Gujarat State Electricity Corporation Ltd

1x800 MW GSECL WANAKBORI THERMAL POWER PROJECT, UNIT #8

VOLUME – II B & III

TECHNICAL SPECIFICATION FOR SINGLE GIRDER EOT CRANE

SPECIFICATION NO.: PE-TS-408-524-A001 Rev 0

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, INDIA

VOLUME – IIB

VOLUME-III

VOLUME - IIB

SECTION – A

INTENT OF SPECIFICATION

SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

1.1 This specification includes, but not limited to design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, forwarding, proper packing and shipment and delivery at site as required on FOR site basis, performance and guarantee testing at vendor's works (as mentioned elsewhere in the specification) of **SINGLE GIRDER CRANE** as per details in different sections / volumes of this specification for **1X800 MW GSECL WANAKBORI**.

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 of Single girder crane & 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 Vol-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 customer.

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, Section - C shall prevail over section – D, however 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.

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 (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (http://124.124.36.198/wrenchwebaccess/login.aspx).

VOLUME - IIB

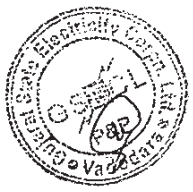
SECTION – B

PROJECT INFORMATION

VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION



VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Supercritical Thermal Power Project would be set up by Gujarat State Electricity Corporation Limited (GSECL) at Kheda district of Gujarat.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

The proposed site is located in Kheda district about 13 kilometers from the nearest commercial town of Balasinor & 10 kilometers from Sevalia town. The National Highway, NH-08, connecting Dakor – Godhra is about 10 kilometers from the site. The State Highway SH – 59 connecting Balasinor – Sevalia is about 2 Kilometers from the site. Nearest railway station to the existing site is Sevalia, located about 8 kilometers from the site on Anand – Godhara main broad gauge line of Western Railway.

Nearby Air Ports are Ahmedabad at a distance of about 110 kilometers from the site and Vadodara at a distance of about 85 kilometers from the site.

3.00.00 LAND

The proposed extension unit will be developed in the existing Wanakbori Thermal Power Station and will be located north east side of the existing plot in the Kheda District of Gujarat. The land of the proposed plant will be filled in upto a desired level. Existing Ash Pond/ Dyke area will be utilized for the extension unit.

4.00.00 SOURCE OF COAL

Indian coal would be sourced from captive mines Machha Kata in Talcher, State – Orissa which are situated about 1800 Kms from the project site. GSECL will arrange for transportation of the coal required for the extension unit from these captive mines by the existing railway facilities for delivery of coal supply to the Wanakbori power station.

CONTENT

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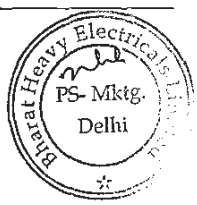

5.00.00 **SOURCE OF WATER**

The water required for the new unit shall be obtained from River Mahi, flowing by the side of the existing Wanakbori Power Station.

One (1) new jackwell will be installed on Mahi river for supply of water for new plant. In addition, existing Canal Water and Jackwell Water will have interconnection with new plant to cater plant water requirement of new plant.

6.00.00 **ASH DISPOSAL AREA**

Existing Ash Pond / Dyke area will be utilized for the extension unit. Fly ash silos will be located outside plant boundary wall (but within GSECL land) in the vicinity of the Ash Dyke area.

7.00.00 **SALIENT DESIGN DATA**

7.01.00 Meteorological data of site is given below:-

Elevation above MSL	:	72 M
Max. daily average temp	:	34 °C
Min. daily average temp	:	11.7 °C
Max. Ambient air temp. (daily)	:	34°C
Max. Ambient air temp. (yearly)	:	30°C
Max. Ambient air temp.	:	42°C
Wet bulb temperature	:	28°C
Relative Humidity	:	RH varies within a range from 50% to 95%.
Average annual rainfall	:	750 mm

[Metrological data of Vadodara is attached for reference].

VOLUME : IIA

SECTION-IX

SALIENT DESIGN DATA

[TABLE-I TO TABLE-VII]

TABLE-VII
CLIMATOLOGICAL TABLE OF BARODA

STATION : Baroda 42747 LAT: 22 18 N LONG: 73 15 E HT. ABOVE M.S.L. 34 METERS DATA 1951 TO 1980

		Mean Temperature						Extremes				Cloud		Rainfall					
MN	SLP	DB	WB	MAX	MIN	HIGH	LOW	MAX DT	MIN DT	RH	VP	TOT	LOW	TOT	RAINY	WET	DRY	HEAVY	DAY	WS
1	1011.8	13.8	10.9	30.3	12.0	34.3	7.5	36.2 25	-1.1 15	67	10.7	1.1	0.3	1.2	0.1	53.6	0.0	33.0	05	4.0
	1008.5	27.9	17.8					1961	1935	33	12.4	1.1	0.1			1920			1920	
2	1010.3	16.2	12.3	33.0	13.8	37.9	8.9	41.7 28	1.7 10	61	11.2	0.9	0.2	0.6	0.1	33.0	0.0	33.0	10	4.1
	1006.7	31.4	18.7					1953	1950	25	11.3	0.9	0.2			1898			1898	
3	1008.5	22.1	16.3	37.1	18.4	41.5	13.1	44.4 26	6.7 03	53	13.8	1.1	0.2	2.2	0.2	44.3	0.0	21.0	23	4.2
	1004.3	35.8	20.5					1973	1936	20	11.7	1.2	0.2			1967			1967	
4	1005.9	27.3	20.7	40.2	22.9	43.9	18.4	45.9 25 *	11.7 16	53	19.2	1.1	0.2	0.9	0.1	83.3	0.0	71.4	18	4.8
	1001.4	39.1	22.5					1979	1955	20	14.1	1.2	0.2			1947			1947	
5	1003.1	29.9	24.6	40.9	26.5	44.5	23.2	46.7 11	18.9 05	64	26.8	1.7	1.2	4.4	0.3	153.9	0.0	59.7	29	8.7
	998.3	39.8	24.9					1960	1939	27	19.3	0.7	0.3			1917			1917	
6	999.4	29.3	26.0	37.1	27.0	41.5	23.5	45.6 06 *	20.2 19	76	30.9	4.5	2.9	146.8	5.6	527.8	0.0	177.4	06	10.3
	995.4	35.3	26.6					1979	1978	51	27.8	3.4	2.0			1913			1976	
7	998.1	27.4	25.8	32.7	25.7	36.9	23.5	40.6 05	21.1 19	88	31.8	6.5	4.0	297.6	13.8	899.0	4.8	247.4	24	8.4
	995.3	30.8	26.5					1962	1943	72	31.1	6.4	4.0			1950	1899		1927	
8	999.8	26.4	25.1	31.5	25.0	34.6	23.4	37.4 30	22.2 01	90	30.9	6.7	3.8	284.7	12.0	748.5	0.3	250.7	05	7.1
	997.0	29.9	26.1					1979	1976	74	30.6	6.5	3.9			1933	1899		1956	
9	1003.6	26.3	24.5	33.2	24.3	37.0	22.4	41.1 30 *	18.9 29	86	29.4	4.3	2.4	141.7	7.1	575.4	0.0	372.1	24	5.1
	1000.2	31.5	25.7					1951	1938	63	28.2	4.0	2.4			1945			1945	
10	1007.5	25.0	21.5	36.0	21.3	38.5	16.7	41.7 13	11.7 30	72	22.9	1.5	0.6	22.0	1.3	272.3	0.0	153.2	29	3.0
	1004.0	33.3	23.9					1951	1955	44	22.2	1.4	0.6			1917			1930	
11	1010.5	20.4	16.4	34.3	16.7	37.2	12.9	39.6 02	7.2 30	64	15.5	1.3	0.4	16.2	0.7	212.4	0.0	64.6	22	3.0
	1007.2	30.5	21.2					1966	1938	41	17.8	1.3	0.4			1979			1976	
12	1011.9	15.6	12.7	31.4	13.4	34.5	9.6	36.8 01	3.3 22	70	12.5	1.3	0.2	4.4	0.2	43.4	0.0	43.4	01	3.6
	1008.7	28.0	19.1					1980	1937	40	15.1	1.3	0.2			1978			1978	
YR	1005.9	23.3	19.7	34.8	20.6	44.8	6.9	46.7	-1.1	70	21.3	2.7	1.4	922.7	41.5	1666.0	133.1	372.1		5.5
LY	1002.3	32.8	22.8							43	20.1	2.5	1.2			1976	1899			
YRS	30	30	30	30	30	30	30	48	48	30	29	30	22	30	30	93	93	93		30
	30	30	30							30	29	30	22							

