N.A.	N.A.	N.A.
	Crab travelling speed (CT motion)	4.0	4.0	4.0	4.0
	Crane travelling speed (LT motion)	8.0	8.0	8.0	8.0
	Hoist speed / cross travel speed of Electric hoists	3/ 15	NA	NA	NA
	Creep speed M/Min	@ 10% of main speed for all the motions through VVVF drive except CT motion of Electric hoists			
2.2.0	Acceleration values	LT motion	CT motion (Trolley travel)		
		As per IS: 3177	As per IS: 3177		
2.3.0	Lift in Meters				



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	Main Hoist	As per attached Crane Clearance Diagram
	Monorail Electric Hoist (for BFP handling Cranes only)	As per attached Crane Clearance Diagram
2.4.0	Hook Approaches	As per attached Crane Clearance Diagram
2.5.0	Hand rail pipes	32 mm NB Medium class of IS: 1161 having top and bottom rail at height of 1050 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick)
3.0.0	COMPONENT DETAILS	
3.1.0	Trolley	The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction and should be covered by flooring as far as possible. On bottom of trolley frame, on each side a double spring bumper shall be provided to engage stops at each end of the bridge.
a.	Type	Fabricated
b.	Method of fabrication	Fusion welded
c.	Material conforming to IS:	Mild Steel (Fe410) Gr-B IS: 2062 100% killed, normalized & Ultrasonically tested
d.	Centre to center distance of wheels (on the same rails)	*
e.	Whether jacking pads for lifting trolley provided or not	Yes
3.2.0	Rope drums	
a.	Dimensions in mm length and diameter (PCD)	*
b.	Material (Indicate IS)	Seamless pipe ASTM -106 Gr. B or fabricated Fe410w IS: 2062 Gr B & stress relieved
c.	Flange / flangeless	Flanged



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d.	Numbers provided	One for each hoist
e.	Number of grooves	*
f.	Type of grooves	Identical Right hand and Left hand
g.	Diameter on bottom of grooves	*
3.3.0	Rope details	
a.	Standard	IS:2266
b.	Construction	Extra flexible plough steel / 6 x 36 or 6x37 construction
c.	Grade	*
d.	Diameter in mm	*
e.	Breaking strength	*
f.	Factor of safety	5.25 as per IS
g.	Type of core	Steel
h.	Number of falls	*
i.	Length of rope	*
3.4.0	Sheaves details	
a.	Material	Fe 410 WA IS: 2062 Gr.B / CS Gr. 280-520 IS: 1030 Design as per IS: 3177- 1999
b.	Diameter of main sheaves in mm on Root	*
c.	Diameter of Equalizing sheaves in mm on Root	Should not be less than 62% of calculated main sheave diameter.
d.	Type of guards provided	Fabricated from rolled steel plate
3.5.0	Coupling & Shafting	
3.5.1	Coupling details (between motor and gear box)	
a.	Type	Flexible shock absorbing coupling excepting pin bush type



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b.	Size & Torque rating	*	*	*
c.	Guards and Enclosures	Provided		
d.	Coupling material and hardness	All couplings shall be of cast, wrought or from forged steel, tooth portion to be heat treated to hardness HB241-280		
3.5.2	Coupling details (gear box and wheels)	Cross Travel	Long Travel	
a.	Type	Flexible geared type		
b.	Size and Torque rating	*		
c.	Guards and Enclosures	Provided		
3.5.3	Coupling details (gear box and rope drum)			
a.	Type	One of the following arrangements will be adopted for connecting the rope drum with the gear- box. 1. Flexible joint, incorporating flexible geared coupling housed within the drum. 2. Fully flexible geared coupling between the drum & gearbox.		
b.	Size	*		
c.	Guards and Enclosures	Provided		
3.5.4	Shafting (Output)			
a.	Diameter in mm	*		
b.	Factor of Safety	As per IS : 3177 (latest edition)		
c.	Number of support bearings	*		
d.	Type of support bearing	*		
e.	Arrangement of Lubrication	Grease cups/ Nipples		
f.	Type of Lubricant	Grease		
g.	Max unsupported length of shaft in mm	*		
3.6.0	Gear box details			
3.6.1	Hoist Motions	MH	MH Micro	
a.	Type of mounting of gear box	Horizontal / Vertical		NA
b.	Classification	Suitable for M5 duty		

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c.	Total no. of reductions	*			
d.	Type of gears	Helical / Spur		Thru' VVVF drive	
e.	Reduction Ratio	*			
f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
g.	Hardness (BHN)- Gear	217-255			
h.	Hardness (BHN) - pinion	266-300			
i.	Difference in Gear and pinion hardness	Min 20 BHN			
j.	Material (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/EN 24 Hardness conforming to IS: 3177 (latest edition) Gears to be hardened, tempered & heat treated as per IS 4460			
k.	Casings	Fabricated Fe 410w IS: 2062 Gr B & stress relieved			
l.	Noise Level	85db			
m.	Standard conforming to	IS 4460 / AGMA			
3.6.2	Travel Motions	CT	CT micro	LT	LT micro
a.	Type of mounting of gear box	Horizontal / Vertical	NA (Through VVVF drive)	Vertic Horiz	NA (Through VVvF drive)
b.	Classification	Suitable for M5 duty			
c.	Total no. of reductions	*			
d.	Type of gears	Helical / Spur	NA.	Helical / Spur	N.A.
e.	Reduction Ratio	*			



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f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication	
g.	Hardness (BHN)- Gear	217-255	
h.	Hardness (BHN) pinion	266-300	
i.	Difference in Gear and pinion hardness	Min 20 BHN	
j.	Material (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/EN 24 Hardness conforming to IS: 3177 (latest edition) Gears to be hardened, tempered & heat treated as per IS 4460	
k.	Casings	Fabricated Fe 410w IS: 2062 Gr B & stress relieved	
l.	Noise Level	85db	
m.	Standard conforming to	IS 4460 / AGMA	
3.7.0	Wheels details	Cross travel	Long travel
a.	Material	C55 Mn75	
b.	Hardness	300 – 350 BHN	
c.	Depth of hardness	10 (min.)	
d.	Tread Diameter (mm)	*	
e.	Tread width (mm)	*	
f.	Process of hardening	Volume Hardening	
g.	Type	Double flanged	
h.	Numbers Provided	4	4
i.	Specification conforming to	IS: 3177 (latest edition)	
j.	Arrangement of lubrication	Grease	



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3.8.0	Lifting hooks	BFP handling Crane		Electrical Workshop crane	Mechanical Workshop Crane	Permanent store Crane
		Main Hook	Monorail EH hook			
a.	Type	Plain shank type with safety latch swiveling type as per latest edition of IS: 15560	Plain shank type with safety latch swiveling type as per latest edition of IS: 15560	Ram shorn type with safety latch swiveling type as per latest edition of IS: 5749	Plain shank type with safety latch swiveling type as per latest edition of IS: 15560	Plain shank type with safety latch swiveling type as per latest edition of IS: 15560
b.	Safe lifting capacity	40 T	3T	55T	10T	30T
c.	Material	➤ Class 2 as per IS 1875:1992 (re affirmed 2004) for hooks conforming to IS : 5749 ➤ Class 1A or class 3 for hook of grades L & M respectively as per IS 1875:1992 for hooks conforming to IS : 15560				
d.	Standard conforming to	IS 15560				
e.	Hook can rotate	Yes				
f.	Safety latch on hook provided	Yes				
g.	Locking device on swivelling hook required or not	Provided				
3.9.0	Buffers	Cross Travel			Long Travel	
a.	Type	Spring loaded type. To be designed to bring the loaded crane (In calculation crane is considered to be loaded with SWL) to rest from speed of 50% of the rated speed.				
b.	Numbers provided	4			4	
c.	Details of end stop	Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS				



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3.10.0	Brakes				
3.10.1	Hoist Motions	BFP handling Crane	Electrical Workshop crane	Mechanical Workshop Crane	Permanen t store Crane
a.	Type of brake	Electro-Hydraulic Thrust brake + Electromagnetic brake	Electro-Hydraulic Thrust brake + Electromagneti c brake	Electro-Hydraulic Thrust brake + Electro-magnetic brake	Electro-Hydraulic Thrust brake + Electro - magnetic brake
b.	Diameter of brake	*			
c.	Torque rating	*			
d.	Number provided per motor	1+1	1+1	1+1	1+1
e.	Braking capacity	150%	150%	150%	
f.	Braking torque actually required	*	*	*	
g.	Material				
i.	Brake Liner	Ferrodo liners			
ii.	Drum	CS IS : 1030 / CL 4 IS : 1875			
iii.	Springs	As per manufacturers standard			
h.	Braking Distance in mm	*	*	*	
3.10.2	Travel Motions	BFP handling Crane	Electrical Workshop crane	Mechanical Workshop Crane	Permanen t store Crane
		BOTH CT & LT MOTION			
a.	Type of brake	AC Electro-Hydraulic Thrust brake	AC Electro-Hydraulic Thrust brake	AC Electro-Hydraulic Thrust brake	AC Electro-Hydraulic Thrust brake
b.	Diameter of brake	*	*	*	
c.	Torque rating	*	*	*	
d.	Number provided	2	2	2	2
e.	Braking capacity	1	125%	125% 171 of 335	



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f.	Braking torque actually required			
g.	Material			
i.	Brake Liner			
ii.	Drum			
iii.	Springs			
h.	Braking Distance in mm			
3.11.0	Drive system for hoisting			
a.	Arrangement of drive from motor to rope drum (main)	Through geared coupling and gear box		
b.	Arrangement of drive from pony motor to rope drum (creep speed)	NA as creep speed through VVVF Drive		
3.12.0	Bearings			
a.	Type	Antifriction ball / roller bearings		
b.	Numbers provided for each	As per assembly requirements		
c.	Method of lubrication	Centralized grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice.		
d.	Bearing life	10,000 working hours.		
3.13.0	Bridge girder			
a.	Type & Quantity	— Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS		
b.	Size	*		
c.	Vertical Deflection	Span / 800		
d.	Type of connection to end carriage	By fitted bolts		
e.	Length	*		
f.	Width	*		
3.14.0	Rails			



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a.	Type / section	Rails sections as per IS: 3443. Rails shall be butt jointed by either thermit welding or fusion welding
b.	Standard conforming to	IS: 3443
c.	Weight per meter	*
d.	Material	50C12 or 55C11
e.	Top width in mm	*
f.	Height in mm	*
3.15.0	Type of platform required on the bridge	Chequered plate platform 6mm thick over plain as per IS : 3502
a.	Length	Full span length
b.	Walkways	Access walkways of not less than 800 mm (clear) with hand railing of height of 1100 mm along the both side of bridge girder and cross over walkways.
c.	Type of access from gantry girder level to crane bridge	Rung ladder at ends from gantry girder level walkway to crane bridges walkway
d.	Type of access to maintenance cage from crane bridges walkway	Rung ladder
e.	Provided at both ends	Yes
3.16.0	Motors	Suitable for ambient temperature of 50° C
3.16.1	Hoist Motions	
a.	Type	Three phase Squirrel Cage Induction motors to be operated from VFD system shall be suitable for speed range and torque without exceeding Temperature rise limits as specified elsewhere in this specification. These motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for Inverter duty
b.	Enclosure	TEFC
c.	Numbers furnished	1
d.	Voltage, phase and frequency	3 Ph, 4 wire, 415V $\pm$ 10%, 50 Hz +3/-5% Combined voltage & frequency variation = 10% absolute
e.	Class of protection	IP – 55



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f.	Rated capacity (KW)	The motor shall be suitable for 150 starts / hr and 40% CDF. Motor name plate rating at shall have Motor rating will be calculated keeping margin of at least 10% over the maximum power requirement in the duty condition specified.	
g.	Rating	S4, 40 % CDF	
h.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to 70 C	
i.	Number of starts/ hour	150 starts / hr	
j.	Pull out torque	The pull out torque of the motor will not be less than 275 % of the full load torque.	
k.	Space heater requirement	For motors above 30KW	
l.	Speed	*	
m.	Contactors for motors	*	
3.16.2	Travel Motions	CT	LT
a.	Type	Three phase Squirrel Cage Induction motors to be operated from VFD system shall be suitable for speed range and torque without exceeding Temperature rise limits as specified elsewhere in this specification. These motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for Inverter duty	
b.	Enclosure	TEFC	TEFC
c.	Numbers furnished	1	2
d.	Voltage, phase and frequency	3 Ph, 4 wire, 415V $\pm$ 10%, 50 Hz +3/-5% Combined voltage & frequency variation = 10% absolute	
e.	Class of protection	IP – 55	
f.	Rated capacity (KW)	The motor shall be suitable for 150 starts / hr and 40% CDF. Motor name plate rating at 50 ⁰ C shall have Motor rating will be calculated keeping margin of at least 15% over the maximum power requirement in the duty condition specified.	
g.	Rating	S4, 40 % CDF	
h.	Class of insulation	Class 'F' for sq. cage Motors with temperature rise limited to 70C	
i.	Number of starts/ hour	150 starts / hr.	
j.	Space heater requirement	For Motors above 30 KW rating	
k.	Pull out torque	The pull out torque of the motor will not be less than 275 % of the full load torque.	



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		torque.		
I.	Speed	*		
m.	Contactors for motors	*		
3.17.0	<u>Limit switches</u>	Main hoist	Cross Travel	Long Travel
a.	Type	Rotary gear (screw type) + Gravity	Lever type (one way/ two way)	Lever type (one way/ two way)
b.	Number provided	1 + 1	2/1	2/1
c.	Rating of contacts	*		
d.	Material of contacts	Double break Silver Cadmium		
e.	Control voltage/ Enclosure	110 V/ IP 55		
3.18.0	<u>Power conductors (DSL)</u>			
a.	Type	LT: PVC shrouded Cu/ Al conductor bus bar CT : EPR insulated, copper conductor trailing cables, as per IS: 9968, on the bridge.		
b.	Size	Shall be sized with a margin of 10% over load requirement. Limit voltage drop at motor terminals within 2% at extreme positions. Protective cover over DSL to be provided.		
c.	Material	*		
d.	Number	*		
e.	Length	Suitable for entire bay length		
f.	Guard provided	Yes		
3.19.0	<u>Protective & Control panel</u>			
	Make	OEM		
	Size	*		
	Material	Rolled sheet steel 2mm size		
	Numbers and location	One no. Protective panel & One no. each for MH, AH, CT and LT located on bridge Platform		
	Degree of Protection	IP 54		
	Illumination	Internal illumination with florescent lamp		
3.20.0	<u>Cable</u>		Control	



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	Material	Copper / Aluminium	Copper
	Size	Min. 2.5 mm ² for Cu. & Min. 16mm ² for Al	Min. 2.5 mm ²
	Type	All cabling shall be carried out using XLPE insulated fire resistant (FRLS) cables & wiring by Heat resistance PVC wires with stranded	
	Voltage grade	1100 V	
	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 2% of rated voltage.	
3.21.0	Earthing		
a.	Material of earthing	GI / Copper	
b.	Earthing as per specification	Yes	
3.22.0	Contactors	AC 4 duty for reversing application. AC 3 duty for non-reversing application	
a.	Switches	AC 23 for motor application, AC 22 for other application.	
b.	Fuses	HRC	
c.	Overload relay	Not applicable as the motor overloading condition is controlled by VVVF drive	
3.23.0	Fire Extinguisher	BFP handling Crane	
a.	Type and size	4.5 kg , CO ₂ type	
b.	Numbers & Location	One no. on bridge per Crane	
3.24.0	Power Supply	415 V, 3 phase, 4 wire supply at operating floor at centre of bay length with change over switch.	
a.	No. of conductors for LT motion	4 nos.	
3.25.0	Transformer		
a.	Quantity	2 X 100 % - 415/110V (for control), 1 no. for lighting, 1 no. for hand lamp	
b.	Voltage rating	Control 415/110V, Lighting 415/240V and hand lamp 415/24V	
c.	KVA rating	20% over loading to be considered while sizing the rating	
d.	Operation	Stand-by control transformer should be able to come in to operation in case of failure of working transformer	
3.26.0	Illumination		
b.	Over Bridge	4 nos fluorescent lamps and 4nos. 24V-5A – 3 pins industrial socket	



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c.	Under bridge (250W HBSV lamps) – Nos.	4 nos.
d.	For inspection of crane components	One (1) portable 40W hand lamp with min. half span length flexible cable for inspection of crane components
e.	Hand lamp socket and hand tool sockets	Hand lamp socket outlets (2 pin, 10A, 24V) and power socket outlets (3 pin, 20A, 240V) shall be provided for use of hand tools along with switches.
3.27.0	Type of control for Hoists/ CT/LT operation	Through VVVF drive
a.	Speed control	Mentioned Elsewhere in the specification
b.	Starting torque of VVVF	
c.	Starting current	
d.	Temperature	
3.28.0	Sweep	Sweep shall be attached to the end carriages and to the trolley to remove foreign materials from the rails.
3.29.0	Main Isolating switch	At the center of bay-length
3.30.0	Additional features on pendant push button	-Emergency Push Button (two nos. on bridge platform with easy reach) -Switches for lights and bells -Lamps for Power 'ON' indication and emergency corner switch operation
3.31.0	MAXIMUM SPAN/DEPTH RATIO FOR GIRDER:	(a) Plate girders : 18 (b) Lattice girders : 12
3.33.0	Minimum thickness of Structure Members:	(a) Load Carrying members : 8 mm (b) Tubes with both ends sealed : 4.9 mm (6 SWG) (c) Tubes with unsealed ends : 8 mm (d) Chequered plate : 6 mm O/P

Note: Other requirements for the system

- Centralized grease lubrication with hand operated grease pump for all bearings.
- The crane electrical shall be designed for ambient air temperature of 50 Deg. C relative humidity of 100%. The equipment shall operate in highly polluted environment.
- All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion. DSL phase indicating lamps to be provided.