* Occurred More Than Once

STATION : Baroda 42747 .. contd

	Weather						Wind speed				% Wind Direction									Total Cloud					Low cloud						Visibility				
MN	PPT	HAIL	THUN	FOG	D.STM	SQUA	62	61	19	0	N	NE	E	SE	S	SW	W	NW	0	0	T-2	3-5	6-7	8	0	T-2	3-5	6-7	8	F8	<1	1-4	4-10	10-20	>20
1	0.3	0.0	0.1	0.5	0.0	0.0	0	0	19	12	13	39	2	2	1	3	1	3	36	20	5	3	2	1	28	2	1	0	0	0	0.3	1.7	2.0	25.6	1.4
							0	0	25	6	12	30	2	0	0	3	8	23	22	19	6	3	2	1	28	2	1	0	0	0	0.0	0.0	0.0	1.9	29.1
2	0.3	0.0	0.1	0.2	0.0	0.0	0	0	17	11	10	31	1	2	2	7	2	4	41	20	4	3	1	0	26	1	1	0	0	0	0.2	1.6	2.3	23.9	0.0
							0	0	24	4	10	21	2	2	0	9	12	28	16	19	5	2	2	0	25	2	1	0	0	0	0.0	0.0	0.0	1.7	26.3
	0.2	0.0	0.2	0.0	0.0	0.0	0	0	19	12	7	15	1	3	5	16	5	7	41	20	5	4	2	0	29	1	1	0	0	0	0.0	0.5	0.7	29.8	0.0
							0	0	27	4	7	13	2	1	1	15	16	32	13	20	6	3	2	0	28	2	1	0	0	0	0.0	0.0	0.0	1.5	29.5
	0.2	0.0	0.5	0.0	0.0	0.0	0	0	22	8	5	5	1	2	6	29	10	12	30	19	5	3	2	1	27	2	1	0	0	0	0.0	0.1	0.1	29.7	0.1
							0	0	27	3	4	4	1	0	1	20	26	35	9	16	7	3	3	1	25	4	1	0	0	0	0.0	0.0	0.0	0.3	29.7
5	0.4	0.0	0.6	0.0	0.3	0.0	0	0	28	3	1	1	1	1	5	57	17	7	10	15	6	7	3	0	19	4	6	2	0	0	0.0	0.0	0.0	30.8	0.2
							0	1	29	1	1	2	0	1	2	45	30	14	5	21	8	1	1	0	24	6	1	0	0	0	0.0	0.0	0.0	1.7	29.3
6	7.6	0.0	3.3	0.0	0.1	0.2	0	0	28	2	0	1	0	2	10	61	16	1	9	2	6	9	7	6	6	8	12	4	0	0	0.0	0.0	0.3	29.6	0.1
							0	2	27	1	0	1	0	2	7	61	21	3	5	4	9	6	6	5	8	11	8	3	0	0	0.0	0.0	0.3	1.8	27.9
7	18.8	0.0	2.1	0.0	0.0	0.1	0	0	27	4	0	0	0	1	8	62	14	0	15	0	2	5	8	16	4	4	14	8	1	0	0.0	0.0	0.2	30.8	0.0
							0	1	27	3	0	0	0	2	8	60	18	3	9	1	1	5	11	13	1	7	13	9	1	0	0.0	0.0	0.3	4.3	26.4
8	17.8	0.0	1.8	0.0	0.0	0.0	0	0	26	5	1	0	0	0	7	55	20	1	16	0	1	4	8	18	4	4	13	9	1	0	0.0	0.1	0.8	29.2	0.9
							0	1	27	3	0	1	0	1	6	55	21	4	12	0	2	5	11	13	1	7	14	8	1	0	0.0	1.1	0.4	5.0	24.5
9	10.2	0.0	2.6	0.0	0.0	0.0	0	0	23	7	2	3	0	2	5	37	18	6	27	4	6	6	6	8	12	4	8	5	1	0	0.0	0.1	0.2	29.3	0.4
							0	0	25	5	2	3	1	1	3	32	26	15	17	2	9	6	8	5	6	12	8	4	0	0	0.0	0.0	0.1	2.6	27.3
10	1.6	0.0	1.4	0.2	0.0	0.0	0	0	17	14	6	16	3	6	4	12	3	3	47	17	7	4	2	1	26	2	2	1	0	0	0.0	0.2	0.3	29.7	0.8
							0	0	20	11	9	15	3	2	1	8	10	16	36	14	11	3	2	1	20	9	2	0	0	0	0.0	0.0	0.0	0.5	30.5
11	1.1	0.0	0.3	0.2	0.0	0.0	0	0	17	13	11	33	4	3	1	2	0	1	45	18	6	3	2	1	27	1	2	0	0	0	0.1	0.3	0.4	28.3	0.9
							0	0	18	12	11	24	4	1	0	2	3	13	42	17	7	3	2	1	25	3	2	0	0	0	0.0	0.0	0.0	0.7	29.3
12	0.3	0.0	0.2	0.2	0.0	0.0	0	0	20	11	12	43	3	1	1	1	0	1	38	19	5	4	2	1	29	1	1	0	0	0	0.0	1.3	1.3	27.4	1.0
							0	0	21	10	17	24	4	1	0	2	4	16	32	17	7	3	3	1	28	2	1	0	0	0	0.0	0.0	0.0	0.6	30.4
YR	58.8	0.0	13.2	1.3	0.4	0.3	0	0	263	102	6	16	1	2	5	29	9	4	28	154	58	55	45	53	237	34	62	29	3	0	0.6	5.9	8.6	344.1	5.8
LY							0	5	297	63	6	12	2	1	2	26	16	17	18	150	78	43	53	41	219	67	53	24	2	0	0.0	1.1	1.1	22.6	340.2
YRS				26					24						29							27					27						27		
									24						29							26					26						27		

Gujarat State Electricity Corpn. Ltd GSECL P&P Vadodara

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Bharat Heavy Electricals Limited PS-Mktg. Delhi

STATION : Baroda (A) 42748 LAT: 22 20 N LONG: 73 16 E HT. ABOVE M.S.L. 38 METERS DATA 1952 TO 1980

		Mean Temperature		Extremes						Cloud		Rainfall					
MN	SLP	DB	WB	MAX	MIN	HIGH	LOW	MAX DT	MIN DT	RH VP	TOT LOW	TOT	RAINY	WET	DRY	HEAVY	DAY	WS
1	1011.5	15.2	11.3	29.4	12.2	33.4	7.2	35.8 13	2.8 22	59 10.3	1.2 0.1	1.3	0.1	15.8	0.0	14.0	07	7.6
	1008.1	27.6	17.3					1979	1962	31 11.5	1.2 0.1			1953			1953	
2	1010.0	17.8	12.4	32.1	13.9	36.6	8.8	40.6 28	3.9 10	50 10.2	1.0 0.3	0.7	0.1	11.0	0.0	6.0	02	7.6
	1006.3	30.9	17.8					1953	1950	23 9.9	1.0 0.3			1961			1961	
3	1008.1	23.2	16.5	36.4	18.2	40.5	13.0	43.9 29	9.3 08	48 13.4	1.1 0.2	1.2	0.2	21.4	0.0	11.5	25	7.5
	1003.9	35.1	20.0					1977	1979	21 11.2	1.3 0.2			1967			1967	
4	1005.6	27.8	20.8	39.5	22.8	42.9	18.2	45.9 29	14.4 15	51 19.0	1.2 0.3	0.3	0.0	8.2	0.0	8.2	25	8.3
	1000.9	38.5	21.8					1979	1955	19 12.8	1.5 0.3			1978			1978	
5	1002.7	29.9	24.6	40.3	26.5	43.7	22.9	46.1 20	19.4 27	64 26.6	1.9 1.6	3.7	0.2	50.1	0.0	40.9	29	14.6
	997.7	39.0	24.5					1955	1974	29 19.0	0.9 0.5			1974			1956	
6	999.0	29.3	26.1	36.7	26.8	40.9	23.2	45.6 06	17.1 03	77 31.0	4.9 3.4	129.7	5.0	439.0	0.0	187.3	06	18.0
	994.9	34.6	26.6					1979	1980	54 28.1	3.9 2.5			1976			1976	
7	997.7	27.4	25.8	32.4	25.6	36.2	23.5	39.6 02	22.2 28	88 32.0	6.6 4.1	290.7	12.6	605.6	60.8	162.0	11	15.2
	994.7	30.2	26.5					1968	1952	75 31.6	6.5 3.9			1976	1974		1976	
8	999.5	26.5	25.2	31.3	24.9	34.4	23.2	39.1 16	21.7 16	90 31.0	6.8 3.9	274.4	11.8	657.4	38.5	277.1	05	12.6
	996.5	29.3	26.0					1969	1956	76 30.8	6.5 3.8			1978	1974		1956	
9	1003.2	26.5	24.6	32.7	24.2	36.5	22.2	41.1 29	18.1 25	85 29.4	4.7 2.6	147.0	7.2	456.4	0.3	221.6	07	9.1
	999.7	30.9	25.4					1951	1972	65 28.1	4.5 2.6			1958	1957		1970	
10	1007.2	26.0	21.7	35.4	21.1	37.9	16.5	41.2 15	12.8 27	67 22.6	1.7 0.6	21.6	1.3	143.9	0.0	71.1	01	6.2
	1003.7	32.9	23.0					1980	1960	41 20.2	1.8 0.8			1956			1954	
11	1010.3	21.7	16.7	33.4	16.7	36.2	12.4	39.4 01	6.0 26	58 15.0	1.6 0.4	16.5	0.7	190.1	0.0	61.4	04	6.7
	1006.9	30.2	20.2					1980	1968	37 15.6	1.5 0.5			1979			1962	
12	1011.7	17.3	13.3	30.7	13.7	33.5	9.5	37.2 06	6.4 30	61 12.1	1.5 0.1	3.3	0.2	34.2	0.0	34.2	01	7.0
	1008.3	28.0	18.3					1968	1977	36 13.3	1.6 0.2			1978			1978	
YR	1005.5	24.1	19.9	34.2	20.6	44.1	6.8	46.1	2.8	67 21.1	2.9 1.5	911.1	39.4	1721.7	314.9	277.1		10.0
LY	1001.8	32.3	22.3							42 19.3	2.7 1.3			1976	1972			
YRS	29	29	29	29	29	29	29	31	31	29 28	29 16	30	30	31	31	31		29
	29	29	29							29 28	29 16							

STATION : Baroda (A) 42748 .. contd

	Weather						Wind speed				% Wind Direction									Total Cloud					Low cloud					Visibility				
MN	PPT	HAIL	THUN	FOG	D.STM	SQUA	62	61	19	0	N	NE	E	SE	S	SW	W	NW	0	0	T-2	3-5	6-7	8	0	T-2	3-5	6-7	8	F8	<1	1-4	4-10	10-20	>20
1	0.2	0.0	0.1	0.2	0.0	0.0	0	1	20	10	34	20	2	4	2	1	1	4	32	19	6	4	2	0	30	1	0	0	0	0	0.3	2.8	14.2	13.1	0.6
							0	2	27	2	26	14	2	0	1	4	11	34	8	19	6	4	2	0	28	2	1	0	0	0	0.0	0.1	2.3	16.9	9.7
2	0.2	0.0	0.1	0.2	0.0	0.0	0	1	18	9	25	18	4	8	5	4	2	5	29	19	4	3	2	0	26	1	1	0	0	0	0.1	2.1	12.1	13.1	0.6
							0	3	24	1	20	13	1	1	1	7	17	36	4	17	6	3	2	0	24	3	1	0	0	0	0.1	0.1	0.9	15.2	11.7
3	0.2	0.0	0.3	0.1	0.1	0.0	0	2	22	7	14	12	4	9	11	12	6	8	24	18	7	4	2	0	28	2	1	0	0	0	0.1	1.3	10.8	18.0	0.8
							0	4	26	1	11	5	2	1	1	11	24	41	4	16	8	5	2	0	26	4	1	0	0	0	0.0	0.1	0.9	17.0	13.0
4	0.1	0.0	0.5	0.0	0.1	0.0	0	2	24	4	12	5	1	2	10	25	14	20	11	19	6	4	1	0	27	2	1	0	0	0	0.0	0.4	9.8	18.9	0.9
							0	3	26	1	7	2	0	0	1	12	32	43	3	17	7	4	2	0	25	4	1	0	0	0	0.1	0.0	1.8	15.5	12.6
5	0.4	0.0	0.9	0.0	0.3	0.2	0	8	22	1	4	1	0	0	8	46	26	10	5	13	7	8	3	0	16	6	7	2	0	0	0.0	0.1	6.1	23.5	1.3
							0	10	20	1	2	1	0	0	4	38	33	19	3	17	9	3	2	0	23	7	1	0	0	0	0.0	0.1	1.7	17.4	11.8
6	7.1	0.0	4.1	0.0	0.2	0.2	0	10	20	0	1	1	0	2	15	51	25	3	2	1	3	10	11	5	4	6	15	5	0	0	0.0	0.7	9.0	19.3	1.0
							0	19	11	0	1	1	1	1	13	59	19	5	0	4	6	7	8	5	7	11	10	2	0	0	0.1	0.7	5.7	14.3	9.2
7	16.7	0.0	3.5	0.0	0.1	0.2	0	6	25	0	0	1	0	2	14	56	22	2	3	0	0	6	13	12	1	6	17	6	1	0	0.0	1.5	14.4	14.5	0.6
							0	16	15	0	0	0	0	2	17	59	17	2	3	0	0	6	14	11	1	7	17	5	1	0	0.1	1.0	8.3	16.1	5.5
8	17.0	0.0	2.7	0.0	0.0	0.0	0	3	27	1	1	0	0	1	9	55	27	4	3	0	1	3	12	15	2	6	16	6	1	0	0.0	1.4	14.2	14.8	0.6
							0	10	20	1	2	1	0	0	11	56	21	5	4	0	1	5	14	11	1	7	16	6	1	0	0.0	0.7	7.2	17.7	5.4
9	9.9	0.0	3.0	0.2	0.0	0.1	0	1	25	4	4	3	1	3	9	32	27	10	11	3	5	7	10	5	9	7	10	4	0	0	0.0	0.9	11.3	15.3	2.5
							0	4	24	2	5	6	1	1	6	28	31	14	8	1	7	9	9	4	3	13	11	3	0	0	0.0	0.3	3.3	13.3	13.1
10	1.7	0.0	1.6	0.3	0.0	0.0	0	1	23	7	11	15	8	14	11	6	5	6	24	13	8	5	4	1	23	4	3	1	0	0	0.1	0.7	8.5	18.3	3.4
							0	1	25	5	17	16	5	2	2	6	14	24	14	10	12	6	3	0	16	11	4	0	0	0	0.0	0.0	1.4	13.9	15.7
11	1.0	0.0	0.3	0.1	0.0	0.0	0	1	21	8	25	26	11	5	2	0	1	2	28	15	7	4	3	1	26	2	2	0	0	0	0.1	1.0	7.8	18.2	2.9
							0	0	25	5	21	19	11	1	1	2	4	26	15	15	7	4	3	1	23	5	2	0	0	0	0.0	0.1	0.9	15.8	13.2
12	0.3	0.0	0.2	0.1	0.0	0.0	0	1	22	8	33	27	5	4	1	0	0	3	27	16	7	5	2	1	29	1	1	0	0	0	0.1	1.2	11.9	15.9	1.9
							0	1	26	4	25	17	6	2	1	2	6	27	14	16	7	5	3	0	28	2	1	0	0	0	0.0	0.0	0.8	17.7	12.5
YR	54.8	0.0	17.3	1.2	0.8	0.7	0	37	269	59	14	11	3	5	8	24	13	6	16	136	61	63	65	40	221	44	74	24	2	0	0.8	14.1	130.1	202.9	17.1
LY							0	73	269	23	11	8	2	1	5	24	19	23	7	132	76	61	64	32	205	76	66	16	2	0	0.4	3.2	35.2	192.8	133.4
YRS				27					24				26									19					19						19		
									25				27									19					19						19		

Seismic Location

The project site lies in zone III as defined in IS: 1893 (Part 1)-2002. All the structures shall be designed complying with the requirements specified in IS: 1893 (Part-1) -2002 and (Part-4) - 2005.

Wind Pressure

Wind force on structures has been considered as per the provisions of IS: 875 (part-3)-1987. The basic wind speed of 39 m/sec at height of 10m above the ground level and wind assumed to blow in any direction and the most unfavorable condition shall be considered for design.

VOLUME - IIB

SECTION – C1

SPECIFIC TECHNICAL REQUIREMENTS

1.0.0 **SCOPE OF WORK**

1.1.0 **SUPPLIES**

1.1.1 Equipment and services to be furnished by the bidder for the Single Girder EOT with accessories as per the details given in data sheet A. Any equipment / accessories not specified in the specification but required to make the crane units complete and efficient shall also be under the bidder's scope of work.

Each EOT crane shall include all necessary items but shall not be limited to the following: -

1. Bridge girder.
2. End carriages complete with wheels
3. Electric Hoist
4. CT / L T drive arrangement
5. Electrical equipments
6. PVC Shrouded Conductor Bus Bar Type DSL with accessories for entire bay length
7. Rail for overhead & semi-gantry crane only.
8. Earthing arrangement.
9. Painting of crane.
10. Initial Fill of lubricant.
11. O & M Manual, drawings and documents.
12. Main isolating switch/MCCB (with earth fault protection) and power cable from 1.5M above ground / operating floor to down shop lead.

1.1.2 Maintenance Tools and Tackles

A complete unused new set of tools & tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied **.**Each tool and wrench shall be stamped, so as it can be easily identified for 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 specially protected against rusting in tropical climate 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 pliers	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: All maintenance tools & tackles are to be supplied in a tool box. Bidder to include additional tool, if required over and above specified.

1.1.3 Erection and commissioning spares (as indicated in price format)

1.1.4 Mandatory Spares as per Annexure-II

1.2.0 Services to be provided by the bidder

1.2.1. Packing, forwarding and transportation to site.

1.2.2. Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL

1.3.0. Inspection and Testing

1.3.1. Inspection and testing at Manufacturer's works

A. **Shop inspection and tests will include but not limited to the following -**

i. Identification, co -relation and verification of material test certificates for the important components like girders, major load carrying components, hooks, gears, shafts, wheels, wire rope drum, wire rope, gear box etc. For other components supporting test certificates or random check tests shall be conducted.

ii. Qualification of welder and welding procedure as per ASME section IX of ASTM -7.1

iii. 100% radiography of tension zone & 25% radiography of compression butt welds of load bearing members shall be carried over and all butt welds as per ASME- 165/ASTME 109 and acceptance norm as per ASME Section viii Div.1.

iv. For fillet welds visual inspection on all welds. Die penetration test (DPT) for fillet welds in the load bearing members as per ASME-165/ASTME 109 and acceptance norm as per ASME section VIII Div. 1.

v. Ultrasonic test on forgings and casting of critical components like hook, shafts, axles, gears, wheels, pulleys, etc. Ultrasonic test for casting as per ASME Section III NB 2572 & for forging as per ASTM A388.