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3X800 MW PATRATU STP PHASE-I
DOUBLE GIRDER EOT CRANES UPTO 100T
STANDARD TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-434-501-A401

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SECTION – II

STANDARD TECHNICAL SPECIFICATION

SUB-SECTION IIA – Standard Technical Requirement (Mechanical)



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DOUBLE GIRDER EOT CRANE

1.0.0 SCOPE

This specification covers the design, material, manufacture, assembly, inspection and testing at manufacturer works for EOT cranes and shall be applicable unless the requirements are addressed otherwise in BHEL / BHEL's Customer approved documents.

2.0.0 CODES AND STANDARDS

The equipment to be supplied under this specification shall conform to the following codes and standards (latest revisions) unless otherwise specified hereinafter.

i)	IS 807	Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists
ii)	IS: 3177	Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes.
iii)	IS: 2266	Specification for steel wire ropes for general Engineering purposes.
iv)	IS: 4029	Guide for testing induction motor (for temperature rise).
v)	IS: 15560	Steel hooks for standard shank design.
vi)	IS: 3443	Specification for crane rail section.
vii)	IS: 325	Three phase induction motors.
viii)	IS: 900	Code of practice for installation and maintenance of induction motors.
ix)	IS: 4237	General requirement of switchgear and Control gear for voltage not exceeding 1000V.
x)	IS: 434 (Part I)	Copper conductors rubber insulated cables for voltage up to 1000V.
xi)	IS 1596	Polyethylene insulated PVC sheathed cables
xii)	IS 3043	Code of practice Earthing



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xiii)	IS: 3938	Electric Wire Rope Hoists.
xiv)	IS: 2147	Degree of protection provided by enclosures for Low voltage switchgear and control gear.
xv)	IS: 1554 Part I	PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts.
xvi)	IS: 691	Flexible trailing cables rubber insulated.
xvii)	IS: 1653	Steel conduits for general engineering purposes.
xviii)	IS: 2509	Rigid non-metallic conduit for electric- Installations
xix)	IS: 2062	Steel for General Engineering purposes.
xx)	IS: 1030	Carbon Steel castings for general engineering purposes.
xxi)	IS: 1570	Schedules for Wrought steels.
xxii)	IS: 1875	Carbon steel billets, blooms, slabs and bars for forgings.
xxiii)	IS: 808	Dimensions for hot rolled steel beam, column, channel and angle sections.
xxiv)	IS: 1852	Rolling and cutting tolerances for Hot rolled steel products.
xxv)	IS: 2291	Tangential Keys and Keyways.
xxvi)	IS: 2292	Taper Keys and Keyways.
xxvii)	IS: 3961	Recommended current rating for cables.
xxviii)	IS: 694	PVC insulated cables for working voltages up to and including 1100V)
xxix)	IS: 1554 (part-I)	PVC insulated (heavy duty) electric cables: Part 1: for working voltages up to and including 1100 volts.
xxx)	IS: 4289	Flexible cables for lifts and other flexible connections: Part 1: Elastomer insulated cables.
xxxi)	BS: 970	Wrought steels in the form of blooms, billets, bars and forgings.
xxxii)	IS: 5749/ BS 3017	Specification for Forged Rams horn Hooks



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Indian electricity rules - 1956.

In the event of any conflict between the specification and standards mentioned above, the more stringent of the two as per interpretation of purchaser shall govern.

3.0.0 DOUBLE GIRDER EOT CRANE

3.1.0 DESIGN REQUIREMENTS

3.1.1 The crane shall be designed in accordance with the latest edition of IS-3177, IS-807 and any other standard as referred there in and subject to any modification and requirement as specified herein after.

Class of crane mechanism shall correspond to that of the crane requirement and as specified elsewhere.

3.1.2 Safety devices should be provided with all equipment/parts covered under this specification.

3.1.3 Parts requiring replacement or lubrication shall easily be accessible without dismantling the other equipment or structures. All electrical cables shall be laid to comply with recognized standards and purchaser's requirements.

3.1.4 For welded construction such as bridge girders, end carriages, rope drum, gearboxes etc. steel shall be conforming to IS-2062 quality. Welding shall be carried out only by qualified welders and subjected to NDT as specified in Quality Plan.

a. Welding shall be performed by shielded electric arc, gas or other approved methods. The electrodes used for welding shall conform to AWS A5.1.

b. Wherever lateral welding of the main plates of box girders are required, it shall be butt-welded.

c.

d. Electrode designations and qualifications shall be as per AWS A 5.1.

e. Electrodes should be of radiography quality with heavy covering as per IS: 814 and relevant requirement of ASME Sec IX and IIC.

f. Bare electrodes as per IS: 7280 and flux wire combination as per IS: 3613.4e

3.1.5 VOID



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3.1.6 Guard shall be provided on crane to prevent the hoist ropes coming in contact with down shop leads.

Guards/ rail sweep of an approved design, which will push forward or off the track any object such as a person foot or arm, placed across it. Guards shall be attached to each end of the end carriages.

Suitable guards shall be provided to revolving shafts, coupling etc.

3.1.7 All cables shall be clamped individually. All trailing cables shall be clamped with PVC or non-metallic clamp.

3.1.8 Walkways of CT shall be of chequered plate minimum 6 mm thick O/P at least 800 mm clear inside with non-skid toe plates 8mm thick, projecting 100 mm above the floor. Walkways shall be of rigid construction and designed to sustain a distributed load of not less than 300 kg/ sq. mm.

Intermediate posts for supporting handrails shall not be spaced more than 1.5 meters apart.

Ladders provided shall have at least 450mm clear width with 20 mm rungs (rods) spaced 300 mm apart.

3.1.9 All wheels, couplings, open gear etc. shall be provided with covers.

3.1.10 All bolts except those with locknut shall be provided with grip lock nuts or spring washers.

3.1.11 Fasteners for pedestal blocks, motors, gearboxes etc. shall be easily removable from the top. Studs shall not be used as fasteners for mechanical items except for fixing covers.

3.1.12 Defects in the material like fractures, cracks, blowholes, pitting etc. are not allowed. Rectification of any such flaw is permissible only with the approval of the purchaser.

3.1.13 All parts of the crane shall be thoroughly cleaned of mill scales, rust or foreign matter and then painted as per the specification requirements.

The permissible camber shall be shown in drawing or data sheet submitted for approval.

3.2.0 STRUCTURAL DETAILS

3.2.1.0 Crane structure shall be designed in accordance with the latest edition of IS-807 after taking the following additions/deviations as applicable.



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- 3.2.1.1 Black bolts shall not be used in the main structure of the crane. The calculated strength of other bolted joints in structural members shall not be less than net strength of member plus 25%.
- 3.2.1.2 The calculated strength of riveted joint or joints made by friction grip bolts in structure members shall be not less than the calculated net strength of the member.
- 3.2.1.3 Bolts used in shear shall be fitted in to reamed hole.
- 3.2.1.4 Nuts and Bolts will be as per IS:1363, IS: 1364 and IS: 1367
High-tension friction grip bolts as per IS: 3757 and High- tension friction grip nuts as per IS: 6623
- 3.2.1.5 Transverse filled welding on load carrying member shall be avoided.
- 3.2.1.6 All butt welds on structural members subjected to tensile stress shall be of radiographic quality as ASME Sec VIII Div.1 acceptance norms.
- 3.2.1.7 Fillet welding on load carrying members shall be avoided.
- 3.2.1.8 For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8mm thick. For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8mm.
- 3.2.1.9 The cranes working out door or in corrosive environment, an allowance of 1.5 mm shall be added to the calculated thickness.
- 3.2.1.10 Minimum thickness of chequered plates for platform shall be over 6 mm over plain. Chequered plates shall not be considered for strength calculations of load carrying members.
- 3.2.1.11 Splice shall be designed to resist all the forces and moments to which it is subjected to plus 50% thereof.
- 3.2.1.12 However, in no case the strength developed by the splice shall be less than 50% of the effective strength of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splice in line with the gravity axis of the member joined so as to avoid the eccentricity of the loading.
- 3.2.1.13 The material of construction of the major components shall be as specified in the specification/data sheet. Manufacturer are however free to use alternate material material which are superior for the intended service. But in all the cases, prior concurrence of the purchaser is must.



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3.2.1.14 Splices shall be designed to resist one and half times the forces and moments to which it is subjected, but in no case it shall be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders shall be designed for full strength of the web in shear as well as bending. For splicing tension members, the net section of the splice plate shall be ten percent more than that of the material spliced. Splices shall be proportioned and arranged, so that the gravity axes of the splices are in line with the gravity axis of the member to avoid eccentricity.

3.2.2 Bridge Girder

3.2.2.1 The bridge girder shall consist of a box construction with double Web plate girders or lattice girders and shall be of adequate strength to withstand the rolling loads and other stresses it is subjected to.. The design of the girder shall be in accordance with latest edition of IS- 807.

3.2.2.2 Maximum deflection of the bridge girder, with safe working load, shall not exceed 1/900 of the span or as per latest IS. The girder shall be supported on the centerline of LT wheels during the deflection check. The girder shall be cambered by an amount by an amount equal to the maximum deflection.

3.2.2.3 Box section shall be adequately reinforced by internal diaphragms and ribs to withstand the most severe combination of load that may develop under different working conditions. Additional Internal diaphragms shall be provided at points where external members are welded for providing support to drives etc.

3.2.2.4 Box girders shall be provided with end plates sealing. Diaphragms inside the girder shall extend to the full - width & depth of the girder and the web plates shall be reinforced by angles all along the full length of the plates spaced midway between the diaphragms. Full depth diaphragms or stiffeners shall be furnished at bridge drive supports and below the line shaft bearings.

3.2.2.5 Short diaphragms shall be furnished and are required to transmit the trolley wheel loads to the web plates. Trolley rail section shall not be considered into design of bridge girders.

3.2.2.6 Full length chequered platforms on both side shall be provided on the side of bridge girders as specified in data sheet - A.



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- 3.2.2.7 There should not be accumulation of water/oil inside the box girders. If required breathing holes can be provided for expansion / contraction, due to change in temperature. Tapped (threaded) holes shall be provided with ½" NPT plug in the bottom of the girders, at both ends, to drain off any accumulation of water / Oil inside the girder. Instruction shall be painted on the girders to remove the plug and check for water/oil before lifting. Plug shall be replaced after installation.
- 3.2.2.8 All connection splices shall be designed for full strength of member of loads indicated unless otherwise approved. Beams and connections shall be designed for 60% of shear capacity of beam section plus additional axial load if any. Not more than one splice shall be provided to make up full length of number.
- 3.2.2.9 Maximum Span/ Depth ratio for Plate Girder shall be 25 or as per IS 807 latest edition.
- 3.2.3 End carriage**
- 3.2.3.1 End carriages shall be fabricated from rolled steel section or plates. End carriage shall be of ample strength to resist all stresses likely to be imposed on them under service conditions including collision with other cranes or stops. The length of the end carriages shall be such that no other part of the crane is damaged in collision. End carriage shall be so designed as to distribute the load evenly between the wheels from each bridge girders.
- 3.2.3.2 The wheel base shall not be less than 1/6th of the span up to 20m, 3.5m for spans above 21m but less than 24.5m & 1/7th of span above 24.5m (as per IS 807 latest edition). End carriage shall be fitted with safety stop to prevent the end carriage falling more than 25 mm in the event of breakage of a track wheel, bogies or axle.
- 3.2.3.3 Suitable jacking pads at a suitable height from rail level shall be provided on each crane for crane jacking. Jacking pad dimensions shall be suitable for full seating of the jacking pad seat without any instability. When changing the track wheel, jacking pads shall not interfere with replacement of track wheel.
- 3.2.4 Crab (Trolley)**
- 3.2.4.1 The crab frame shall be built from heavy steel section, welded properly to form single piece frame & to resist vertical, lateral and torsional strain and to support all loads without undue deflection. It should be properly machined to receive hoisting mechanism, cross traverse arrangement/mechanism, wheels etc. etc.



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3.2.4.2 Sheaves, part of hoisting mechanism, shall be so arranged on trolley that rope reeling arrangement shall ensure lifting of load in vertical line with minimum of swing or side movement. Trolley shall be provided with chequered plates all over except for opening required for ropes and equipment foundation. Equipment foundation shall not be welded/ supported on chequered plates. Toe plates 100 mm high and 6mm thick shall be provided around opening provided for movement of ropes. Suitable railing shall also be provided around the opening for rope in case the opening is large.

3.2.4.3 Platforms and Ladders

a) Safe means of access shall be provided to every place where any person engaged in the examination or maintenance of the crane has to work. Adequate handholds and footholds shall be provided as necessary..

b) Every platform shall be provided with steel chequered plate top and be securely fenced with 1050 mm high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely

c) Safety hand railing of tubular construction 32 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1100 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick) shall be provided on bridge walkways and on end carriages, staircases, trolley and at any other place where access is provided. Bends shall be neat and made by machine. The top rail should be so laid that there is no intermediate obstruction and hand need not be lifted from rail while walking

d) In case lattice riveted construction is offered for the bridge girder, full length chequered plate platform with adequate headroom shall also be provided at bottom chord level for periodic checking of all rivets/bolts and other items.

3.2.5.0 Brief description of crane operation, Maintenance and periodical lubrication etc. typed in English and in local language neatly framed in a permanent frame for easy reference.