Unacceptable defects in forgings are as given below: -

1. Cracks, flaws, seams and laps.
2. Defects giving indication larger than 4mm diameter equivalent flaw.

3. Groups of defects with maximum indication less than that from a 4mm dia, equivalent flaw, which cannot be separated at testing sensitivity if the back echo is reduced by 50%.
4. Defects giving indication of 2 to 4 mm diameter equivalent flaw separated by a distance less than 4 the size of the larger of the adjacent flaws.

vi. PT/MT on component with surface hardening as per ASTME -165 and ASTME 138 respectively with no surface defects.

vii. Gearbox trial run test as per AGMA standards.

viii. Verification of valid type test certificates and enclosure for electrical and electro mechanical items. If type test certificates of the similar items are not available, arrangement shall be made to conduct the same in the presence of BHEL/ Customers representative.

ix. Acceptance and routine tests (HV and insulation) for all electrical and electromechanical components and system as per governing specification

x. Functional and simulated operation test, sequencing, interlocks, safety, protection and alarm system. Test on CRANE / CRAB motors and other mechanical, electrical, electro-mechanical as per BHEL technical specification and or as per applicable code

xi. Cranes shall be completely assembled at manufacturers' works to check the misalignment of gears, shafts and other items. Gear box shall have the idle run for minimum two (2) hours.

B. Testing At Works

i. Deflection test of bridge girder at rated load.

ii. No load / load (SWL) / Over load test (running of CT at full load & hoisting mechanism at 125% of rated load.)

iii. Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177

iv. Measurement of speed of CT & Hoisting (lowering & raising) at rated load.

v. All Other tests as per IS-3177.

Note: Refer Annexure-III, Section-C, Volume II-B for "Shop test Procedure for Load/Overload testing of EOT cranes at Manufacturer's Works.

1.3.2 Testing at site

The following tests shall be carried out at site by **BHEL** as a part of Erection and Commissioning: -

a) All the tests as mentioned against S.N. 1.3.1 (B) above, with actual hook and wire rope.
b) Speed test at rated load for hoisting / CT and LT mechanism.
c) Brake test and working of electric hoist.
d) Any other test as per IS-3177-1999.

The successful bidder shall furnish their recommended procedure for carrying out the Erection, Commissioning & testing at site as mentioned above..

1.4.0 SURFACE PREPARATION, PAINTING & COLOUR SCHEME

Detailed painting procedure has been attached as Annexure IV, Section C, Volume IIB. Bidder shall follow the same.

1.4.1. Color Scheme

Color-coding procedure shall be as per enclosed Annexure-IV, Section C, Volume IIB.

1.5.0. **Drawing / design document for submission**.

Drawing/ design documents to be submitted as per list & submission schedule attached as Annexure-V.

Any other design document/ drawing as required by customer/ BHEL shall be submitted by bidder during detail engineering without any implication.

2.0.0. **Works Excluded**

2.1.0 Supply of steel gantry girders

2.2.0 For EOT crane:

The purchaser shall provide single point 415V, 3 phase, 4 wire and 50Hz power feeder at any point of the bay or in the middle of the bay as specified in the Data sheet A. Vendor shall provide main isolating switch at 1.5 M above the ground / operating floor level and cable required from isolating switch to DSL.

Any other supply required by the bidder shall be arranged by the bidder himself by using suitable transformer as per the specification.

3.0.0. **Number of drawing and documents for submission**

The number of prints / copies required for various drawing and documents are listed in Annexure –V, section-C, volume II-B of this specification.

4.0.0. **Deviations**

If the proposal submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the “Schedule of Deviations” 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 indicate ‘NO DEVIATION’ in the deviation format attached in volume III.

5.0.0. **Make of Sub - Vendor items**

Reference makes of bought out items will be as per Annexure-II, section C, volume II-B of the specification. No other make will be acceptable, until and unless specifically got approved by BHEL/Customer during detail engineering. Acceptance/non acceptance of same shall not have any impact on manufacturing & delivery schedule and on cost of crane.

6.0.0 **INFORMATION TO BE FURNISHED BY BIDDER ALONG WITH THE OFFER**

As detailed in volume-III

TECHNICAL DATA SHEET FOR SINGLE GIRDER EOT CRANE

S.N.	Description	Technical Particulars
1.0.0	GENERAL	
1.1.0	Name of Manufacturer	
	a) EOT Crane	*
	b) Crane motors	*
	c) Control Equipments	*
	d) Runway conductors	*
1.2.0	WEIGHT OF EQUIPMENTS	
	a) Crane weight (Kgs.)*	*
	b) Weight of DSL (Kgs.)*	*
1.3.0	Design, fabrication and testing of crane conform to standard / code	IS-3177 & 807 (latest edition)
1.4.0	Number of cranes	Refer Annexure-I/Section C-4
1.5.0	Crane Classification	Group M5 of IS: 3177 – 2006(latest edition) for structure and machinery.
1.6.0	Type of service	Indoor/Outdoor
1.7.0	Type of Crane	Refer Annexure-I/Section C-4
1.8.0	Capacity (SWC)	Refer Annexure-I/Section C-4
1.9.0	Span	Refer Annexure-I/Section C-4
1.10.0	Lift	Refer Annexure-I/Section C-4
1.11.0	Over Load Test	(125% of rated capacity-SWC)
1.12.0	Crane structure	Single girder
1.13.0	Design ambient temperature	50^0 C
1.14.0	Runway Rail	By Bidder for overhead & semi-gantry crane only
1.14.1	Type & Size	As per IS 3443.
1.14.2	Material	As per IS 3177.
1.14.3	Weight per metre	*
1.15.0	End carriage	
1.15.1	Material	M.S. as per IS: 2062, GR A/B
1.15.2	Manufacturer	*

1.16.0	Main girder	
1.16.1	Type & Size	Single girder/Braced I beam/Fabricated section
1.16.2	Material	M.S. as per IS: 2062, GR A/B
1.16.3	Vertical Deflection	Span/900
1.16.4	Manufacturer	As per Sub-vendor list
1.17.0	**Power supply**	415V ± 10%, 3 phase, 4 wire, 50 Hz+5% -5% variation. Combined voltage and frequency variation 10% (Shall be arranged by Purchaser at 1.5 M above floor level / operating level)
1.18.0	Control Supply	24 V/110V (Shall be arranged by vendor)
1.19.0	Load test	As per IS: 3177
2.0.0	**CRANE PERFORMANCE**	
2.1.0	**Operation**	Electrical -- From floor by means of Pendant Push Button controller suspended from panel
2.2.0	**Crane speed with full load**	
	a) Hoist (Full speed)	3 M/Min
	b) Hoist (Creep speed)	(10% of main speed through VVVF drive)
	c) Cross travel (CT)	15.0 M/min
	Cross travel (creep speed)	NA
	d) Longitudinal bridge travel (LT)	25.0 M/min
	Longitudinal bridge travel (LT)	NA
2.3.0	**Hoisting Mechanism**	Gear
2.4.0	**Type of power transmission**	Gear
2.5.0	**WIRE ROPE**	
2.5.1	Make	As per Sub-vendor list
2.5.2	Core / Construction	Steel/ fiber core as per IS-2266 / 6 X 36
2.5.3	Wire rope dia. (mm)	*
2.5.4	Wire rope fall	*
2.5.5	Material	Extra flexible Plough steel
2.5.6	Tensile strength	160-180 Kg /mm^2
2.5.7	Min. Breaking load	*
2.5.8	Conform to (Std. / code)	IS-2266

2.5.9	Factor of safety	6		
2.6.0	**LOAD HOOK / HOOK BLOCK**			
2.6.1	Make	As per sub-vendor list		
2.6.2	Type of load hook	C shank, Trapezoidal section-forged with swiveling type as per IS: 15560, with safety latch.		
2.6.3	Material of load hook	Forged steel		
2.6.4	Type of Bearing of hook suspension	Thrust ball bearing		
2.6.5	Make of Bearing of hook suspension	*		
2.6.6	Type and Material of hook suspension.	M.S. Fabricated		
2.7.0	**ELECTRIC HOIST**			
2.7.1	Model No.	*		
2.7.2	Duty	Class II (M5) as per IS: 3938 (latest edition)		
2.8.0	Type of DSL			
2.8.1	Long travel	PVC shrouded Cu conductor type		
2.8.2	Cross traverse	Flexible cable with Taut wire / Festoon cable arrangement		
2.9.0	**MOTORS**	M.H.	C.T.	L.T.
2.9.1	Make	As per sub-vendor list		
2.9.2	Rating (KW)	*		
2.9.3	RPM	*		
2.9.4	Qty.	1	1	2
2.9.5	Maximum number of poles	6	6	6
2.9.6	Type	TEFC, Sq. cage induction type,S4 duty, 40%CDF		
2.9.7	Enclosure	IP-55		
2.9.8	Number of start	150 starts/Hr.		
2.9.9	Insulation	Class “F” temp. rise limited to class “B”		
2.9.10	Margin	Maximum continuous motor ratings shall be 15% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.		
2.9.11	Over load protection provided	YES		
2.9.12	Ambient Design temperature	50^{o}C		
2.10.0	**LIMIT SWITCHES**			
2.10.1	Location	M.H.	C.T.	L.T

2.10.2	Qty.	1+1	1	1
2.10.3	Type	Gravity / Rotary gear	Two way lever	Two way lever
2.10.4	Method of actuation	Snap action	Shunt type	Shunt type
2.10.5	Material of contact	Silver Cadmium		
2.10.6	Make	As per Sub-vendor list		
2.10.7	Control Voltage	110V		
2.11.0	**Control panel**	A suitable control panel will be provided comprising of main contractor, motor contactor, single phase preventor with overload relays, transformer, fuses, MCCB's, etc. Rectifier panel for brake shall also be provided		
2.12.0	**BRAKES**			
2.12.1	Location	M.H.	C.T.	L.T.
2.12.2	Qty. / Motor	1	1	1
2.12.4	Type	DCEM Disc Type	DCEM Disc Type	DCEM Disc Type
2.12.5	Capacity	150% FLT	125% FLT	125% FLT
2.12.6	Size / rating	*		
2.12.7	Make	As per sub-vendor list		
2.13.0	**GEAR (HOISTING)**			
2.13.1	Make	As per sub-vendor list		
2.13.2	Type	Spur / Helical		
2.13.3	Material	Gear: EN8 / 20 Mn Cr5 / 16 Mn Cr5 Pinion: EN9/EN19		
2.13.4	Lubrication	Grease / Oil splash		
2.13.5	Reduction	*		
2.13.6	Bearing Make	*		
2.13.7	Bearing Type	Antifriction deep groove ball / roller bearing		
2.13.8	Hardness (BHN)	As per IS 3177 (Latest Edition)		
2.14.0	**GEAR (L.T. & C.T.)**			
2.14.1	Location	C.T.	L.T.	
2.14.2	Make	As per sub-vendor list		
2.14.3	Type	Spur / Helical	Spur / Helical	
2.14.4	Material	Gear: EN8 / 20 Mn Cr5 / 16 Mn Cr5 Pinion: EN9/EN19	Gear: EN8 / 20 Mn Cr5 / 16 Mn Cr5 Pinion: EN9/EN19	

2.14.5	Lubrication	Grease / Oil splash	Grease / Oil splash
2.14.6	Reduction	*	*
2.14.7	Bearing Make	As per sub-vendor list	
2.14.8	Bearing Type	Antifriction deep groove ball / roller bearing	Antifriction deep groove ball / roller bearing
2.14.9	Hardness (BHN)	As per IS 3177 (Latest Edition)	
2.15.0	**WIRE ROPE DRUM**		
2.15.1	Material	Fabricated from M.S. as per IS: 2062, Gr B and stress relieved or seamless pipe ASTM A106 Gr B	
2.15.2	Diameter	*	
2.15.3	Length	*	
2.15.4	Type	Flanged	
2.15.5	Type of grooves	*	
2.16.0	**WHEELS**		
2.16.1	Location	C.T.	L.T.
2.16.2	Diameter (mm)	*	*
2.16.3	Qty	*	*
2.16.4	Hardness	200 BHN (Max.)	As per IS 3177.
2.16.5	Material	EN8 / EN9	EN8 / EN9
2.16.6	Bearing make		
2.16.7	Bearing Type	Antifriction deep groove ball bearing	Antifriction deep groove ball bearing
2.16.8	Flange	Single	Single/double flanged
2.16.8.1	Conform to IS	3177	
2.16.8.2	Wheel Base	*	
2.17.0	**SHEEVE**		
2.17.1	Material	Cast steel	
2.17.2	Groove dia. / O.D. (mm)	*	
2.17.3	Bearing make	As per sub-vendor list	
2.17.4	Bearing Type	Antifriction deep groove ball bearing	

2.18.0	CONTROL PANEL	* Fabricated from CRCA steel sheet min 2 mm thick. * Degree of protection shall be IP 55. * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos. earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate thickness shall be minimum 3mm. * Gland plate shall be double brass compression type.	
2.18.1	Qty	One	
2.18.2	Make	As per sub-vendor list	
2.18.3	Location	On the crane	
2.18.4	Size	*	
2.18.5	Thickness of sheet	2 mm	
2.19.0	ISOLATING SWITCH		
2.19.1	Qty	One (1) no at 1.5 m from operating floor.	
2.19.2	Make	As per sub-vendor list	
2.19.3	Rating	*	
2.20.0	PENDANT PUSH BUTTON	Up /down / forward / Reverse push buttons (glow type) Indicative marking for easy operation shall be provided with indicating lamps	
2.21.0	Cables	Power	Control
2.21.1	Make	As per Sub-vendor list	
2.21.2	Material	As per requirement detailed elsewhere in specification.	
2.21.3	Type	*	*
2.21.4	Dearing factor to be considered	YES	YES
2.21.5	Voltage grade	1100V	
2.22.0	END STOPPER		
2.22.1	Qty.	4 Nos.	
2.22.2	Material	As per IS 2062	
2.23.0	BUFFER		
2.23.1	Location	CT	LT
2.23.2	Qty	Two	Four
2.23.3	Material	Rubber/Spring	Rubber/Spring

2.24.0	PAINTING	Refer painting specification
2.25.0	Control for Hoisting operations	Thru' VVVF drives
a.	Speed Control	Thru' VVVF with minimum 6 pulse design
b.	Starting torque of VVVF	Upto 400% typical
c.	Starting current	Less than 150 % of rated torque
d.	Temperature	Capable of withstanding upto 50°C without derating

Note:

- **Bidder to confirm the compliance of technical details as mentioned against each item. Deviation, if any shall be brought out clearly.**
- **The bidder shall fill Technical details against each item marked (*), during detailed engineering only.**
- **In case of discrepancy between the Data sheet and requirement given elsewhere in the technical specification, the more stringent of the two as per the interpretation of purchaser shall be applicable.**
- **For outdoor application crane anchorage and other requirement as per IS 3177 shall be fulfilled.**

MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 1x800 Wanakbori TPP
	ITEM: EOT CRANES - SINGLE GIRDER CRANE	REV Rev 00	PACKAGE: Single Girder EOT Crane
		DATE 30.07.15	P.O.NO –
	CAPACITY:	PAGE Page 1 of 5	BHEL NO:
			CONTRACTOR: BHEL

S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Agency D	Agency M	Agency C	Agency N	Remark
1	2	3	4	5	6	7	8	9		10			11
	FOR EOT CRANE												
1.0	**RECEVING INSPECTION**												
1.1	Structural-Plates/RSJ for Main Girders, End Carriages Trolley, Pulley, Gearbox housing , rope drum (if fabricated) etc.	Physical & Chemical	Major	Lab Analysis	100%	IS:2062 Gr. A or B / As per approved G.A.		MTC / Lab Report	_/	P/V	V	V	
1.2	Rope Drum (Seamless Pipe)	Chemical Mechanical	Major	Lab Analysis	1/pipe	Approved drg/DS ASTM A106 Gr A or B		Lab Report	_/	P	V	V	
		Flattening & Acid etching Test	Major	Mech test	1/pipe	no cracks, pitting, rusting, damage ,etc		I.R.	_/	P	V	V	
		Surface defect		Visual	100%								
1.3	Gears, pinions, shafts, axles & wheels (#)	Chemical& Mechanical,	Major	Lab Analysis	1/lot	(Relevant IS/appd drg)		MTC	_/	P	V	V	
			Major	UT	100%	ASTM A388/NOTE 1		I.R	_/	P	V	V	# If wheel, gears, pinions, shafts & axle diameter / thickness is equal to or more than 50 mm UT shall be carried out, ref & acceptance norm at S.no.1.4(UT of hook) to be followed
1.4	Hook	Chemical & Mechanical	Major	Lab Analysis	100%	IS: 15560 Related Std. As per appd. Drg./data sheet		MTC	_/	V	V	V	
		UT (above 50 mm dia)	Major	UT on shank portion only	100%	ASTM A388 / ASME Sec VIII Divn 2 – NOTE:1		MTC/ ALC/QCR /UT report	_/	P	V	V	

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		LEGEND: CLASS **A: Critical, B: Major, C: Minor**		DOC. NO.:
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MANUFACTURER	CONTRACTOR			NAME & SIGN OF APPROVING AUTHORITY & SEAL
NAME & SIGNATURE				

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		DATE 30.07.15	P.O.NO –
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S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record		Agency			Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
1.5	Wire Rope	Examination of report of breaking load	Major	Review of TC	100%	IS: 2266	IS: 2266	Mfr's TC	_/	P	V	V	
		Dimension & Type, construction		Measurement	100%	Appd G A drg	Appd G A drg	QCR		P	V	V	
1.6	Motors & cables.	Make/Type/Rating/ Routine test	Major	Visual / Measurement	100%	Appd drg/DS/Tech spec/Rel IS		I.R STC	_/	P	V	V	
	Brakes	Make/ type / rating/ HV/IR functional test											
1.7	Sheaves	Mech		Tensile & Hardness	1/lot	Approved Drg / Mfg drg		MTC	_/	P	V	V	
1.8	Limit switch, SFU, Relays, MCB, Fuses, Push buttons Etc	Make/Type/Rating Functional /continuity	Major	Review of TC	100%	Appd drg./DS/Scheme/ Spec./Manu.Std		QCR Routine TC/COC of mfgr	_/	V	V	V	
	Control transformer	Make , type, rating, input/output											
1.9	DSL	Make , type, rating, Dimension.	Major	Review of TC	100%	Appd drg./DS/Scheme ./ Manu.Std		QCR Routine TC/COC of mfgr.	_/	V	V	V	
2	**INPROCESS- INSPECTION**												