3.2.6.0 Suitable inspection cages to accommodate two persons to facilitate inspection of DSL.

3.3.0 MECHANICAL

3.3.1 Rope drums



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Rope drums shall be of mild steel plate fabricated/ cast steel/ as per IS 3177. All fabricated rope drums shall be stress relieved. The drum shall be so designed to take full length of hoisting rope in single layers. The end of the rope shall be anchored to the drum in such a way that the charger is readily accessible. Each rope shall have not less than two (2) full turns on the drum when the hook is at lowest position not taking into consideration the turns covered by the rope in charge. One spare groove shall be provided for each rope drum when the hook is at the highest position. Each rope end shall be clamped with minimum two clamping wedges with at least two bolts on each clamping arrangement.

The pitch diameter of the drum shall be as per IS - 3177 or as specified elsewhere. The depth of the groove shall not be less than 0.35 times the rope diameter. Each rope shall be clamped to drum with two clamp wedges with at least two numbers of bolts on each clamping arrangement.

For evaluation of Radiography the designed thickness of the drum (top of crest to ID) shall be taken into consideration and not the thickness of plate selected.

3.3.2 Hoist ropes

Ropes of steel core as specified in Data sheet" A" shall be of 6x36 or 6x37 construction of extra flexible plough steel as per IS 2266 having minimum UTS of 1770 kN.

3.3.3 Rope sheaves

Sheaves shall be of cast (Castings to IS: 1030 Gr. II with Y.P. greater than 50% of UTS) or forged steel. All sheaves shall be identical, however, exception may be made for equalizer sheave. Sheave groove shall be ground finished for getting increase rope life. Equalizer sheave shall be arranged to turn and swivel in order to maintain rope alignment under all circumstances.

3.3.4 Wheels

LT & CT wheels shall be double flanged with straight tread. The wheels shall be capable of taking up misalignment in span. Solid wheel shall either be of forged steel or as specified in Data sheet. The wheel rim shall be with minimum hardness of BHN 300-350. Wheels may be either hardened on tread portion as per IS -3177 or Volume hardened. Contact stresses between wheels and rails should be within permissible limits.



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3.3.5 Buffer

Each End carriage shall be provided with buffer as per data sheet 'A'. Buffers should be so located that removal is not required while changing wheels or bogies. Buffers shall have sufficient tension on energy absorption capacity to bring the unloaded crane to rest from the speed of 100% of the rated speed to zero speed. Buffer is to be fitted to each end of carriage assembly and crab so that buffer contact takes place before the bridge or trolley reaches the end of rail.

3.3.6 LT drive

The bridge motion shall be achieved by suitable drive arrangement as specified elsewhere. When twin drives are used, these shall be operating in unison to avoid skewing effect. The drives shall be interlocked for simultaneous starting, stopping & speed control.

3.3.7 CT drive

Trolley drive shall be achieved by suitable drives & power shall be transmitted to the geared wheel by means of pinions mounted on both ends of the output shaft.

3.3.8. Gearing

3.3.8.1 Gears in speed reducer unit for bridge drive, hoists and trolley drive gearing shall be enclosed in substantial housing and shall operate in oil bath. The housing shall be of sufficient design not to permit temperature in excess of 90°C for the oil bath. Spur and helical gearing shall normally be used for all motions. Worms and bevel gears shall not be used. First high-speed reduction shall be through helical gears. All gears shall be hardened and tempered and of alloy steel with machine cut teeth 1.6 Micron finish or better and lapped with some minimum applied load to remove high spots and to improve tooth contact. Cast alloy steel is acceptable only for gears in the last stage of speed reduction. Surface hardening of teeth is not acceptable. Gear teeth shall preferably be cut in metric module system. Gears shall be designed to meet requirement of crane duty as per IS: 3177. The ratings of gears shall be established as per IS: 4660.

3.3.9 Gear Box

3.3.9.1 All gears shall be completely covered and enclosed in oil tight casing & sealed with gasket. In case of totally enclosed gearboxes, splash or automatic lubrication system shall be used. Covers shall be split horizontally at each shaft centre line, so that top



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half can be removed for inspection and repair with out disturbing the bottom half. Gear shafts shall be supported on ball/roller bearings mounted in gearbox unless specially agreed otherwise. The gear boxes shall be provided with breather, air vent, oil level indicator, dip stick, drain plug and lugs for lifting.

Radial clearance between the gear boxes inner surface and outside diameter of the gears shall be at least 1.25 times the depth of larger gear tooth inside the gear box or 20mm which ever in higher. Facial clearance between inner surface of gearbox and face of gear or pinion shall be at least 20 mm. Gearbox shall be inspected in line with QP and as per PEM (Q)/001 enclosed.

3.3.9.2 The gearboxes shall be

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3.3.10 Bearing

3.3.10.1 Ball and roller antifriction bearing of attached sub-vendor list, make shall be used throughout, except where specified otherwise.

Rated life of ball and roller bearing shall be not less than total working life as per data sheet-A. Life of bearing shall be calculated in accordance with manufacturer's recommendations.

3.3.10.2 Provision shall be made for service lubrication of all bearings. Lubrication arrangement and clamping shall be done neatly. Bends in pipe shall be done with the help of machine. Bearing enclosures shall be designed as far as practicable to exclude dirt and shall prevent oil leakage. Accessibility should be such that parts may be safely lubricated from the walkway or ladder when the crane is not in motion.

3.3.11. S C

3.3.11.1 Shafts and axles shall be made from solid rolled or forged steel bars and shall have ample strength and rigidity and adequate bearing surface. If shouldered, they shall be provided with fillets of ample radius and /or be tapered to avoid stress concentration.

Motor shafts shall be connected to gearbox input extension shafts through flexible gear coupling. Solid coupling shall be used for connecting intermediate lengths of long travel shafts. For driving hoist drum full-gear couplings shall be used between



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hoists drum & hoist gearbox output shaft. Couplings shall be of cast steel/wrought steel conforming to IS: 1030 grade 280-520 and shall be designed to suit service conditions.

3.3.11.2 Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement whenever necessary. Whenever components of considerable amount of inertia are directly mounted on the high-speed shaft (e.g. brake drum, coupling etc.) they shall be balanced statically to minimise vibration.

3.3.12 Repair Cage

A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. The repair cage shall be adequately sized to accommodate two persons. And guarded for safety and correctly located for the intended service. Suitable access to the cage shall be provided. Repair cage shall be provided at the corner of the crane.

3.3.13 Lifting hook

Standard hooks shall be used unless otherwise specified. These hooks shall conform to the latest edition.

3.3.14 LIFTING HOOK BLOCK ASSY

3.3.14.1 Lifting hook block assembly shall be Ram shorn type or approved for capacity greater than 50 Tonnes and point hook with Shank for capacity below 50 Tonnes and shall be of steel construction.

Each hook shall be supported on ball or roller thrust bearing and shall rotate freely.

3.3.14.2 The sheaves of the hook block shall be enclosed in a casing permitting generous lubrication of wire ropes, sheaves and also preventing accidental tapping of hands.

3.3.15 Brakes

3.3.15.1 Selection and design of brakes shall be such as to meet the requirement. Brakes shall be designed to suit 150% of torque transmitted to the brake drum with full load for hoist motions and 125% of motor rated torque before de-rating for LT/CT motion. Brakes shall be provided as specified in Data Sheet 'A'.



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i) **SERVICE BRAKE**

Double shoe types & disc type service brakes shall be provided for each motion of the crane as/or as specified in Data Sheet. The service brakes shall apply automatically when power supply to the drive motor is cut off or fails.

ii) **HOIST CONTROL**

Hoist motion shall be provided with a self-contained sturdy braking system to control the speed of hoisting as well as lowering motion. The braking system shall be reasonably uniform and effective in all loads at any position.

3.4.0 **ELECTRICAL**

3.4.1 The scope of supply shall cover all electrical equipments comprising from Main isolating switch, down shop leads, trolley conductors, current collectors etc.

3.4.1.1 Main Disconnecting/Isolating Switch fuse unit shall be provided at 1.5M above the operating floor level at one end / at both the ends of bay length or in the middle as specified in the data sheet A. Termination of incoming power supply cable to isolating switch fuse unit and further cable from switch to down shop leads shall be included in the bidder's scope of work. The switch shall be provided with Power ON Red indication lamp.

3.4.1.2 Run way conductors (Down shop leads) shrouded conductor as specified in the data sheet A shall have four conductors. One of the conductors shall be connected to earth grid for earthing connections of all electrical equipment on the crane and shall be connected to suitable collecting gear of earth conductor. Voltage drop across the down shop leads shall be less than 3% or specified in data sheet "A". It shall be supplied with brackets. Maintenance cage for DSL shall be provided on crane.

3.4.1.3 The current collectors shall be with adequate current carrying capacity and shall maintain adequate contact pressure. Spacing between current collectors shall be such as to provide sufficient quenching area for sparks coming out of collectors surface. The collector system per conductor shall spring loaded CI/carbon metallic shoes to maintain adequate contact pressure.

3.4.1.4 The cable, supplying power to crane trolley shall be flexible trailing cable as per IS-9968 Part I (latest edition) and mounted on retracting supports (festoon type).

3.4.2 **DRIVE MOTORS**



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- 3.4.2.1 Crane Motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The starting torque of motor shall not be less than 2.25 times the rated torque and pull out torque shall not be less than 275% of the rated full load torque of motor. In case of VVVF drive system, the creep speed will be achieved through VVVF drives and the motors for Main hoists, Auxiliary hoist, CT and LT will be Squirrel cage. Hoisting drive motors shall be provided with antifriction roller / ball bearings on the drive side.
- 3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending up on the ambient temperature and voltage /frequency variation shall be applied to de-rate the motors. The minimum margin of 10% shall be considered over the calculated rating of the motor. The protection class of the motors shall be as IP-55. Motors shall be tested at manufacturer's works in accordance with IS-325/as per agreed Quality plan & Reports shall be submitted for approval. Motors shall comply with the requirement of IS-325 or as per the motor spec.
- 3.4.2.3 All the motors shall be provided with lifting lugs two earth terminals of adequate size to accept the earthing conductors shall be provided at diametrically opposite points unless specifically designed For higher speeds, motors shall be capable of with-standing 2.5 times the rated speed.
- 3.4.2.4 Motors shall be painted in line with painting instructions specified in Painting Scheme Annexure IV attached along with the technical specification.
- 3.4.3 **Limit switches**
The hoist mechanism of the crane shall be provided with rotary type limit switch to open the control circuit & in order to prevent the crane hook from over hoisting and over lowering, one gravity type back up limit switch of hand reset type shall also be provided. This switch will operate in the event of failure of main limit switch. Lever operated limit switches shall be provided at both ends of longitudinal travel and cross traverse. These limit switches shall be self-reset type. The limit switches shall be as per "Data Sheet A"
- 3.4.4 **Switch**
All switches shall be hand operated; air break, heavy duty, quick make and quick break type. Incoming supply disconnect switch shall be interlocked with panel door so that the same cannot be opened unless the switch is in OFF position. Safety Interlocks-Disconnect Switch-The operating handle of the main/ safety disconnect



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switch shall be mechanically interlocked with enclosure cover such that the same cannot be opened unless the switch is in OFF position. Main/ safety disconnect switch shall have provision of pad locking in OFF position

3.4.5. Contactors.

Contactors shall be suitable for heavy duty, with current rating not less than connected motor full load current. All reversing contactors shall be mechanically and electrically interlocked.

Each contactor shall be provided with three positive acting ambient temp. Compensated thermal overload relay with adjustable setting to suit the motor current. The relay shall be hand reset type, suitable for current. The relays shall be replaceable from front. The main contactor shall be electrically interlocked so that it cannot close unless all the motor overload relays are RESET and all controllers are in OFF position. The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

3.4.6 Push button and lamp

Push button shall be spring return type with 2 NO + 2 NC contacts, rated 10A, 240 V AC. Indicating lamps and lens shall be replaceable from front.

3.4.7 Protective Panel

3.4.7.1 The electrical protective panel shall be a cubicle fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick with lockable-hinged door. The control cabinet's door shall be interlocked with the operating handles of isolating switches of supply circuits so as to prevent opening of the door when an isolating switch is closed. A device for bypassing the interlock shall also be provided. It shall be dust and vermin proof with degree of protection as IP-54 or as specified in data sheet A. All the equipment inside the panel shall have permanent identification. The panels shall be front connected type with front-hinged door for access to wiring and terminals. Engraved nameplate shall be furnished for all panels and also for the equipment and devices mounted there on.

The following minimum equipment shall be provided.

- a) One triple pole air break type main contactor with thermal overload relay.
- b) One triple pole main line connecting/disconnecting switch.



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- c) Emergency push button at convenient height for the operation for interruption of the entire power.
- d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.
- e) Contactors, timer and auxiliary contactors.
- f) Portable Lighting Transformer rated for 415/24V.
- g) Lighting Voltage Transformer with fuse 415/24V.
- h) Control transformer with fuses.
- i) Indicating lamps to indicate the live condition of all three phases.
- j) Main supply ON/OFF lamps on the door of the protective panel.
- k) Electrical interlock shall be provided to prevent the main contactor being closed unless all controllers are in OFF position.
- l) Other equipment as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The main contacts shall have the rating for 5 Amps or as specified in the data sheet A. The contactor drop off voltage shall be between 45-50% of rated voltage.
- m) All internal wiring shall be identified with numbering rules at both ends as per the relevant wiring diagram.
- n) Each panel shall have internal illumination with fluorescent lamp. The inside of the panel shall be painted white.
- o) Separate terminal blocks shall be provided for terminating circuits of various voltage classes. At least 20% spare terminals for the wire terminations shall be provided in the cabinet.

3.4.8 Starter Panel

Separate panels shall be provided for CT, LT & hoist motion (Main and Auxiliary), with following type of items.

- a) Contactors : AC4 duty for reversing applications
AC3 duty for non-reversing applications
- b) Switches : AC23 for motor application.
AC22 for other application
- c) Fuses : HRC



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- d) Overload relays: Temperature compensated bi-metallic
with single phasing preventer.

3.4.9 MOTOR CONTROL PANEL

The motor control panels shall be dust and weatherproof to IP-54/55 or as specified in "Data Sheet A" & shall be provided separate for each motion. The panel shall contain minimum the following components.

- a) Switch fuse unit with contacts of adequate rating for each motion.
- b) Thermal overload relay for each drive. These shall be ambient temperature compensated adjustable type.
- c) Contactors, timers and auxiliary contactors.
- d) The panel shall be provided with space heater. The space heater with thermostat shall be located at the bottom of the panel and shall have individual ON/OFF switch.
- e) Terminal blocks shall be stud or snap on type. A protective cover shall be fixed on top of terminal blocks to prevent accidental contact. A minimum of 20% spare terminals shall be provided.
- f) Air break contactors shall be provided for main supply as well as for motors. They shall conform to category AC-4 as per IS-1322. These shall have three main contacts and 2 No. & 2 NC auxiliary contacts.
- g) The main contacts shall have the ratings as per duty requirement but auxiliary contact shall be rated for 5 amp 240V AC. The contactor drop off voltage shall be between 45-50% of rated voltage. The contactor coil shall be suitable for 240V AC supply.
- h) The auxiliary contactors shall have 4 No. + 4 NC contacts for control and interlocking purposes. The contacts shall be convertible. The contacts rating shall be suitable for 5 amps at 240 Volts AC.
- i) Adequate protection for overload and short circuit shall be provided for all the three phases of each motor.
- j) Double pole switch fuse unit for control circuit of the contractor 'START (push button and a pilot lamp with the red lens for indicating the contactor "CLOSED" shall be furnished.



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3.4.11 Illumination

Crane lighting and space heating system shall be designed for 240V, 1Phase 50Hz supply and receptacle system with 24V 1Phase 50Hz supply or as specified in the Data sheet A. Suitable dry type transformers shall be furnished for this purpose, complete with isolation facility and Primary/secondary fuses.

- a) Branch Circuits for lighting and receptacles shall be individually protected by switch fuse units.
- b) CFL fixtures shall be used for lighting operator's cabin and bridge platform.
- b) 60W bulkhead fittings with fluorescent lamp shall be used for lighting bridge platform.
- c) Four (4) no.s - 250 W HPSV lamps shall be provided under the bridge as specified in the data sheet "A"
- d) All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
- e) 24V - 5A - 3 pin industrial socket outlets shall be provided. Minimum four (4) on the bridge along the walk way on both sides of full length platforms.
- f) One (1) portable 40 W hand lamp with min. half span length flexible cable for inspection of crane components.

3.4.13 Grounding

3.4.13.1 The crane structure, motor frame and all other electrical equipment/s shall be grounded in accordance with the Indian Electricity Rules. The connections from Crane Bridge to 4th conductor of down shop leads shall be by means of current collector.

3.4.13.2 The equipment fed by flexible cables shall be grounded by means of fourth core provided in the flexible trailing cable. Pendent push button station shall be earthed Separately.

3.4.14 Red warning light 3 Nos. shall be provided at both ends of the gantry girder to indicate the aliveness of DSL.

3.4.15 Wiring Systems

- a) All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion. All cabling shall be carried out using XLPE insulated fire resistant (FRLS) cables & wiring by Heat resistance PVC wires with stranded conductor



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- b) All wiring shall be done with 1100V grade fire resistance PVC insulated wire in conduits or by 1100V grade PVCA PVC cables with extruded inner sheath.
- c) For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.
- d) Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.
- e) Each motor shall be wired independently. Power and control wiring shall be effectively separated.
- f) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.
- g) All wire termination to the panels shall be provided with clamp type connections screw. Screw Type terminals with screw directly impinging on conductors are not acceptable.
- h) Multi way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring.
- i) Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points
- j) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.



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1.0 General

- a) This part of the specification describes the general requirements for the Variable Voltage Variable frequency Drives, herein referred to as AC Drives, for use with standard IEC design AC squirrel cage induction motors. The nominal values, the standard documents and the drive's minimum performance are defined in this part. **To avoid any mismatch between the motor and its control equipment, the AC Drive shall be capable of auto adjustment by automatic measurement of the motor parameters with/without motor rotation.**

- b) Inverter construction and related devices:

Construction shall be divided in 3 broad sections. Section one converts AC Supply into DC supply. Section 2 Converts and controls DC supply into AC Supply with regulation. Section 3 shall be used for braking action of the motor and Dynamic Braking Unit (DBU) can be inbuilt or external depending upon the drive capacity. VVVF can be used in open loop (without external speed feed back) like in Travel motions or close loop (With external speed feed back) like in Hoist motions. Chokes on input supply side are generally used in crane application for power regulation. Like all other electronic / electric devices VVVF drives are also protected by MCB / MCCB / Fuses. VVVF drives are sensitive to temperature and hence drive internal as well as external cooling fans are provided.

- c) Programming of VVVF Drives.

VVVF drives shall be programmable and for that purpose detachable digital Operator display unit shall be supplied along with the VVVF having required buttons for setting the user constant, functions etc. The VVVF drive is to be fine tuned by matching the motor parameters and setting the parameters on full load.

- d) VVVF drives shall be connected with power supply and these drives generate their own low voltage control supply. Potential free contacts shall be connected to this control supply and few programmable control terminals. Starting / stopping / set speeds operations of VVVF drive shall be achieved by above control connection.
- e) VVVF shall give smooth control over acceleration and deceleration making the motion jerk free and using Variable voltage variable frequency limits the inrush current to the squirrel cage motors. VVVF provides controlled torque to the motor due to which crane operations are jerk free.

1.1 Experience

The Frequency Converter Manufacturer shall have adequate experience in frequency converter manufacturing and have adequate business volume in order to provide credibility in his commitments and a capability of long term support.

1.2 Local support



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The Supplier shall have a permanent representative office with a trained and skilled support staff, in the country where the goods are delivered, in order to prove his commitment for local support and to provide a channel for communication.

The engineers employed by the Supplier's regional office shall be certified by the Manufacturer and provide start-up service including physical inspection of the drive, connected wiring and final adjustments, to ensure that the AC Drive meets the required performance.

The Supplier shall be able to give basic drives training to the Customer's engineers, preferably on the site. The training shall, as a minimum, include system concepts and basic troubleshooting.

2.0 Basic requirements for the AC Drives

2.1 General requirements

The AC Drive shall comply with National(country of origin) and International standards and the recommendations for electrical industrial control devices (IEC, EN, UL, NFC, VDE).

The AC Drive shall be of the most modern design, yet user friendly and be simple to install, commission and maintain. The AC Drive shall be able to start and control the speed of a standard squirrel cage induction AC motor. The AC Drives shall be : CE marked, conforming to European Low Voltage (73/23/CEE and 93/68/CEE) and EMC (89/336/CEE) Directives, UL/CSA marked according to UL 508C.

The AC Drives have to be built to comply with the IEC standards.

The AC Drive shall be a digitally controlled drive, using, at least, the Pulse Width Modulation (PWM) with flux vector control open loop(for travel) and closed loop(for hoist). It shall have diodes / thyristors in rectifier and IGBT's in the inverter section in their entire power range, and it shall have the following minimum specifications.

Rated Input Voltages	380V -15% 480V +10%, three-phase
Rated Input Frequency	50Hz +/- 5%
Output Voltage	0 – Input voltage, three-phase
Output Frequency Range	0 to 400 Hz
Acceleration / Deceleration Time	0.01 – 999s, adjustable, linear, with S, with U or customised shapes
Overload capability (Constant Torque)	150% of nominal current for 1min.
Operating ambient Temperature	-10°C up to 50°C(shall be derated suitably)



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	if not rated at 50°C)
Storage ambient Temperature	-25°C up to 70 °C
Maximum operating altitude	1000 m without de-rating, 1000...3000 (shall be de-rated suitably)
Max. Relative Humidity	95 %, without condensation and dripping water.
Main Protections	Over current, short circuit between phase, short circuit between phase and ground, input phase loss, output phase loss, motor overload, over speed, over voltage, under voltage, drive over temperature

The AC Drive shall be able to give a 100 % output current continuously in the above specified conditions. In order to ensure that the drive can provide the required output current in the specified ambient conditions, the Manufacturer shall inform the required derating, if the ambient temperature given in the project-specific specification is higher than rated ambient of the drive or if the installation altitude is more than 1000 m above the sea level. The de-rating factor shall be specified so that neither the lifetime of the AC Drive nor the unit's performance, overload capability included, nor the reliability of the AC Drive shall suffer.

The VVVF drives shall have all necessary protections i.e input phase loss, earth fault, over voltage, output short circuit, load loss , input transient protection, overload etc

Suitable encoder shall be provided for all motions.

3.0 User interface

3.1 General

The user interface shall be identical throughout the power range and type to avoid confusion amongst the users and need for training in several different units.

3.2 Inputs and outputs

A. At least, the following standard Inputs and Outputs shall be provided, to be used in interface with the control system:

Analogue Inputs	:	1 x Programmable differential voltage input $\pm 10V$, 1 x Programmable current input 0(4) - 20mA 1 x Programmable voltage input 0 – 10V
Analogue Output	:	1 x Programmable analogue outputs 0(4) - 20mA or 0 – 10V
Logic inputs	:	6 x Programmable logic Inputs isolated from the mains



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Relay Outputs : 2 x Programmable Digital outputs with a changeover dry contact

All the control terminals shall be clearly marked.

B. At least, it shall be possible to assigned the following functions to the I/Os:

Analogue input	Analogue outputs
Speed reference Summing reference	Motor current Motor frequency Motor torque Motor power
Logic input	Relay or logic outputs (open collector)
Forward Reverse Jog Preset speeds Reference switching Ramp switching Parameter sets selection Fast stop Freewheel stop + speed - speed External fault	Ready Drive running High speed attained Drive fault Frequency threshold attained Motor thermal state attained Torque or current limitation attained Brake control

3.4 Programming terminal

- A. The AC drive shall have a keypad /display for programming and controlling purposes. An IP54 or IP65 remote mounting shall be possible at a distance of 10m.
- B. Password protection shall be provided to avoid unauthorized tampering with the set parameters.
- C. The programming terminal shall be able to display the commercial reference of the AC drive and of the options, the software version, the serial number
- D. Direct keypad entry shall be provided to observe the following actual parameters. Any one of the following parameters or actual values shall be selected to be always displayed:-
- i) Input Voltage
 - ii) Input Frequency
 - iii) Output Frequency
 - iv) Output Power
 - v) Output Current

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vi) Motor Speed

The following parameters shall always be displayed during normal operation:-

i) Drive Status

The following drive control functions at least shall be available from the keypad:-

i) Run

ii) Stop

iii) Local / Remote selection.

iv) Forward/Reverse (if function enabled)

v) Accelerate

vi) Decelerate

vii) Parameter setting

3.5 Application programming

The AC Drive shall be designed for both simple and the most complicated applications, yet it shall be user friendly. It shall be possible to reset the parameter settings back to the original factory settings through the keypad.

3.6 PC Tools

The AC Drive Supplier shall have a Windows based PC software available for monitoring and controlling the AC Drives, and the software shall be offered as an option. The software shall be supplied with the necessary hardware and a provision for connecting a PC with the AC Drives. It shall be possible to set and modify parameters, control the drive, read actual values and make trend analysis using the software.

4.0 Software features

A. Restart

In the event of a fault trip due to over voltage, over current or loss of analogue signal, the AC DRIVE shall be programmable to attempt an automatic restart. For safety reasons, the maximum number of attempts shall be within a selectable time. If the fault does not clear after the attempts, the drive shall lock out.

B. Brake logic control

The AC Drive shall have a built-in function to control a mechanical brake in order to move the load in a smooth and safe way. The brake logic control shall be adapted to the different movements, hoisting, travel, and orientation.

5.0 Preferred makes:

As per attached sub-vendor list

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SECTION – II

Site Storage and Preservation Guidelines

CONTENT

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- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
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 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

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

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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



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

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





iii Open storage (O)

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

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

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



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

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

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

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

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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

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

5. CONCLUSION

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

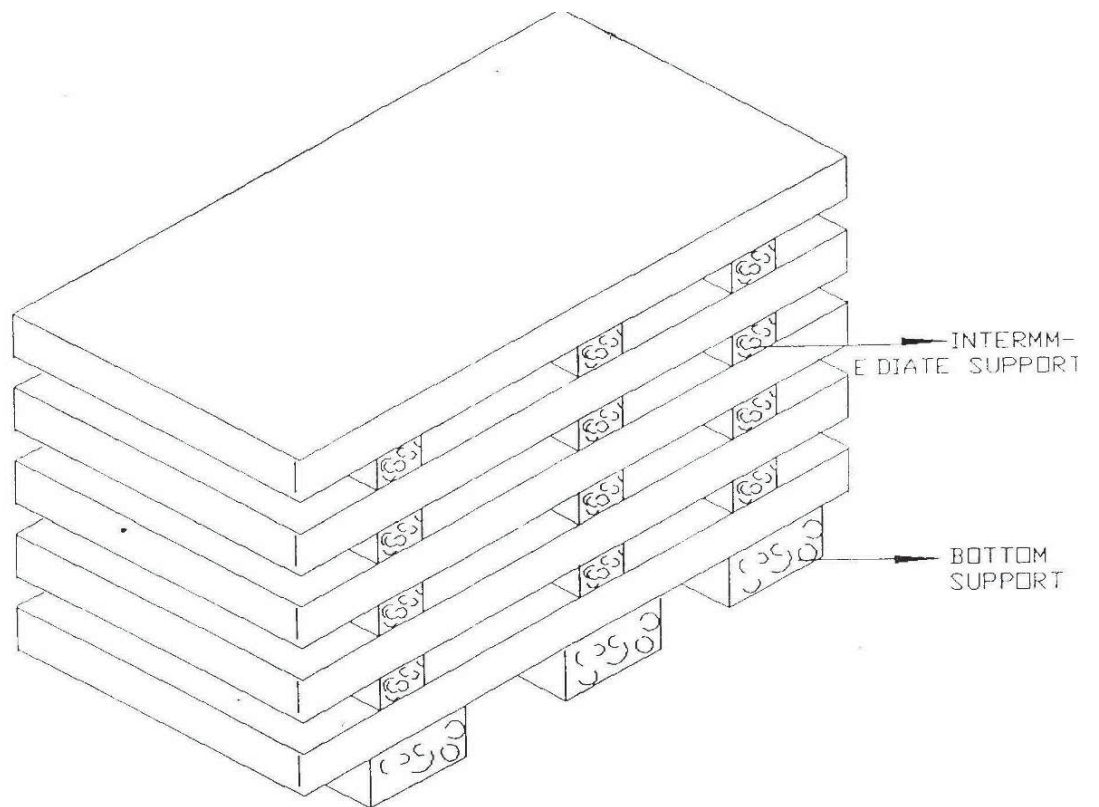


Figure – 1 – PLATE STACKING ARRANGEMENT

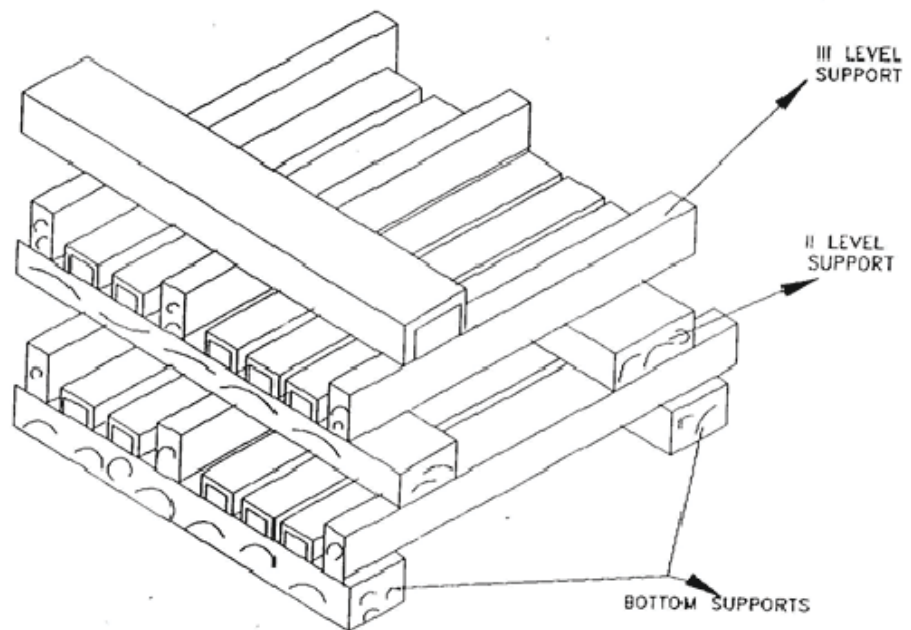


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

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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			
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 2 OF 111

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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			
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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.		
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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.			
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 6 OF 111

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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.		
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 7 OF 111