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MANUFACTURER	CONTRACTOR	LEGEND: CLASS **A: Critical, B: Major, C: Minor**		DOC. NO.:
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	ITEM: EOT CRANES - SINGLE GIRDER CRANE	REV Rev 00	PACKAGE: Single Girder EOT Crane
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S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record		Agency			Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
2.1	WPS,PQR & WPQ	Verification of approval				WPS,PQR & WPQ			_/	P	V	V	Llyod/EIL/NPCIL approved WPS to be used. Procedure & welders qualified by Llyod/EIL/NPCIL be used/ deployed.
2.2	Assembled gear box	No load run test backlash & contact pattern, noise, vibration & oil temp rise (for oil lubrictd)	Major	Performance	100%	Apprvd drg/DS/Mfg std Noise 85dbA max, vibration 75 microns max, oil temp rise – 30 °C above ambient max			_/	P	V	V	
2.3	Welding of end carriage, Main Girder, Trolley , rope drum (if fabricated) etc.,	DPT of Welds(all)	Major	LPI	100% on butt&10% on fillet	ASTM E165 or Eq. / No crack or linear indication		I.R.	_/	P	V	V	
		RT of Butt weld	Major	RT	100%/10%	ASME Sec.VIII,Div.1, UW 51/52		RT film & report	_/	P	V	V	@RT-100%, for Butt weld in tension & 25% in compression. 100% RT on butt weld for fabricated rope drum
2.4	Hook	Dimension	Major	Measurement	100%	Mfr's drg / Related Std. As per appd. Drg./data sheet/		QCR	_/	P	V	V	
		Proof Load	Major	Load Test		IS: 15560	IS: 15560	QCR	_/	P	V	V	
		NDT after proof load	Major	LPI	100%	ASTME 165 or Eq. / No crack or linear indication		I.R.		P	V	V	
2.5	Gears, pinions, shafts, axles & wheels (#)	Hardness Surface Defect (after machining)	Major	DPT	100%	Approved Drg/ Data sheet ASTM E-165 No linear indication		MTC	_/	P	V	V	
3	**FINAL INSPECTION**												

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MANUFACTURER	CONTRACTOR
NAME & SIGNATURE	

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DOC. NO.:

NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 1x800 Wanakbori TPP
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S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Agency				Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
3.1	Overall dimensions	Dimensions (span) level, alignment	Critical	Measurement	100%	Appd GA drg & IS: 3177/IS:3938		I.R.	_/	P	W	V	FUNCTIONAL CHECK OF PENDENT &
3.2a	Assembled Crane along with individual control panel & pendant station	Current & speed for Cross Travel & Hoisting, interlocking sequencing, inching operation, Limit switch operation	Critical	Measure /Verify	100%	Appd GA drg & IS: 3177/Appd data sheet		I.R.	_/	P	W	V	PANEL FOR SPECIFIC CRANE
		Deflection at SWL		Measurement					_/	P	W	V	
3.2b	Overload test at 125% of SWL	Holding capacity of brakes		Lifting from mid Air	100%	Appd GA drg & IS: 3177/ IS:3938/ Appd data sheet		I.R.	_/	P	W	V	
3.3	Control Panel & Pendant station	1. Make/type/rating of Bois.	Major	Visual, Operational & Functional	100%	Approved drawing / Data sheet / is: 3177		I.R.		P	W	V	
		2.IR-HV functional &interlocks	Major	Measurement	100%								
		3.DOP by paper insertion for panel	do	do	100%	Paper should not go easily.				P	W	V	
3.4	Painting	Examination – shade	Minor	Visual & measurement	100%	Customer's / Approved Painting Procedure				P	V	-	
		Dry FilmThickness	Major	Measurement	Sample					P	V	-	

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									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11

NOTE1:'**' When back wall echo is set to 100% in sound area then,
a) defect echo shall not exceed 20%
b) Back echo shall be minimum 80% in any area

2.Attached MQP is for reference only. Customer comments in MQP during engineering shall be incorporated by the vendor without commercial implication

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NAME & SIGNATURE				

VOLUME - IIB

SECTION – C2

CUSTOMER SPECIFICATION – GENERAL REQUIREMENTS

CONTENTS

ANNEXURES

MISCELLANEOUS CRANES

1.00.00 GENERAL INFORMATION

This section covers the Electric Overhead Traveling Cranes (EOT) which will be required for handling various power plant equipment for erection and maintenance purposes. An indicative list of such cranes has been provided in Annexure-I. Apart from these locations, E.O.T cranes may also be provided to other locations, which the Bidder feels necessary subject to approval of Consultant/Owner.

2.00.00 CODES AND STANDARDS

The design, manufacture and testing of the crane shall conform to the latest editions of the following codes and standards

2.01.00	IS : 807 -	Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.
2.02.00	IS : 3177 -	Code of Practice for Design of Overhead Traveling Cranes and Gantry Cranes other than Steel Works Cranes.
2.03.00	IS : 1835 -	Round Steel Wires for Ropes.
2.04.00	IS : 2266 -	Steel Wire Ropes for General Engineering Purposes.
2.05.00	IS : 3443 -	Crane Rail Sections.
2.06.00	IS : 3815 -	Point Hook with Shanks for General Engineering Purpose.
2.07.00	IS : 5749 -	Forged Ramshorn Hooks.
2.08.00	IS : 816 -	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.
2.09.00	IS : 823 -	Code of Practice for Use of manual Metal Arc Welding of Mild Steel.
2.10.00	IS : 1181 -	Qualifying Tests for Metal Arc Welders (Engaged in Weldi Structures other than pipes).
2.11.00	IS : 1323 -	Code of Practice for Oxy-Acetylene Welding for Structural Work in Mild Steel.
2.12.00	IS : 9595 -	Recommendations for metal arc welding of carbon & carbon - manganese steel.
2.13.00	IS : 15560 -	Point Hook with Shank up to 160 tones - Specification

2.14.00 All electrical installation work shall comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended upto date.

2.15.00 ANSI-830.2.0 - Safety codes for overhead and Gantry Cranes.

In case of any contradiction between the above mentioned codes and standards (item 2.01.00 thru' 2.14.00 above) and this technical specification, the later will prevail. However, nothing in this specification shall be construed to relieve the Contractor of his responsibility to comply with what is mentioned against item 2.13.00 above.

3.00.00 SCOPE OF WORK

3.01.00 Scope of work includes supply of the following :

3.01.01 The required no. of E.O.T cranes as indicated in Annexure-I having duty and service conditions as specified hereinafter alongwith all accessories.

3.01.02 Runway rails for entire runway length alongwith railclamps, all inserts, insert plates, anchor bolts, nuts, buffers & stops, limit switches etc. as required.

3.01.03 Runway conductors for the entire runway length complete with all insulators, supports, support brackets, fixing clamps, bolts, nuts etc. as specified and as required to complete the installation. Power supply cabling including isolating switch complete alongwith electrical items, attachments and accessories as required to feed power to the runway conductor.

3.01.04 All protective devices, anticollision limit switches etc. as required for the crane.

3.01.05 All facilities, accessories and attachments for single ~~and tandem~~ operation of the cranes.

3.01.06 Bridge and trolly current collectors and bridge cross conductors alongwith all wirings etc. for the crane as specified and as required to complete the scope of work.

3.01.07 Crane components shall be provided with lifting lugs, eye-bolts etc. at suitable locations for handling assembling, lifting and placing into position.

4.00.00 SPECIFIC PERFORMANCE REQUIREMENTS

4.01.00 Capacity

4.01.01 The safe working load (Y) for E.O.T cranes shall be computed as

Y = 1.25 a (For all other Cranes)

Where,a = Single heaviest equipment expected to be lifted.

4.02.00 **Highest Position**

The highest position reached by the lifting hooks should be such that during operation, the minimum vertical critical clearance between bottom of the equipment being handled and the top of any permanent structure or equipment in the operating area should be at least one metre.

4.03.00 **Lowest Position**

4.03.01 The lifting hooks of the turbine hall cranes should reach upto the ground level (0 m). The auxiliary hooks should reach upto the condenser pit level.

4.03.02 In case of all other E.O.T. cranes, the lifting hooks should reach upto the floor of its operating area or sump pits as necessary.

4.04.00 **Horizontal Clearance**

4.04.01 The lifting hooks in vertical position should reach at least upto 5m from the end stopper in case of turbine hall cranes and upto 2.5m in case of all other cranes.

4.04.02 Either the main or the auxiliary hook in vertical position should reach at least upto 1.5 m from the runway rails in case of turbine hall cranes and upto 1.0 m for all other cranes.

4.05.00 If safe and reliable handling necessitates more operating space for the E.O.T. cranes, the same shall be provided.

5.00.00 **DESIGN & CONSTRUCTION**

5.01.00 **General**

5.01.01 In the design of components on the basis of strength, factor of safety shall not be less than five (5) based on ultimate strength. Impact, fatigue, wear and stress concentration factors shall be taken into account, wherever applicable. Mechanism class shall be as indicated in the Data Specification Sheet.

5.01.02 The crane shall be rigid in construction and all movements shall be smooth and non-jerky. Acceleration for cross travel and long travel motors shall be limited to reasonable values as to preclude any swinging of the load.

5.01.03 Drives shall be designed with adequate margin to give best performance and efficiency. Safety arrangements shall be incorporated to prevent damage to motors on account of mechanical overload and electrical faults and to gearing, shafts, etc. due to over-stressing and other detrimental conditions.

5.01.04 All materials shall be of tested quality and shall conform to the specification requirements and standards mentioned and shall be new and first class in all respects.

5.01.05 Castings and forgings shall be of tested quality and shall conform to their respective material specifications and shall be free from flaws and objectionable imperfections, machined true and in a workman like manner.

5.01.06 No wood or other combustible material shall be used unless specifically approved by the Owner/Consultant.

5.01.07 Proposals for repair or any similar operations involving plugging, welding, boring or addition of metal to the original castings or forgings shall be submitted to the Purchaser and his approval must be obtained before any such work is carried out. Drawing showing details and location of such repairs shall be submitted to the Purchaser.