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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 8.05.01 8.05.02 8.05.03	Engineering Co-ordination Procedure 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 : _____ All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations. 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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	Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.			
11.00.00	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 performed 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 co-relation 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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	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.			
22.25.00	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.			
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25.00.00 25.01.00 25.02.00 25.03.00 25.04.00 25.05.00 25.06.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES 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. 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. 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. 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. 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. 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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	b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation. e) Master slave implementation with different slave combination. f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable. (ii) HMI Functions: a) LVS Annunciation. b) Graphics. c) HSR d) Logs/Reports. e) Calculations (Basic & Performance Calculations).			
25.12.02	The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings. After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.			
25.12.03	During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.			
26.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES			
26.01.00	(a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-			
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26.01.00	commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications. (b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant. (c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness. (d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period. (e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer. (f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable. Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain : (1.) Biodata including experience of the Commissioning Engineers. (2.) Role and responsibilities of the Commissioning Organisation members. (3.) Expected duration of posting of the above Commissioning Engineers at site.		
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26.02.00	Initial Operation (a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests. (b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours. The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility. The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect. (c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation. (d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.		
26.03.00	Guarantee Tests a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up and initial operation shall make the unit ready to		
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	conduct such test. Such test will be commenced, within a period of three (3) months after the successful completion of Initial Operations. Any extension of time beyond the above three (3) months shall be mutually agreed upon. b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee. c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points. d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost. e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.		
27.00.00	TAKING OVER Upon successful completion of Initial Operations and all the tests, other than Guarantee Tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.		
28.00.00	TRAINING OF EMPLOYER'S PERSONNEL		
28.01.00	The scope of service under training of Employer's engineers shall include a training module covering the areas of Operation & Maintenance. Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer: (a) Training for Steam Generator & ESP Equipment, TG & Auxiliaries and related equipments. (b) Training for Electric Systems including VFD and Electric power supply system.		
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28.03.00	(c) Training for other SG/TG related C&I systems/equipments including training on Flame Monitoring System, Furnace and Flame Viewing System , Turbine Supervisory System (TSS) including vibration analyzer, vibration monitoring system axial shift, eccentricity measurements etc. for Main Turbine, BFP Turbine etc. Burner management study, control loop study, misc system for SG C&I, EHTC, Turbine stress control system, Turbine protection system, ATRS, instrumentation etc. (d) Training for special packages for various PC based systems specified elsewhere in Part-B of Technical Specification, Section-VI. (e) Training for various C&I systems/equipment supplied includes the following: i) DDCMIS - Human Machine Interface – Hardware & Operating System ii) DDCMIS-Human Machine Interface System Engineering & Application Software. iii) DDCMIS – Control System Hardware and Control system Application Software. iv) DDCMIS – Operator Training : Use of the system at Works + at site. v) DDCMIS – Specialized Network security. (f) Training for power cycle piping/critical piping. (g) Training for UPS systems Annunciation system, SWAS, PA system, flue gas analyzers, CCTV and 24 VDC system. (h) Training for numerical relays & networking systems supplied under MV & LT switchgear system. (i) Training for Simulator System (j) Details of training modules for SG, TG, Electrical, C&I systems and Simulator System are given at Annexure – VII, VIII, IX, X, XI & XII. The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval.			
	The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering a training module as indicated in Annexure – VII, VIII, IX, X, XI & XII . This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product deign software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of			
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	problems which may be encountered in fabrication, manufacturing erection, welding etc.			
28.04.00	Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.			
28.05.00	Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above [i.e. Annexure – VII, VIII, IX, X, XI & XII for O&M and Engineering] is indicative only. Employer reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.			
28.06.00	Exact details, extent of training and the training schedule shall be finalized based on the Bidder's proposal within two (2) months from placement of award.			
28.07.00	In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.			
28.08.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.			
	Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.			
29.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION			
	In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:			
	i) Working platforms should be fenced and shall have means of access.			
	ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.			
30.00.00	NOISE LEVEL			
	The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for			
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 44 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	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 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.		
33.01.00	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)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS PAGE 45 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																		
	All scales and charts shall be calibrated and printed in Metric Units as follows: <table><tr><td>1. Temperature</td><td>- Degree centigrade (deg C)</td></tr><tr><td>2. Pressure</td><td>- 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.</td></tr><tr><td>3. Draught</td><td>- Millimetres of water column (mm wc).</td></tr><tr><td>4. Vacuum</td><td>- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).</td></tr><tr><td>5. Flow (Gas)</td><td>- Tonnes/ hour</td></tr><tr><td>6. Flow (Steam)</td><td>- Tonnes/ hour</td></tr><tr><td>7. Flow (Liquid)</td><td>- Tonnes / hour</td></tr><tr><td>8. Flow base</td><td>- 760 mm Hg. 15 deg.C</td></tr><tr><td>9. Density</td><td>- Grams per cubic centimetre.</td></tr></table>			1. Temperature	- Degree centigrade (deg C)	2. Pressure	- Kilograms per square centimetre (Kg/cm ²). 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.	3. Draught	- Millimetres of water column (mm wc).	4. Vacuum	- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).	5. Flow (Gas)	- Tonnes/ hour	6. Flow (Steam)	- Tonnes/ hour	7. Flow (Liquid)	- Tonnes / hour	8. Flow base	- 760 mm Hg. 15 deg.C	9. Density	- Grams per cubic centimetre.
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7. Flow (Liquid)	- Tonnes / hour																				
8. Flow base	- 760 mm Hg. 15 deg.C																				
9. Density	- 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).																				
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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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		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
38.01.00 39.00.00	documentation requirements for C&I systems shall be as stipulated under C&I "Technical Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification. The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage. Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer. MAINTENANCE MANUALS OF ELECTRONIC MODULES The Contractor shall have to furnish two(2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further, the contractor shall furnish a set of operating manuals which should include block diagrams, make, model/type, details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules.		
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 48 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		(ISO/R-65-1958) (BS 1387 : 1957) IS:1239 Part-II Mild steel tubulars and other wrought steel pipe fittings 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. IS:2254-1970 Dimensions of vertical shaft motor for pumps IS:2266 Steel wire ropes for general engineering purposes IS:2312 Propellant type Ventilation fans IS:2365 Steel wire suspension ropes for lifts and hoists IS:3346 Method for the determination of thermal	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965 API Standards 5L IEC Pub 72-1 part I NEMA Pub MG 1 1954 BS :302 : 1968 BS : 1957 DIN 52612 (Deutscher Normenausschuss)	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
		conductivity of thermal insulation materials (two slab guarded hot plate method) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963 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 Diameter) IS:3677 Unbonded rock and slag wool for thermal insulation IS:3815 Point hook with shank for general engineering purposes BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS) IS:3895 Specification for monocrystalline 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 monocrystalline rectifier assembly	
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 51 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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 exhauster (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.		
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 53 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	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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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	(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		एनटीपीसी NTPC	
	IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.		
	IS: 516	Method of test for strength of concrete.		
	IS: 650	Specification for standard sand for testing of cement.		
	IS: 1199	Methods of sampling and analysis of concrete.		
	IS: 1791	General requirements for batch type concrete mixers.		
	IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).		
	IS: 2204	Code of practice for construction of reinforced concrete shell roof.		
	IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.		
	IS: 2438	Specification for roller pan mixer.		
	IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.		
	IS: 2505	General requirements for concrete vibrators, immersion type.		
	IS: 2506	General requirements for concrete vibrators, screed board type.		
	IS: 2514	Specification for concrete vibrating tables.		
	IS: 2645	Specification for Integral cement water proofing compounds.		
	IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)		
	IS: 2750	Specification for Steel scaffolding.		
	IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.		
	IS: 3025	Methods of sampling and test waste water.		
	IS: 3366	Specification for Pan vibrators.		
	IS: 3370	Code of practice for concrete structures for the storage of		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(Part I to IV) IS: 3414 IS: 3550 IS: 3558 concrete. IS: 4014 (Parts I & II) IS: 4326 of buildings. IS: 4461 IS: 4656 IS: 4925 IS: 4990 IS: 4995 (Parts I & II) IS: 5256 IS: 5525 concrete work. IS: 5624 IS: 6461 IS: 6494 IS: 6509 IS: 7861 IS: 9012 IS: 9103	liquids. Code of practice for design and installation of joints in buildings. Methods of test for routine control for water used in industry. Code of practice for use of immersion vibrators for consolidating concrete. Code of practice for steel tubular scaffolding. Code of practice for earthquake resistant design and construction of buildings. Code of practice for joints in surface hydro-electric power stations. Specification for form vibrators for concrete. Specification for batching and mixing plant. Specification for plywood for concrete shuttering work. Criteria for design of reinforced concrete bins for the storage of granular and powdery materials. Code or practice for sealing joints in concrete lining on canals. Recommendations for detailing of reinforcement in reinforced concrete work. Specification for foundation bolts. Glossary of terms relating to cement concrete. Code of practice for water proofing of underground water reservoirs and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. (Parts I & II) Recommended practice for shot concreting. Specification for admixtures for concrete.		
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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.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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 		
	IS: 1608 IS: 1599 IS : 228 IS : 2595 IS : 1182 IS : 3664 IS : 3613 IS : 3658 IS : 5334 Plastering and Allied Works IS : 1635 IS : 1661 IS : 2333 IS : 2402 IS : 2547 IS : 3150 Acid and Alkali Resistant Lining IS : 158 IS : 412	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. Method of Bend Tests for Steel products other than sheet, strip, wire and tube Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. Code of Practice for Radio graphic testing. Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. Code of practice for Ultra sonic Testing by pulse echo method. Acceptance tests for wire flux combination for submerged Arc Welding. Code of practice for Liquid penetrant Flaw Detection. Code of practice for Magnetic Particle Flaw Detection of Welds. Code of practice for field slaking of Building lime and preparation of putty. Application of cement and cement lime plaster finishes. Plaster-of-paris. Code of practice for external rendered finishes. Gypsum building plaster. Hexagonal wire netting for general purpose. Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting. 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			एनटीपीसी NTPC
	IS : 4441 IS : 4443 IS : 4456 IS : 4457 IS : 4832 IS : 4860 IS : 9510	Code of practice for use of silicate type chemical resistant mortars. Code of practice for use of resin type chemical resistant mortars. Method of test for chemical resistant tiles. (Part I & II) Specification for ceramic unglazed vitreous acid resistant tiles. Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type Specification for acid resistant bricks. Specification for bitumasitc, Acid resisting grade. Water Supply, Drainage and Sanitation IS : 458 IS : 554 IS : 651 IS : 774 IS : 775 IS : 778 IS : 781 IS : 782 IS : 783	Code of practice for use of silicate type chemical resistant mortars. Code of practice for use of resin type chemical resistant mortars. Method of test for chemical resistant tiles. (Part I & II) Specification for ceramic unglazed vitreous acid resistant tiles. Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type Specification for acid resistant bricks. Specification for bitumasitc, Acid resisting grade. Water Supply, Drainage and Sanitation Specification for concrete pipes. Dimensions for pipe threads, where pressure tight joints are made on thread. Specification for salt glazed stoneware pipes. Flushing cisterns for water closets and urinals. Cast iron brackets and supports for wash basins and sinks. Copper alloy gate, globe and check valves for water works purposes. Cast copper alloy screw down bib taps and stop valves for water services. Caulking lead. 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	Basic requirements for water supply, drainage and sanitation.	
	IS : 1230	Cast iron rain water pipes and fittings.	
	IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.	
	IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.	
	IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.	
	IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.	
	IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.	
	IS : 1726	Cast iron manhole covers and frames.	
	IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.	
	IS : 1742	Code of practice for building drainage.	
	IS : 1795	Pillar taps for water supply purposes.	
	IS : 1879	Malleable cast iron pipe fittings.	
	IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.	
	IS : 2065	Code of practice for water supply in building.	
	IS : 2326	Automatic flushing cisterns for urinals.	
	IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.	
	IS : 2501	Copper tubes for general engineering purposes.	
	IS : 2548	Plastic seat and cover for water-closets.	
	IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).	
	IS : 2963	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
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS : 3114	Code of practice for laying of cast iron pipes.		
	IS : 3311	Waste plug and its accessories for sinks and wash basins.		
	IS : 3438	Silvered glass mirrors for general purposes.		
	IS : 3486	Cast iron spigot and socket drain pipes.		
	IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).		
	IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.		
	IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.		
	IS : 4127	Code of practice for laying of glazed stone-ware pipes.		
	IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.		
	IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.		
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.		
	IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.		
	IS : 5822	Code of practice for laying of welded steel pipes for water supply.		
	IS : 5961	Cast iron grating for drainage purpose.		
	IS : 7740	Code of practice for road gullies.		
	IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.		
	IS : 8934	Cast copper alloy fancy pillar taps for water services.		
	IS : 9762	Polyethylene floats for ball valves.		
	IS : 10446	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 IS : 12592 IS : 12701 SP: 35 - Doors, Windows and Allied Works IS : 204 Part-I Part-II IS : 208 IS : 281 IS : 362 IS : 420 IS : 1003 Part-I door IS : 1038 IS : 1081 IS : 1341 IS : 1361 IS : 1823 IS : 1868 IS : 2202 (Part-II)	Industrial emergency showers, eye and face fountains and combination units. Specification for precast concrete manhole covers and frames. Rotational moulded polyethylene water storage tanks. Hand book on water supply and drainage. Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated. Tower Bolts Ferrous metals. Nonferrous metals. Door Handles. Mild steel sliding door bolts for use with padlocks. Parliament Hinges. Specification for putty, for use on metal frames. Specification for timber panelled and glazed shutters- (Part-I) shutters. Steel doors, windows and ventilators. Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators. Steel butt hinges. Steel windows for industrial buildings. Floor door stoppers. Anodic coatings on Aluminium and its alloys. 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	एनटीपीसी NTPC		
	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 		
	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			एनटीपीसी NTPC
	IS:8009 Part-I Part-II IS:12070 DIN:4024 VDI:2056 VDI:2060 Stop Log and Trash Rack IS:4622 IS:5620 IS:11388 IS:11855 Roads IRC:5 IRC:14 IRC:16 IRC:19 IRC:21 IRC:34 IRC:36 IRC:37 IRC:56 IRC:73 IRC:86	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads. Shallow foundations. Deep foundations. Code of practice for design and construction of shallow foundations on rocks. Flexible supporting structures for machines with rotating machines. Criteria for assessing mechanical vibrations of machines. Criteria for assessing rotating imbalances in machines. Recommendations for fixed - wheel gates structural design. Recommendations for structural design criteria for low head slide gates. Recommendations for design of trash rack for intakes. General requirements for rubber seals for hydraulic gates. Standard specifications and Code of practice for road bridges, section-I general Features of Design. Recommended practice of 2cm thick bitumen and tar carpets. Specification for priming of base course with bituminous primers. Standard specifications and code of practice for water bound macadam. Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced). Recommendations for road construction in waterlogged areas. Recommended practice for the construction of earth embankments for road works. Guidelines for the Design of flexible pavements. Recommended practice for treatment of embankment slopes for erosion control. Geometric design standards for rural (non-urban) highways. 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 PAGE 69 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	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 - Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). - Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. - Temperature measurement by electrical Resistance thermometers - IS:2806. - Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements - Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). - Electronic transmitters BS:6447. - Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. - 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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Flow Measurements Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II. Measurement of fluid flow in closed conduits - BS-1042. Electronic Measuring Instrument & Control Hardware/ Software - Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319. - Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. - Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975. - Dynamic response testing of process control instrumentation ISA - S 26 (1968). - Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472. - Printed circuit boards - IPC TM - 650, IEC 326 C. - General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. - Edge socket connectors - IEC 130-11. - Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. - Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). - Direct acting electrical indicating instrument - IS:1248 - 1968 (R). - Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. - Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. - Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. - Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.		
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 72 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985. 17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985. 18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984. 19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983. 20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978. 21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987. 22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984. Instrument Switches and Contact 1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000. 2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600. Enclosures 1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13). 2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972). 3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962. Apparatus, enclosures and installation practices in hazardous area 1. Classification of hazardous area - NFPA 70 - 1984, Article 500. 2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973. 3. Intrinsically safe apparatus - NFPA 493 1978. 4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982. 5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Sampling System 1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316. 2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977. 3. Water and steam in power cycle - ASME PTC 19.11. 4. Standard methods of sampling system - ASTM D 1066-99. Annunciators 1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979. 2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472 3. Damp heat cycling test - IS:2106 4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78 Protections 1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989. 2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973. 3. Turbine water damage prevention - ASME TDP-1-1980. 4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991. UPS System 1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973. 2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983. 3. Surge withstand capability test - ANSI C 37.90 1 -1989. 4. Performance testing of UPS - IEC 146. 5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.		
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 74 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985. 7. Printed Circuit Board - IPC TM 650, IEC 326C. 8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973. Control Valves 1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985. 2. Face to face dimensions of control valves - ANSI B 16.00 - 1973. 3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2). 4. Codes for pressure piping - ANSI B 31.1 5. Control Valve leak class - ISA RP 39.6 Process Connection & Piping 1. Codes for pressure piping "power piping" - ANSI B 31.1. 2. Seamless carbon steel pipe ASTM - A - 106. 3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182. 4. Material for socket welded fittings - ASTM - A - 105. 5. Seamless ferritic alloy steep pipe - ASTM - A - 335. 6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234. 7. Composition bronze of ounce metal castings - ASTM - B - 62. 8. Seamless Copper tube, bright annealed - ASTM - B - 168. 9. Seamless copper tube - ASTM - B - 75. 10. Dimension of fittings - ANSI - B - 16.11. 11. Valves flanged and butt welding ends - ANSI - B - 16.34. Instrument Tubing 1. Seamless carbon steel pipe - ASTM - A 106. 2. Material of socketweld fittings - ASTM - A105. 3. Dimensions of fittings - ANSI - B - 16.11.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1. Cables 1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992. 2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815. 3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorough 2/83. 4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6). 5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977. 6. Rules for Testing insulated cables and flexible cables : VVDE - 0472 7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980) 8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81. 9. Oxygen index and temperature index test - ASTM D - 2863. 10. Smoke density measurement test - ASTM D - 2843. 11. Acid gas generation test - IEC - 754 - 1. 12. Swedish Chimney test - SEN - 4241475 (F3). 13. Teflon (FEP) insulation & sheath test - ASTM D - 2116. 14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784. 15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I). Cable Trays, Conduits 1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984. 2. -do- Test Standards. NEMA VE-1-1979. 3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTM A - 386-78.		
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 76 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Public Address System - Specifications for loud speakers - IS:7741 (Part-I, II and III) - Code of safety requirement for electric mains operated audio amplifiers - IS:1301 - Specification for Public Address Amplifiers - IS:10426. - Code of practice for outdoor installation of PA system - IS:1982. - Code of practice for installation for indoor amplifying and sound distribution system - IS:1881. - Basic environmental testing procedures for electronic and electrical items - IS:9000. - Characteristics and methods of measurements for sound system equipment - IS:9302 - Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732 - Rigid steel conduits for electric wiring - IS:9537 (Part-I and II) - Fittings for rigid steel conduits for electrical wiring - IS:2667 - Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147. Vibration Monitoring System - API 670 - 1994 - BS : 4675 Part-2		
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SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT :	
			ITEM :		QP NO.:		PACKAGE :	
			SUB-SYSTEM:		REV. NO.:		CONTRACT NO.:	
					PAGE: OF		MAIN-SUPPLIER:	

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.	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.	
				FOR NTPC USE			
		1/1		ENG. DIV./QA&I			

EPC PACKAGE FOR 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

ANNEXURE-III

		Project Package Supplier Contractor No.	Stage ::	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL SUB-SYSTEM :						DOC. NO.:
										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.”
Q/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.

	Project : Package : Contractor : Contractor No. :		Stage ::		STATUS OF ITEM REQUIRING QP & SUB-SUPPLIER APPROVAL				DOC. NO. : REV. NO. : DATE : PAGE : OF			
	S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commit Appl.	Status Code C/I/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
FORMAT 1/1 Engg. Div. / QA&I												

		Project Contractor : Contractor No. : System :		Stage :		FIELD WELDING SCHEDULE (To be raised by the contractor) Welding Code:					DOC. NO.: REV. NO.: DATE : PAGE : OF			
Sl. No.	DRG No. for Weld Location and Identification mark	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														

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)					
	S.No	Description of Drgs/Docs	No Prints	of ROMs/DVDs/Portable Hard Disk	CD	
	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		
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 ROMs/DVDs/Portable Hard Disk CD	
	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	

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training		Training at Manufacturer works		Training at Operating Plants		Total no of days
					Content of training	Location of training	No of days	Content of training	Location of training	No of days	
1.0 Steam Generator & Auxiliaries (Mechanical)											
1.1	Boiler	General familiarisation of supplied boiler	6 months	3	a) General Design, equipment, system and parameter familiarisation of supplied boiler i.e. features, design, operating parameters etc. b) General Layout of boiler & ESP area, basic layout selection criteria, arrangement of pressure part, flue gas duct, coal pipe, bunker, valves, dampers, equipments, piping testies etc.	Design office of the QSGM	3	1. Manufacturing of pressure parts 2. Welding processes 3. Testing Facilities 4. Product Development in process/ progress 5. Future plan for Technology induction 6. R&D work in progress	Manufacturer's works where the boilers of the subject project is being manufactured.	4	27
1.2	Boiler	Pressure parts	6 months	3	Basic theory/ concept, calculation with illustrative example, Design application, arrangement of following: 1. Thermal design and hydraulic circulation balance 2. Strength Calculation 3. Pressure Part arrangement, coil orientation and basis. 4. Tube metal temperature calculation, criteria for location of thermocouple. 5. Selection Criteria for soot blower (i.e. location, nos. etc.)	Design office of the QSGM	3	The paint visit should include the following: a) Boiler each floor /level walk through b) Visit to all the boiler auxiliaries location. c) Visit to BOP area. 2. Collection of Performance data of the plant	Operating plants in any country including India where same make with similar capacity boilers are under operation.	2	9
1.3	Boiler	Performance	6 months	3	Basic concept, calculation of performance data with illustrative example (such as Heat Duty, boiler efficiency, predicted performance, NOX calculation, furnace sizing etc.) of offered boiler and its application to boiler design.	Design office of the QSGM	4				12
1.4	Boiler	Boiler System	6 months	3	a) Basic concept, Sizing calculation of following systems with illustrative examples alongwith details of criteria affecting the sizing calculation : 1. Air & Gas System (duct sizing, air & gas weight calculation, damper & gates sizing etc.) 2. Start up system (Circulation calculation, sizing and input data for SGWC pump etc.) 3. Fuel firing/ Combustion system (Sizing calculation of Pulveriser, feeders, burners, PA & Seal Air Fans etc.) 4. Fuel Oil firing system (Sizing calculation of HFO/ LFO pump, heater, strainers, pressure drop calculation etc.) 5. Draft System (sizing calculation of FD & ID Fans etc.) b) Impact of the above sizing calculation on the overall boiler design/ performance.	Design office of the QSGM	6				18

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training		Training at Manufacturer works		Training at Operating Plants			Total no. of days
					Content of training	Location of training	No of days	Content of training	Location of training	No of days	No of days	
					c) Selection/ optimisation of above system from techno-economics point of view such as start up system: selection criteria for wet mode upto 30% or 40% BMCR flow etc. d) Selection/ Optimisation of various auxiliaries/ equipments covered under above systems from techno-economics point of view. Such as type & no. of fans (axial- single/ double stage), APH (Tri sector/ bisector APH), Mills etc.	Design office of the QSGM						
1.5	Boiler	General familiarisation of supplied SCR System	6 months	3	General Design, equipment, system and parameter familiarisation of supplied SCR system i.e. features, design, operating parameters etc.	Design office of the SCR System supplier	2	1. Manufacturing of Catalyst 2. Testing Facilities for Catalyst 3. Product Development In process/ progress 4. Future plan for Technology induction 5. R&D work in progress	Manufacturer's works where the SCR Catalysts of the subject project is being manufactured.	1	Operating plants in any country including India where same make with similar capacity SCR system are under operation.	12
1.6	Boiler	Ammonia Dosing System for SCR System	6 months	3	1. Basic theory/ concept. 2. Selection & Sizing calculation of Ammonia dosing system with illustrative examples for Compressors, Storage Tanks, Pumps, vaporisers, Air-NH3 mixers, Glycol-water heaters etc. 3. Familiarisation of Safety measures to be ensured for Storage & Using Ammonia. 4. Selection & Sizing Criteria for Safety equipments to be ensured as per Indian Regulations for Ammonia Handling	Design office of the SCR System supplier	2					6
1.7	Boiler	Catalyst Modules for SCR System	6 months	3	1. Basic theory/ concept. 2. Selection criteria of catalyst 3. Sizing calculation of catalyst & calculation of performance data (i.e. Activity etc.) with illustrative examples	Design office of the SCR System supplier	1					3
1.8	Boiler	FGD System	6 months	3	1. Mass balance, Design, selection and sizing calculations of FGD 2. Training on factors affecting sizing/ efficiency of FGD system, equipments & auxiliaries 3. Materials for FGD & selection 4. Basic concepts, Design and sizing calculations on slurry systems including piping, valves, etc. 5. Layout & model of FGD area, cable & piping trestles etc. 6. Erection strategies, erection procedures. 7. Performance as per applicable code and demonstration tests.	Design office of the FGD System supplier	5	1. Manufacturing process of Absorber and other equipment 2. Welding process 3. Testing facilities 4. Product development In process 5. Future plan for technology induction 6. R&D work in progress.	Manufacturer's works where FGD system equipment of the subject project are being manufactured.	2	Operating plants in any country including India where same type with similar capacity FGD system are under operation.	30
1.9	Boiler	Buck stay & structure	6 months	3	Basic theory, calculations with illustrative example & Design application of Buck stay & structure design	Design office of the QSGM	2					6
1.10	Boiler	Erection & PG Test	6 months	3	Erection strategies, erection procedures Performance and demonstration tests.	NTPC PMI	2					6

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training		Training at Manufacturer works		Training at Operating Plants			Total no. of days
					Content of training	Location of training	No of days	Content of training	Location of training	Content of training	No of days	
1.11	Boiler	Review & discussion after Plant Visit	6 months	3	1. Analysis and review of collected performance data of the plant visited. 2. Co-relation of the operating plant design, parameter visited wrt to boiler supplied under contract. 3. O&M feedback of the plant 5. Failure analysis: Atleast elaborate case study of one major failure	NTPC PMI	2					6
1.12	Boiler Auxiliaries	Equipments /Auxiliaries	6 months	2	Selection criteria of auxiliaries (Type, Model, Nos. etc.) based on input data, design features, working & importance of	NTPC PMI		Manufacturer's works where the equipment of the subject project is being manufactured.				
				2	1. Coal pulveriser		2	Visit to manufacture Works			1	6
				2	2. Fans (ID, FD, PA & Seal Air Fans)		2	Visit to manufacture Works			1	6
				2	3. Air-preheater		2	Visit to manufacture Works			1	6
				2	4. Soot Blowers		1					2
				2	5. Dampers & Gates		1					2
				2	6. Valves including safety valves		2					4
				2	7. Feeder		1					2
				2	8. Burner		1					2
				2	9. SG WC pump		1					2
				2	10. Fuel Oil (HFO & LFO) Pumps, Heaters, Strainers etc.		2					4
				2	11. Any other equipment/ auxiliaries not specified above		1					2
Steam Generator & Auxiliaries (Mechanical) TOTAL Mandays							128				27	173

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training		Training at Manufacturer works		Training at Operating Plants		Total no. of days
					Content of training	Location of training	No of days	Content of training	Location of training	No of days	

2.0 Steam Generator & Auxiliaries (Power Cycle Piping)											
2.1	Power Cycle Piping	Stress analysis of piping	6months	4	1. Critical pipe sizing including pressure drop calculation 2. Static analysis of critical piping system 3. Dynamic analysis (safety valve blowing, wind, seismic & steam hammer) of critical piping 4. Familiarisation of Hanger engineering 5. Familiarisation of piping vibration analysis & norms	Design office of the QSGM	2	1. Familiarisation of manufacturing/ fabrication/testing of critical piping (including welding techniques & heat treatment methods employed) and norms 2. Familiarisation of variable & constant load hanger setting & snubber setting	Manufacturer's works	2	20
2.2	Power Cycle Piping			4		Design office of the QSGM	2		Manufacturer's works	1	12
2.3	Power Cycle Piping			4		Design office of the QSGM	2				8
2.4	Power Cycle Piping			4		Design office of the QSGM	1				4
2.5	Power Cycle Piping			4		Design office of the QSGM	1				4
POWER CYCLE PIPING TOTAL Mandays							32			12	48

3.0 Steam Generator & Auxiliaries (Electrical)											
3.1	Boiler	Electrical	6 months	3	Integral Actuator	Manufacturer Works	3	1. Design interface and functional aspect 2. Familiarisation with various types of actuator	Manufacturer Works	2	15
3.2	Boiler	Electrical	6 months	3	BCW motor	Manufacturer Works	3	1. Design review , manufacturing process, preservation. 2. operation and maintenance,preservation in during storage	Manufacturer Works	2	15
3.3	Boiler	Electrical	6 months	3	HT Motor	Manufacturer Works	3	Design review , manufacturing process, storage.	Manufacturer Works	2	15
Electrical TOTAL Mandays							27			18	45

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training		Training at Manufacturer works		Training at Operating Plants		Total no of days	
					Content of training	Location of training	No of days	Content of training	Location of training	No of days		
4.0 Steam Generator & Auxiliaries (Control & Instrumentation)												
4.1	C&I	SG-DDCMIS Hardware and Operating System	18 months	4	(a) Hardware & Software organization of the system (b) Basis of selection of H/W memory sizing (c) Operating System features (d) Interface with other system, Openness and inter-operability (e) Upgradability and System testing features	SG-DDCMIS vendor works	2	(a) Hardware & Software organization of the system (b) Basis of selection of H/W memory sizing (c) Operating System features (d) Interface with other system, Openness and inter-operability (e) Upgradability and System testing features	SG-DDCMIS vendor works	2	Operational feedback Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1.5
4.2	C&I	SG-DDCMIS Human Machine Interface System Engineering & Application Software	18 months	5	(a) Specific system customization (b) Various system modules & interface with OS (c) Database organisation & development (d) Development of mimics, other applications like calculations, logs, historical storage functionalities & use	SG-DDCMIS vendor works	4	Hands on experience, Testing methodologies	SG-DDCMIS vendor works	2	Operational feedback Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1
4.3	C&I	SG-DDCMIS- (i) Control system hardware (ii) Control system software Application Software	18 months	4	(i) (a) Basic design features for system & its Modules, (b) System capabilities & system design techniques (c) Communication with HMI & other systems (ii) (a) Database structure (b) Organization & interface between application program & database (c) Application for implementation of Control functions (d) Study of standard algorithms & development of new algorithm	SG-DDCMIS vendor works	4	(a) Manufacturing processes with special attention to handling of the modules (b) (ii) (a) System integration & system capabilities testing	SG-DDCMIS vendor works	1	Operational feedback Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1
4.4	C&I	Boiler Controls: (i) Study of Control loops (ii) Burner Management system	20 months	4	(i) (a) General concept of closed loop controls of the OEM (b) Critical analysis of some important control loops like Boiler Start up control, Feedwater control etc.	Design office of the QSGM	3		Operational feedback		Operating plants in any country including India where same make/ model of SG-DDCMIS is in operation.	1
4.5	C&I	Special SG-related instrumentation (i) Flame Scanners (ii) Boiler Flame viewing system (iii) Acoustic	24 months	2	(i) (a) Hardware logic (b) NFPA-85/ EN-50156/ EN-61508/ EN-61511 requirements and other applicable safety standards (c) Flame scanner locations.	Design office of the QSGM	4		Operational feedback		Operating plants in any country including India where same make/ model of Flame scanner is in operation.	1
					(i) (a) Flame scanners: Principle of Operation (b) Suitability for the proposed boiler	Flame scanner vendor's work	1	Manufacturing & testing procedures	Operational feedback		Operating plants in any country including India where same make/ model of Flame scanner is in operation.	1
					(ii) (a) Boiler Flame viewing system: Principle of operation (b) Location (c) Details of software & methods of modification/ customization	Flame camera vendor's work	1		Operational feedback		Operating plants in any country including India where same make/ model of Flame scanner is in operation.	1