5.01.08 All fabrication by welding shall be carried out by qualified and certified welders as per IS : 1181.

5.01.09 Design shall provide for easy maintenance of all parts, particularly the wheel bearings on end-trucks.

5.01.10 Temperature Effects

Where any portion of the structure is not free to expand or contract under variation of temperature, allowance shall be kept for stress resulting from these conditions; the co-efficient of expansion for each degree centrigrade variation of temperature above and below normal being taken as 0.000012 for mild steel. The maximum range of variation of temperature shall be as given in the Lead Specification. Cl. 8 of Section II of IS: 800-1962 Code of practice for use of structural steel in General Building construction - shall also apply.

5.01.11 Maximum use shall be made of shop fabricated sub-assemblies.

5.01.12 Alternative design to those prescribed in specifications will be considered only if found technically suitable and acceptable to the Owner in the light of requirements and accompanied by substantial reduction in cost.

5.01.13 Material of Construction

The material of construction of the major components of the crane shall be as indicated in the Data Specification Sheet. Manufacturers are however free to use alternative material, which are superior for the intended service. But in all cases they are required to obtain prior concurrence of Owner after furnishing chemical and physical properties of the offered material and any other information that may be asked for by the Purchaser.

5.01.14 Load Indication

The crane bridge shall have permanent inscription in English on each side, readily legible from operating floor, stating manufacturer's name, serial no., the year of manufacture and the safe working load.

5.02.00 **Structural Design Consideration**

5.02.01 Minimum thickness of metal

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. The chequered plates for platforms shall be minimum 6 mm thick over plain.

5.02.02 Accessibility for maintenance

All structural parts shall be designed so that they are accessible for periodic cleaning, brushing and painting. All rivets/bolts shall also be accessible for periodic checking.

5.02.03 Ruling dimensions and ratio

a) For compression members, the slenderness ratio shall not exceed 120. In case of other load carrying members and subsidiary members the slenderness ratio shall not exceed 180.

b) For girders, the following values of maximum span to depth ratio shall be governing :

Plate girders : Span/depth = 18

Lattice girders : Span/depth = 12

5.02.04 Connections

a) Unless otherwise specified, only rivetted or welded joints shall be used.

b) Where welding or riveting is not practicable, turned and fitted bolts shall be used, preferably as per IS-1364 and IS-1367.

c) Minimum number of rivets or turned and fitted bolts in a connection shall not be less than two.

d) Black bolts shall not be used in main structures and high tensile bolts shall not be used unless approved by the Owner. Bolts shall preferably be not used in tension.

e) Where bolts pass through sections having tapered flanges, tapered flats shall be welded to inside of the flanges. Tapered washers shall not be used.

f) Transverse fillet welds on load carrying members shall be avoided. If side fillets are used in end connections, the length of each side fillet should not be less than the edge distance between the fillets.

g) Butt welds on structural members under tensile stress shall be checked by Radiographic examination as and when directed by the Owner/Consultant.

h) 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 axis of the splices are in line with the gravity axis of the member to avoid eccentricity.

5.02.05 Deflections and Camber

a) The total maximum vertical deflection of the girders for the live load plus trolley and not including impact or dead load of the girder shall not exceed limit of Span/900.

b) The girders shall be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.

5.03.00 **Bridge Girder and End Carriage**

5.03.01 The crane shall have single girder or double girder as required.

5.03.02 The bridge girder shall be box section type or braced I beam type as per standard design of the manufacturer. The exterior surface shall be smooth and as free from projections etc. as possible to minimise dust collection on it.

5.03.03 Single girder cranes shall be provided with suitable truss for supporting the bridge drive machinery and motor.

5.03.04 The crane bridge shall be carried on end trucks of suitable design. Each end truck shall be built up from steel plates welded together to form a closed box section with opening at each end to receive the wheels. Welded to the trucks shall be steel sections to form bearings for the wheel axles and the driving shaft. End trucks shall be provided with rail sweep and bumper. They shall also be provided with suitable jacking pads for maintenance of the wheel and bearings. The location of the jacking pads shall be such that it will not interfere with the maintenance of the wheels and its bearing. Single girder crane will be provided with suitable truss for supporting bridge device machine & motor.

5.03.05 Driving wheels shall be of the double flange and taper tread type and shall be ground to equal diameter in pairs. Wheel axles may be either of the stationary or rotating type as per standard of the manufacturer. If stationary type, they shall be prevented from turning in the truck by means of a key plate fitting into a slot in the end of the axle and if rotating type, wheels shall be keyed to them.

5.03.06 Where more than two bridge wheels are used per end truck, the end truck shall be split into two sections, each carrying one bridge independent of other. Two sections of the end truck shall be joined by suitable joining device that will ensure uniform wheel loading. Steel pads shall be welded on the top of end trucks where the girder rests and shall be machined to receive the girder ends.

5.03.07 Trolley travel rail ends shall be curved upwards to stop the trolley smoothly and prevent it from leaving the rails in case of over travel at its maximum speed.

5.03.08 End trucks shall be equipped with spring/rubber buffers and rail sweep for bridge travel. The rail sweep shall be such that it can push away any object that may fall on the runway. The buffers shall be of substantial design and suitable for engaging the stops at the end of runway.

5.03.09 Breathing holes shall be provided in completely enclosed welded box type girders. Drain holes shall be provided in all places where water or oil is likely to collect. Where practicable, means of access shall be provided for inside inspection of completely enclosed box girders.

5.03.10 In bridge girder strength calculations, the trolley rails and chequered plates shall not be considered as load carrying members.

5.04.00 **Trolley Frame**

5.04.01 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.

On bottom of trolley frame, on each side shall be a double spring bumper to enagage stops at each end of the bridge.

5.04.02 Equaliser sheaves shall be mounted on the trolley frame in such a manner that deflection resulting from the force on the sheaves are not directly transmitted to the hoisting mechanism.

5.04.03 Sheaves shall be so arranged on the trolley that rope reeving arrangement resulting therefrom will ensure a lifting of the load in almost a vertical line with minimum of swing or side-movement.

5.05.00 **Platforms and Ladders**

5.05.01 Safe means of access shall be provided to the operator's cab and 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.

5.05.02 One metre high double tier handrail and suitable toe-boards shall be provided along the entire length of platform (on the bridge), which shall not be less than 750 mm wide. One platform for full span length on each side of the crane girder.

5.05.03 Every platforms shall be provided with steel chequered plate top and be securely fenced with one metre high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely.

5.05.04 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.

5.05.05 Access to operator’s cabin from bridge girder platform shall be by staircase having adequate width and proper sloping.

5.06.00 **Operation**

The crane shall be operated either from cabin in the crane bridge or from a pendant control station as specified in Data Specification Sheet.

5.06.01 Operator's Cabin

a) The operator's cabin shall be closed type, suitable for indoor service & complete with light, air-conditioning & seat. The cabin shall be located on one end of the crane bridge and under one of the bridge girders, so that it is offset to one side. The cabin shall be provided with guarding hand rails and the floor shall be covered with electric insulating carpet. A clear headroom of 2000 mm shall be ensured within the cabin.

b) A foot operated type warning gong shall be provided within the cabin. The cabin shall be of ample size to contain controllers, protective pannel, main isolating switch and other accessories required for operating the crane. A ten (10) lbs. capacity portable CO_2 fire extinguisher shall be provided in the cabin.

c) Provision shall be there for emergency exit of the Crane Operator at three convenient positions in case of power failure.

5.06.02 Pendant Station

a) The pendant station shall locate the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 metre above the operating floor.

b) With pendant operation, foot operated bridge travel brake and the drum controllers need not be provided.

5.07.00 **Repair Cage**

5.07.01 A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. In case, the trolley current collectors are located below trolley rail level on the inside webs of the bridge girders, guards shall be provided on the trolley to prevent the hoisting ropes from coming in contact with conductors as well as a repair cage shall be provided on the trolley to attend these conductors.

5.07.02 Repair cages shall also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels.

5.07.03 The repair cages shall be adequately sized, guarded for safety and correctly located for the intended service. Suitable access to the cages shall be provided.

5.08.00 **Lifting Hook Block Assembly**

The lifting hook block assembly shall be ramshorn type or approved equal for capacity greater than 40 Tonnes and point hook with shank for capacity below 40 Tonnes and shall be of steel construction. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely on its bearings. Safety latch shall be provided in the hook.

The sheaves of the hook block shall be encased in an oil tight casing permitting generous lubrication of wire ropes and sheaves and also preventing accidental tapping of hands. Sheave pulley block shall be provided with ball/roller bearings.

All sharp edges on the hooks shall be eliminated to prevent damage to the sling ropes. The hooks shall conform to the requirements of IS: 3177.

5.09.00 **Gearing**

5.09.01 Gears in the speed reducer unit for bridge drive and also all hoists and trolley drive gearing shall be enclosed in substantial housing and shall operate in oil bath. The oil shall have additives of approved quality and shall be of approved viscosity at standard temperature (say 60ºC). The housing shall be of sufficient design not to permit a temperature in excess of 90ºC for the oil bath and shall be adequately supported and readily removable without disturbing the gear assembly.

5.09.02 Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.

5.09.03 Gears shall have tooth form and modules as recommended in IS-3681 and they shall be adequately designed to stand shock load and vibration and shall not be excessively noisy in operation. The ratings of gears shall be established as per IS : 4460.

5.09.04 Spur and helical gears only shall be used for reduction gearing.

5.09.05 Mounting of the gears shall be such that axial thrust on the bearing is minimum. Centre distance of the connecting shafts shall be as close as possible to the theoretical value. Shafts shall be designed to keep their deflections within permissible limits.