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training		Training at Manufacturer works		Training at Operating Plants			Total no of days	
					Content of training	Location of training	No of days	Content of training	Location of training	No of days	Content of training		Location of training
		Pyrometer		2	(iii) (a) Acoustic Pyrometer: Principle of operation (b) Location (c) Details of software & methods of modification/ customization	Acoustic Pyrometer vendor's work	1			Operational feedback	Operating plants in any country including India where same make/ model of Acoustic Pyrometer is in operation.	1	4
4.6	C&I	Electric Power Supply System	22 months	2	System architecture and Component details	Electric power supply system vendor's work	2	Manufacturing/ assembling & testing procedures	Electric power supply system vendor's work	0.5			5
C&I TOTAL Mandays							94			29		25	148
5.0 Steam Generator & Auxiliaries (Quality Assurance)													
5.1	Quality Assurance & Inspection- QA System & Programme	QA System	12 months	2	a) Integrated QA Management System for enhanced reliability of equipments. b) QA system in design, procurement, manufacturing, installation and operation of equipments/ systems. c) QA System for developing and establishing new processes and vendors. d) System of structured documentation of Engg. and test records.	Manufacturer's work	5	1. Appreciation of QA programmes in various manufacturing, assembly and testing activities. 2. Appreciation of developmental activities for new processes and vendors. 3. System of prequalification of special processes.	Manufacturer's works where the equipment of the subject project is being manufactured.	3	1. operating feedbacks 2. Co-relation of reliability and performance of the equipment with implementation of QA system. 3. Appreciation of the use of structured Engg./ QA documentation during operational phase of plant and during RLA studies of plant.	1	18
5.2	Quality Assurance	SG & Auxiliaries	12 months	5	a) General Design, equipment, system and parameter familiarisation of supplied boiler	PMI	3						15
5.3	Quality Assurance	SG & Auxiliaries (Mechanical)	12 months	4	Pressure parts (Water wall panels, superheaters, Reheaters, headers, economiser, power cycle piping etc.) & Auxiliaries (Fans, Pulversier, APH, Soot blowers, Gates & Dampers, Feeder, SGWC pump etc.) Main design aspect including material of construction and applicable codes/ standards, manufacturing processes, machinery involved, various welding process involved, testing and inspection etc.	Manufacturer's work	3	1. Manufacturing, testing and inspection at various stages of Boiler Pressure parts and Auxiliaries 2. Shop level exposure to these processes with understanding of applicable code/ standard/ parameters involved in manufacturing of main pressure parts and auxiliaries. 3. Various testing and inspection activity in shop for above components.	Manufacturer's works where the equipment of the subject project is being manufactured.	4			28

STEAM GENERATOR AUXILIARIES

Sl.No	Area	Sub Area	Time of training from date of award	Batch size	Class Room training		Training at Manufacturer works		Training at Operating Plants			Total no. of days
					Content of training	Location of training	No of days	Content of training	Location of training	Content of training	No of days	
5.4	Quality Assurance	SG & Auxiliaries: Control & instrumentation: Material, construction, Manufacturing, assembly, testing wrt QA aspects, quality procedure and QA system & I	12 months	1	1. Familiarisation with control system and instrumentation. 2. QA system for manufacturing of reliable components.	Manufacturer's work	2	1. Manufacturing activities for critical instruments/ items. 2. Implementation of testing programme to ensure reliability.	Manufacturer's works where the equipment of the subject project is being manufactured.	Feedback on performance of C&I system	2	1
QA TOTAL Mandays		66					39				24	66

SUMMARY

1.0	Steam Generator & Auxiliaries (Mechanical)	TOTAL Mandays	173
2.0	Power Cycle Piping	TOTAL Mandays	48
3.0	Electrical	TOTAL Mandays	45
4.0	C&I	TOTAL Mandays	148
5.0	QA	TOTAL Mandays	66
GRAND TOTAL MANDAYS OF TRAINING FOR STEAM GENERATOR & AUXILIARIES			480
GRAND TOTAL MANMONTHS OF TRAINING FOR STEAM GENERATOR & AUXILIARIES			16.0

GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
CLAUSE NO.						
PRODUCT	AREAS OF TRAINING REQUIREMENT				Operation & Maintenance of Plant	
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work			
TURBINE GENERATOR AND IT'S INTEGRAL AUXILIARIES	Turbine cycle optimization and turbine performance in off design condition.	Familiarization of power plants of various makes of turbines for super critical units	Manufacturing processes of turbine			
	Rotor design and strength calculation	Collection of data for analysis of availability of turbines	Assembly of turbine			
	Rotor dynamic behavior studies wrt natural frequency, critical speed, vibration etc.	Comparative studies for integral systems of turbine	Testing of turbines			
	Blade profile/root design and blade strength design, blade vibration analysis	O&M history/problems related to turbine	Product development in process			
	Casing & diaphragm design	Failure analysis	Future plan for technology induction			
	Labyrinth seal selection & design for different turbine configurations		R&D work in progress			
	Selection of turbine type (i.e. Tandem vs cross compounding, separate HP/IP vs combined HP/IP, material of construction etc.)					
	Design principle for Up rating/down rating of existing design/ modules for the					
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-VIII		PAGE 92 OF 111

GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
CLAUSE NO.						
PRODUCT	AREAS OF TRAINING REQUIREMENT				Operation & Maintenance of Plant	
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work			
	specific project. of bearings, load calculation on bearings, bearing oil flow calculation Selection, design and control principle for Turbine governing system Performance calculation Steam path audit Layout principle of various equipment's of TG and its integral system Latest technological advancements					
MANDAYS Boiler Feed Pumps	45 Techno-economic studies for Selection of BFP Configuration and its drive Criteria for selection of boiler Feed Pump parameters Rotor design, strength calculation and rotor dynamic behavior studies wrt critical speed, vibration etc	10 Familiarization of power plants of various makes of feed pumps for super critical units Data collection of BFP parameters and configuration Collection of data for analysis of availability of BFP	10 Manufacturing process of various components of BFP Assembly of BFP Testing, capabilities of BFP at works wrt performance, NPSH, dry run, visual cavitation, axial thrust measurement			
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-VIII		
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GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
CLAUSE NO.						
PRODUCT	AREAS OF TRAINING REQUIREMENT				Operation & Maintenance of Plant	
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work			
	Impeller design and its hydraulic behavior Role of critical para- meters such as NPSH(R), Suction specific speed, running clearances, speed etc. in design of feed pumps Material selection of BFP components Guiding factors for selection of BFP seals Computation of axial thrust under various flows Performance calculation Transient analysis in pump suction piping wrt NPSH margin Latest technological trends in BFP design	O&M history/problems related to BFP Comparative studies for various types of BFP& its features	Product development in process Future plan for technology induction R&D work in progress			
MANDAYS	20	5	10			
Condenser	Selection of condenser type and its optimization wrt temp rise across condenser, pressure drop in condenser, surface area etc.	Comparative studies of salient features	Manufacturing process of various components of condenser Assembly			
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-VIII		
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GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
CLAUSE NO.	PRODUCT	AREAS OF TRAINING REQUIREMENT				Operation & Maintenance of Plant
		PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work		
		Techno economic studies for Selection of condenser tube material and other parts depending on water quality Condenser support selection & design Sizing of condenser w.r.t. super critical units Latest technological trends in condenser arrangement and design Condenser vacuum system design	Collection of data for analysis of availability of Condenser O&M history/problems related to condenser	Testing capability at works Product development in process Future plan for technology induction R&D work in progress		
MANDAYS		10	5	5		
Feed Regenerative Equipment's		Thermal and mechanical design calculation of heaters Basis of selecting horizontal/vertical heaters Selection of TTD and DCAs for various heaters, and their effect on turbine heat rate Configuration of HP heaters (2x50% v/s100% capacity) Sizing criteria for De-aerator/Heaters Selection of tube & tube sheet material of heaters	Comparative studies of salient features Analysis of data O&M history/problems related to heaters	Manufacturing process of various components of heaters Assembly Testing capability at works Product development in process Future plan for technology induction R&D work in progress		
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-VIII	PAGE 95 OF 111	

GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
CLAUSE NO.	AREAS OF TRAINING REQUIREMENT					
PRODUCT	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant		
MANDAYS	Latest technological trends in heaters design 15	10	10			
3-dimensional CFD modeling	CFD model development and validation of design data for steam turbine, BFP, CEP, condenser, heaters etc.					
MANDAYS	20					
CONTROL & INSTRUMENTATION	Hardware & Software organization of the system					
DDCMIS*-Man Machine Interface Hardware & Operating System	Basis of selection of H/W memory sizing Operating system features, interface with other system, openness & interoperability Upgradability System testing features	Operational feedback				
MANDAYS	Trouble shooting and fault analysis 15	5				
DDCMIS*-Man Machine Interface System Engineering & Application Software	Specific system customization Various system modules & interface with OS Database organization & development	Operation feedback				
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-VIII	PAGE 96 OF 111	

GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
CLAUSE NO.	AREAS OF TRAINING REQUIREMENT					Operation & Maintenance of Plant
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work			
	Development of mimics Other application like calculations, logs historical storage functionalities & use					
	Trouble shooting and fault analysis					
MANDAYS	30	5				
DDCMIS* Control System Hardware	Basic design features for system & its modules System capabilities & system design techniques	Operation feedback	Manufacturing processes special attention to handling of the modules Maintenance facilities			
MANDAYS	15	3	10			
DDCMIS*- Control system Application Software	Database structure Organisation & interface between application program & database Application for implementation of Control functions Study of standard algorithms & development of new algorithms Trouble shooting and fault analysis	Operation feedback	System integration & System capabilities testing			
MANDAYS	8	2	4			
DDCMIS* DDCMIS- Control Strategies for TG System:	P&ID and process/System Descriptions of Governing System, Protection System, Automatic Turbine Testing, Oil System, Evacuation System & Generator Auxiliaries, Turbine stress Computation	Yes	Yes			
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-VIII		
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GENERAL TECHNICAL REQUIREMENTS					
CLAUSE NO.	ANNEXURE-VIII				
PRODUCT	AREAS OF TRAINING REQUIREMENT				
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant	
Process Concepts of Main Integral Systems	System, Gland seals, Turbine Start up and Shut-down process, Hot ,cold and Warm modes of Turbine start up etc.				
DDCMIS* DDCMIS- Control Strategies for TG System: Control Strategies	Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system. Function Blocks: Introduction and explanation of TG process specific Function block as being implemented in offered Control system. Open Loop Control strategies for ATRS, including turbine Run/Up Shutdown, Auto Synch, Oil System Automation concept, Auto Changer over philosophies, Condenser evacuation system, ATT and Generator Auxiliaries. Close Loop Control strategy-EHTC, Seal/Leak steam Controls, Interfacing of unit Controls Protection-Fail Safe philosophy implementation in turbine protection.	Yes	Yes		
DDCMIS- Control Strategies for TG System: Process Concepts of HP/LP Systems	P&ID and process/System Descriptions of HP/LP BP System, Protection System, Oil System, HPBP operations under various modes like start up, Shutdown, Load throw off etc.	Yes	Yes		
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-VIII	PAGE 98 OF 111

GENERAL TECHNICAL REQUIREMENTS					
CLAUSE NO.	ANNEXURE-VIII				
PRODUCT	AREAS OF TRAINING REQUIREMENT				
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant	
DDCMIS-Control Strategies for TG System: BP HP/LP Systems Control Strategies	Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system. Function Blocks:- Introduction and explanation of HP/LP process specific Function block as being implemented in offered Control system. Open Loop Control strategies for HPBP operation during various modes of plant operation like Start Up/Shut down and Load Throw Off etc. Close Loop Control strategy- Applicable Control Loops like HP/LP BP Press Control/Position Control, LP BP Spray Controls etc. Interfacing o unit Controls etc. Protection-Fail Safe philosophy implementation in HP/LP BP system	Yes	Yes		
DDCMIS-Control Strategies for TG System: Process Concepts of Drive BFP Turbine/ BFP Systems	P&ID and process/System Descriptions of Drive Turbine Governing System, Protection System, Oil System, Turbine Start up and Shut-down process, Hot, cold and Warm modes of Turbine start up etc.	Yes	Yes		
DDCMIS-Control Strategies for TG System:	Measurement System-Redundancy in Measurement for OLCS/CLCS and Protection system.	Yes	Yes		
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-VIII	PAGE 99 OF 111

GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
CLAUSE NO.	AREAS OF TRAINING REQUIREMENT					Operation & Maintenance of Plant
PRODUCT	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work			
BFP Drive Turbine/ BFP Systems Control Strategies	Function Blocks:- Introduction and explanation of BFP Drive Turbine process specific Function block as being implemented in offered Control system. Open Loop Control strategies for Drive Turbine Start UP/Shutdown, Oil System Automation concept, Auto Changer over philosophies. Close Loop Control strategy-EHTC, Seal/Leak steam Controls, Interfacing of unit Controls Protection-Fail Safe philosophy implementation in Drive turbine protection.					
MANDAYS	24	5	4			
DDCMIS-operator	Use of the system at work + at Site					
MANDAYS	4					
Turbo supervisory system : Measurement Concepts	Discussions on various measurement points, Types, Ranges and locations for the offered Turbine	Yes	Yes			
Turbo supervisory system : System Concepts	System implementation of sensors, Monitors, Drivers, Cabling, earthing shielding and grounding, Buffered signals, Technical aspects of sensor selection, Sensor specifications, filter setting, Configuration settings for displacement, Velocity ,acceleration, key phasor and other types of sensors. Diagnostics and	Yes	Yes			
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-VIII	PAGE 100 OF 111	

GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
PRODUCT	AREAS OF TRAINING REQUIREMENT				Operation & Maintenance of Plant	
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work			
	trouble shooting features of Sensors, Drivers and Monitors.					
Turbo supervisory system : Analysis Software	1)System Setup-Hardware and Software 2)Case Studies showing utilization of various data displays e.g Bode Plot, Polar Plot, Waterfall Plot, Orbit & Waterfall Plot etc. 3)Tools and methods of finding Machinery faults like oil whirl, Oil whip, Mis-alignment etc	Yes	Yes			
MANDAYS	8	2	2			
(ELECTRICAL) GENERATOR	Wherever "DDCMIS" is indicated, it will mean TG C&I part of DDCMIS, which is in Contractor's Scope					
	(a) Design aspects of the following areas - Insulation system - Cooling medium & arrangement - Winding & core support systems b) Design aspects associated auxiliary systems	- Operational back feed - Familiarisation with different sub-systems	(a) Manufacturing process for - Core - Winding bars Assembly - Testing facilities (b)			
MANDAYS	30	15	15			
Generator Excitation system including AVR.	Design features of various sub- System Exciter PMG Transformer Controllers & different limiters etc.	- Operational back feed - Familiarisation with various equipment functioning at reference plants	Manufacturing process & testing facilities for various equipment of excitation system			
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-VIII	PAGE 101 OF 111	

GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-VIII
CLAUSE NO.	AREAS OF TRAINING REQUIREMENT					Operation & Maintenance of Plant
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work			
	PSS & associated system studies	functioning at referplants				
MANDAYS	30	15	15			
Integral Actuators	a) Basic design philosophy of integral actuator b) Design aspects of wiring diagram c) Type and range of application of integral actuators d) Operation and selection of integral actuator to various type of loads Methods of fault diagnose system.		Manufacturing process & testing facilities for various equipment of actuators			
MANDAYS	2	1	1			
MDBFP motor	Design criteria for the stator core and winding rotor core and winding, insulation systems and cooling arrangement. Study of forces and vibration. Diagnostic and testing of large Electrical machines	Operational Feedback	Manufacturing process and testing facilities.			
MANDAYS	14	4	10			
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-VIII		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	ANNEXURE-IX			
	Area	Topics	MANDAYS	
	DDCMIS-Man Machine Interface - Hardware & Operating System	- Hardware & Software organization of the system - Basis of selection of H/W memory sizing - Operating system features, interface with other system, openness & inter-operability - Upgradeability - System testing features	20	
		Trouble shooting and fault analysis.		
	DDCMIS-Man Machine Interface System Engineering & Application Software	- Specific system customisation - Various system modules & interface with OS - Database organisation & development - Development of mimics - Other application like calculations, logs historical storage functionalities & use - Trouble shooting and fault analysis.	40	
	DDCMIS - Control System Hardware and Control system Application Software	- Basic design features for system & its modules - Manufacturing processes with special attention to handling of the modules Maintenance facilities	50	
		- System capabilities & system design techniques - System integration & System capabilities testing		
		Communication with MMI & other system		
		Database structure Organisation & inter- face between application program & database		
	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-IX

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
		- Application for implementation of Control functions - Study of standard algorithms & development of new algorithms	
		Trouble shooting and fault analysis.	
	DDCMIS-Operator Training	Use of the system at Works + at Site	20 + 100
	DDCMIS-Specialized Network security training	To be finalized during detailed engineering.	15
	UPS system	- Theory & design features Manufacturing/assembly process - Testing methodology	5
		Trouble shooting and fault analysis.	
	24 V DC system	- Theory & design features Manufacturing/assembly process - Testing methodology - Trouble shooting and fault analysis.	5
	SWAS	- Theory & design features - Trouble shooting and fault analysis	5
	PA System	- Theory & design features - Trouble shooting and fault analysis	4
	CCTV System	- Theory & design features - Trouble shooting and fault analysis	4
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-IX PAGE 104 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	QA SYSTEM & PROGRAMME	- Integrated QA Management system for enhanced reliability of equipments. - QA system in design, procurement, manufacturing, installation and operation of the equipments/ systems. - QA system for developing and establishing new processes and vendors. - System of structured documentation of Engg and test records. - Appreciation of implementation of QA Programme in various manufacturing, assembly and testing activities. - Appreciation of develop-mental activities for new processes and vendors. - System of pre-qualification of special processes.	10	
	Controls & Instruments	- Familiarization with control system and instrumentation - QA System for manufacture of reliable components. Manufacturing activities for critical instruments/items. - Implementation of testing programme to ensure reliability.	10	
	Note	One week shall constitute of five (5) man days.		
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-IX	PAGE 105 OF 111

GENERAL TECHNICAL REQUIREMENTS						ANNEXURE-X
CLAUSE NO.	AREAS OF TRAINING REQUIREMENT					
PRODUCT	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant		
GIS			Training on GIS equipments including system description basic design and engineering. Quality assurance concepts and Erection and operational aspects for the offered equipments.	Training on Operation, Maintenance,, site testing & troubleshooting of GIS.		
MANDAYS			40	30		
Substation Automation System				Training for site personnel for operation, maintenance & troubleshooting of total system for 5 working days at NTPC site.		
MV and LT Switchgear : Numerical relays & Switchgear SCADA system	Numerical relay engineering and associated training for relay software and O&M SCADA system design, engineering and associated training for SCADA and O&M					
MANDAYS	60 (Total) inclusive of visit to manufacturer's site)					
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)						GENERAL TECHNICAL REQUIREMENTS ANNEXURE-X
TECHNICAL SPECIFICATION SECTION-VI, PART-C BID DOC. NO.: CS-9585-001-2						PAGE 106 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	ANNEXURE - XI			
	Area	Topics	MANDAYS	
	UF Membranes	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ultrafiltration membranes and design Plant Visit - Operational feedback - O&M history/problems related to UF membranes Visit to Manufacturer’s Work - Manufacturing process of UF membranes and equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	7	
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-XI
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	RO membranes	Product design - Basic design features - Theory & principle of operation - Latest technological trends in RO membranes and design Plant Visit - Operational feedback - O&M history/problems related to RO membranes Visit to Manufacturer's Work - Manufacturing process of RO membranes and equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	7
	Zero Liquid Discharge (ZLD)	System Design - Plant water optimization and Scheme to achieve the ZLD - Basic design features - Latest technological trends for ZLD in Thermal Power Plant Plant Visit - Operational feedback	5
	Note	One week shall constitute of five (5) man days.	
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-XI	PAGE 108 OF 111

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC									
	Annexure-XII TRAINING REQUIREMENTS FOR SIMULATOR In addition to the other stipulations in the bidding documents regarding training of Employer's personnel, the following shall also be covered: (i) The scope of service under training of Employer's Engineers shall necessarily include, training in the areas of: (a) Design, engineering and Quality Assurance. (b) Operation & maintenance. Arrangement for the trainees to get trained at the Works of the Contractor's, Works of their sub-vendors and at the plants of similar type and comparable size, operating elsewhere shall be made by the Contractor. (ii) The training shall enable the O&M personnel to individually take responsibility of operating & maintaining the respective systems to ensure sustained guaranteed performance of the equipment and availability of the systems offered. The design & engineering personnel of the Employer shall be familiarized with the design philosophy adopted & practices followed by the Contractor or Sub-Contractor's Engineers for design engineering and shall be given special training in the shops, where the equipment will be manufactured and/or in their collaborator's works and where possible, in any other plant where equipment manufactured by the Contractor or his collaborator is under installation operation, or testing to enable these personnel to become familiar with the equipment being furnished by the Contractor. The training requirements of Employer's Engineering and O&M personnel are as below: <table><tr><th>Area</th><th>Topics</th><th>MANDAYS</th></tr><tr><td rowspan="4">Simulator & Human Machine Interface – Hardware and Operating System</td><td> • Hardware & software organization of the system </td><td rowspan="4">90</td></tr><tr><td> • Basis of selection of HW memory sizing </td></tr><tr><td> • Operating system features, interface with other system, openness & inter operability & upgradability System Testing features </td></tr><tr><td> • Trouble shooting & Fault Analysis </td></tr></table>				Area	Topics	MANDAYS	Simulator & Human Machine Interface – Hardware and Operating System	• Hardware & software organization of the system	90	• Basis of selection of HW memory sizing	• Operating system features, interface with other system, openness & inter operability & upgradability System Testing features	• Trouble shooting & Fault Analysis
Area	Topics	MANDAYS											
Simulator & Human Machine Interface – Hardware and Operating System	• Hardware & software organization of the system	90											
	• Basis of selection of HW memory sizing												
	• Operating system features, interface with other system, openness & inter operability & upgradability System Testing features												
	• Trouble shooting & Fault Analysis												
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-XII	PAGE 109 OF 111									

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
	Simulator System Engineering (Simulator Kernel and Interface) & Application Software (Process and C&I Modelling)	• Overview of Simulator • Starting up and Shutting down of the simulator • Details of Simulator hardware & software • Interaction between Simulator Models and controls & Instructor Station operations • Manipulation of Simulator parameters and data.	150	
		• Details of Plant Modelling & C&I Modelling simulation software		
		• Details of Simulator and DCS interface		
		• Backup and Restore procedures		
		• Details of I/O system		
		• Fault finding of simulator hardware & Software diagnostic procedures		
		• Simulator maintenance procedures		
	Human Machine Interface System Engineering & Application Software	• Specific system customisation	90	
		• Various system modules & interface with OS		
		• Database organisation & development • Development of mimics • Other application like calculations, logs historical storage functionalities & use		
		• Trouble shooting and fault analysis.		
	Instructor Training	Use of the system including • Interaction between Simulator Models and controls • Instructor Station operations	150	
		• Communication with MMI & other system		
• Database structure Organisation & inter-face between application program & database				
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-XII	PAGE 110 OF 111 327 of 335

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
		• Application for implementation of Control functions • Study of standard algorithms & development of new algorithms		
		• Trouble shooting and fault analysis.		
	UPS system	• Theory & design features manufacturing/assembly process • Testing methodology		10
		• Trouble shooting and fault analysis.		
	Note	Note One week shall constitute of five (5) man days.		

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-XII	PAGE 111 OF 111

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**TITLE****3X800 MW PATRATU STP PHASE-I****DOUBLE GIRDER EOT CRANES UPTO 100T****DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

SPECIFICATION NO. PE-TS-434-501-A401

REV 00

Section III Date APRIL'19

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SECTION-III**DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

**TITLE****3X800 MW PATRATU STP PHASE-I****DOUBLE GIRDER EOT CRANES UPTO 100T****DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

SPECIFICATION NO. PE-TS-434-501-A401

REV 00

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DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid

- a) Signed and Stamped copy of Compliance cum Confirmation Certificate
- b) Electrical load list, duly signed and stamped
- c) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format given under Section-III
- d) Un priced copy of price format indicating quoted/ not applicable against each row/column

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF ABOVE DOCUMENTS. DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND WILL NOT BE CONSIDERED FOR BID EVALUATION.



**3X 800 MW PATRATU STP PHASE-I
DOUBLE GIRDER EOT CRANES**

SPECIFICATION NO.: PE-TS-434-501-A401

SECTION: III

SUB SECTION:

REV: 00

DATE: April'19

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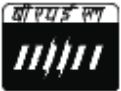
COMPLIANCE CUM CONFIRMATION CERTIFICATE

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" in section C and those resolved as per 'Schedule of Deviations', if applicable, 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 shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- 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 and within purview of the tender specification even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel

	3X 800 MW PATRATU STP PHASE-I DOUBLE GIRDER EOT CRANES	SPECIFICATION NO.: PE-TS-434-501-A401	
		SECTION: III	
		SUB SECTION:	
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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) Regarding commercial documents / deviations, BHEL clarified that commercial documents / deviations shall not been considered during technical evaluation. However if any issue in the commercial documents / deviation related to technical requirements needs to be highlighted and resolve in technical evaluation only.
 No aspect of commercial issues needs to be highlighted / resolved in technical evaluation and their offer is strictly in compliance with technical specification. BHEL also clarified to the bidder any technical deviations (e.g. related to MDL, required documentation etc. for completion of the project) raised by them in commercial deviation either explicit or implicit shall be considered null and void even if agreed by BHEL during commercial evaluation stage.
 Bidder agreed to confirm and compliance with technical specification and subsequent clarification on bids during pre- award discussion.



TITLE
3X800 MW PATRATU STP STAGE-I
DOUBLE GIRDER EOT CRANES UPTO 100T
PRE BID CLARIFICATION SCHEDULE

SPECIFICATION NO. PE-TS-434-501-A401

REV 00

Section III Date APRIL'19

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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: _____

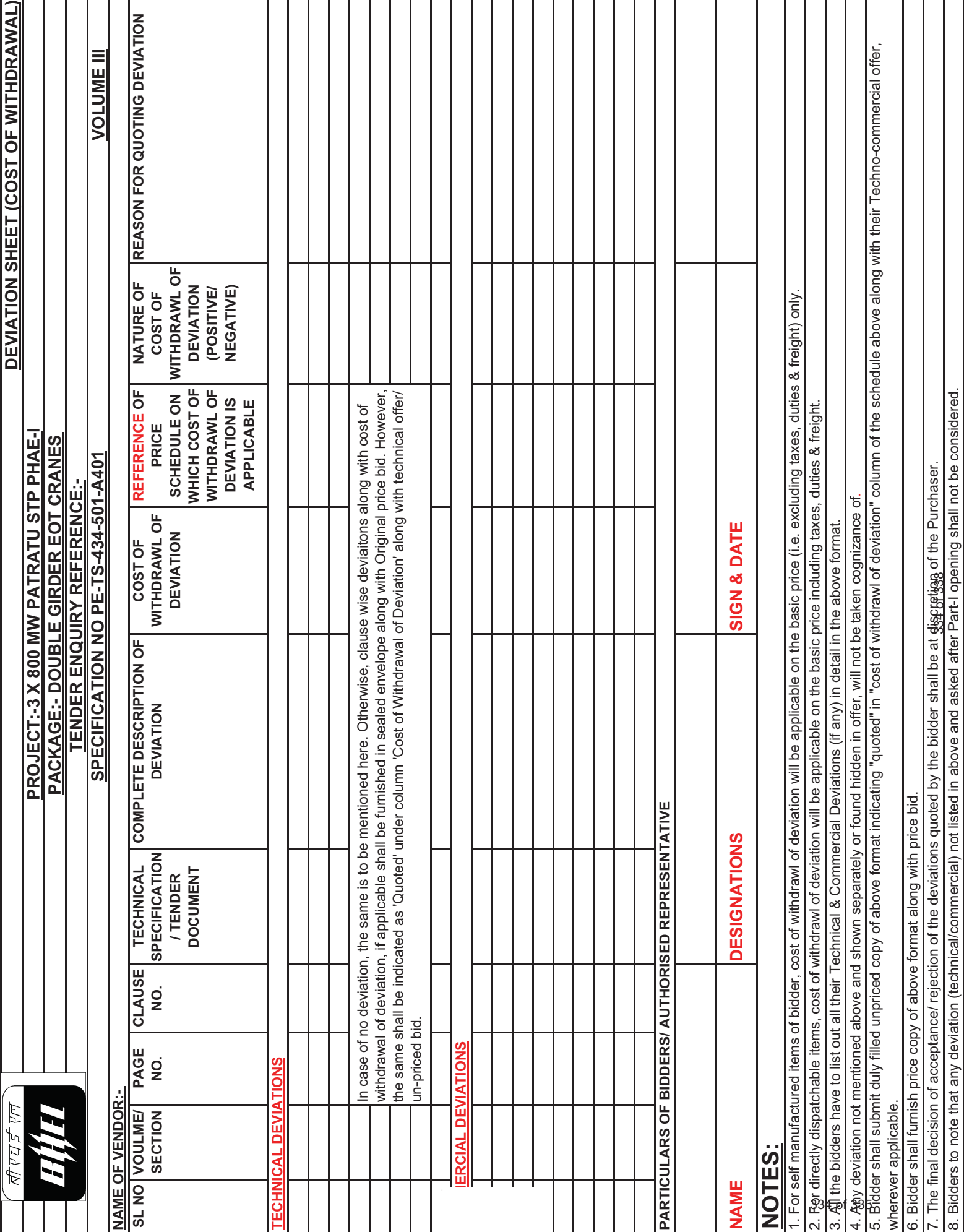
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DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL



9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given 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.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.