5.10.00 **Bearing**

5.10.01 The type of bearings for various parts shall be as per IS-3177 and standard of manufacturer.

5.10.02 Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as practicable to exclude dirt and prevent leakage of oil or grease. Arrangement for centralised lubrication of bearings shall be tried to the maximum extent possible and a detailed scheme for the same shall be furnished alongwith the tender.

5.10.03 Suitable drip pans shall be provided as required to collect oil and grease which may drop from operating parts. All drip pans shall be accessible for draining and cleaning.

5.10.04 All bearings of the gearing shall be antifriction type. Angular contact ball or taper roller bearings shall be used wherever necessary. The bearings shall correctly locate the shafts while allowing for thermal expansion of the shafts. Bearings shall be enclosed in suitable housing with proper holes and plugs to prevent any ingress of dirt and to permit easy lubrication of the bearings.

5.11.00 **Guarding**

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

5.11.02 Protection guards to live electrical wirings/conductors shall be provided.

5.11.03 Suitable guards to revolving shafts and coupling, long travel cross shafts and gears, shall be provided.

5.11.04 The sheaves of the hook block fitted with two sheaves or fewer shall be guarded to prevent tapping of a hand between a sheave & the running rope.

5.11.05 Effective means of guiding the wire ropes over the sheaves shall be provided so as to prevent dismounting of rope from the sheave grooves even when a slack rope condition is developed.

5.11.06 All openings in footwalk flooring, for access to bottom chord platform, if any, and to other inspection platforms, shall be provided with covers having suitable locking means to avoid any accidental opening.

5.11.07 All electrical panels, resistance boxes shall have suitable rain/ dust hoods over them to prevent water and building construction material falling on them, as it is apprehended that erection and commissioning of the crane might have to be taken up before completion of the building roof.

5.12.00 **Runway Rails**

5.12.01 Crane runway rails with bolts and nuts and complete with shims, anchor bolts, inserts and other fixtures for fixing the rails to crane girders shall be under the scope of supply of the present specification.

5.12.02 The length of the rail supplied shall be sufficient to cover the whole of runway length. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.

5.12.03 The rail section shall be as per IS: 3443.

5.13.00 **Trolley Rail**

5.13.01 The specification includes the supply of trolley travel rails complete with fixtures for fixing the rails to the body of crane.

5.13.02 The length of the rail supplied shall be adequate for maximum permissible trolley travel. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.

5.14.00 **Rail Joints and Fixing**

5.14.01 The rails shall be butt jointed by either thermit welding or fusion welding process. The Contractor shall get his proposal for edge-preparation of rails, welding procedure and sequence, approved in advance by the Purchaser/ Consultant.

5.14.02 The schemes of securing the rails to the gantry girder/bridge structure with clamps, bolts and nuts, their alignment etc. shall be subject to the approval of the Purchaser/Consultant.

5.15.00 **Tolerances**

The limits of tolerance as specified in the Data Specification Sheet shall be observed.

5.16.00 **Rail End Stops**

Rail end stops of adequate design shall be provided on both ends of the runway. The end stop location and arrangement shall be such that the unavailable length of runway (for crane operation) on any end is a minimum.

5.17.00 **Drive Mechanism**

5.17.01 Equal driving effort shall be applied at each drive wheel of bridge and trolley to prevent one end from travelling faster than the other.

5.17.02 For bridge, the torsional deflection in the cross shaft shall be limited to safe value as per applicable code.

5.17.03 For bridge drive, the motor shall be located at mid position of the span. If twin motors are used for drive, motors shall be equidistantly located at each wheel end. Suitable interlock shall be provided to prevent single motor operation at any time.

5.17.04 Trolley drive shall be achieved by single motor in which the motor shall drive a common output shaft through proper gearbox and tractive power shall be transmitted to the geared wheels by means of pinions mounted on both ends of the output shaft.

5.17.05 All machineries for the drive unit shall be properly aligned. Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement wherever necessary. Wherever components of considerable amount of inertia is directly mounted on the high speed shaft (e.g. brake drum, couplings, etc.) they shall be balanced statically to minimise vibration.

5.17.06 Motor ratings shall be calculated keeping margin of at least 15% over the maximum power requirement. Further, the hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed. For other details the clause no. : 5.19.00 below shall be referred to.

5.17.07 Along with the drive mechanisms adequate brakes shall be provided as detailed in clause no. : 5.20.00 below. Selection and design of brakes shall be complete responsibility of the manufacturer. The brakes shall be of accurate rating to stop each motion within a very short distance and in a safe and smooth manner.

5.18.00 **Crane Electricals**

5.18.01 The crane(s) shall be furnished complete with all electrical equipment, accessories (like drive motors with VVVF Drives, conductors, insulators, protective & operating devices, cables, current collectors, main disconnecting switch, Illumination etc.) and cabling/wiring as may be necessary for the efficient and safe operation of the crane.

5.18.02 The crane electricals shall be designed for satisfactory operation from the available power supply as given in the Data Specification Sheet.

5.18.03 All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion.

5.18.04 All electrical equipment shall be laid out so that they are readily accessible for inspection and maintenance.

5.18.05 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 resistance (FRLS) cables & wiring by Heat resistance PVC wires with stranded conductors.

5.18.06 All electrical equipment shall be laid out so that they are readily accessible for inspection and maintenance.

5.18.07 The hoist structures, motor frames & metal comes of all electrical equipment on EOT crane/hoist shall be effectively grounded as per Indian Electricity Rules.

5.18.08 If the pendent control is of metal, it shall be earthed.

5.18.09 All equipment offered shall have suitable provisions for termination and connection of power and control cable inclusive of cable end box, brass compression glands terminal lugs and terminals. Incoming switch-fuse shall be provided at each panel for incoming AC/DC power supplies.

5.19.00 **Drive Motors**

5.19.01 All crane motors shall be totally enclosed fan cooled (TEFC) type, having class-F stator insulation and class-F rotor insulation for slip ring motors & class-F insulation for squirrel cage motor with temperature rise limited to class-B operation in all cases.

5.19.02 Motor enclosures shall conform to the degree of protection IP-55.

5.19.03 Motors shall be slip ring wound rotor type, designed for crane duty requirement of frequent starting. Reversing and plugging motors of single girder EOT crane shall also be squirrel cage type. All motors shall be suitable for VVVF operation.

5.19.04 Motors shall suit the duty class S4

5.19.05 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.19.06 The motor shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage.

5.19.07 Starting current shall not exceed 6 times full load current for creep speed motor and 2.00 times full load current for slip ring motor.

5.19.08 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.19.09 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.

5.19.10 The starting torque developed by motor at minimum permissible voltage at start i. e. 80% of rated voltage shall be more than the starting torque requirement of driven equipment by margin of at least 10% throughout the range of starting in order to account for higher starting torque required during service due to wear and tear.

5.19.11 Motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energised shaft rotating at 125% rated speed in reverse direction.

5.19.12 The motor shall start smoothly and rapidly and maintain steady operation. The motor characteristic such as speed, starting torque, acceleration time etc. shall be properly co-ordinated with requirement of driven equipment. Maximum torque shall not generally be below 200% of full load torque.

5.19.13 Breakaway torque and pullout torque shall be properly co-ordinated with speed torque characteristic of the driven equipment. The torque speed characteristic of motor super imposed thereon, driven equipment torque speed characteristic at 100%, 90%, 80% and 110% of rated voltage shall be furnished to establish capability to start the motor successfully with load connected.

5.19.14 The locked motor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3.0 seconds for motors upto 20 seconds starting time.

5.19.15 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.19.16 Hot thermal withstand curve shall have a margin or at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

5.19.17 Each motor more than 30 KW rating shall be provided with space heater, sized to maintain motor internal temperature above dew point when the motor is idle.

5.20.00 **Brakes**

Selection and design of brakes shall be such as to meet the following requirements

5.20.01 Service Brake

a) Double-shoe type service brakes shall be provided for each motion of the crane and its hoists. The service brakes shall apply automatically when power supply to the drive motor is cut-off or fails.

b) Service brakes for main hoist motion shall be electro- hydraulic thruster type, for all double girder cranes either cabin or pendant operated and electromagnetic disc. type for single girder crane; adequately sized to arrest motion and hold at rest any load upto and including test load at any position of the lift.

5.20.02 Hoist Control Braking Means

Hoist motion (both main and auxiliary) shall be provided with a self-contained sturdy braking system, electro- hydraulic thrustor type, to control the speed of hoisting as well as lowering down to 10% rated speed. The braking system shall be reasonably uniform and effective with all loads (from no-load to full-load) on hooks.

5.21.00 **Main Disconnect Switch**

5.21.01 Main disconnect switch shall be metal-clad, 3-pole, load-break type in IP-54 enclosure, complete with compression brass glands and lugs to suit Purchaser's power supply connection.

5.21.02 The switch shall be provided with "Power On" red indication lamp (Clustered LED type) and shall be suitably located so that it can be manually operated from the operating floor level.

5.21.03 Power leads shall run from the main disconnect switch to the runway conductors.

5.22.00 **Runway Conductors (Down Shop Leads)**

5.22.01 The runway conductors shall be four (4) in number for three phase supply and ground.

5.22.02 The runway conductors shall be of M.S. angle sections / PVC shrouded Busbar (in case PVC shrouded Busbar, PVC shrouds shall be full voltage class and temperature rise of Busbar shall be 85^{o}C), liberally sized so as not to exceed current density of 0.42 Amps/sq.mm. However, for small capacity cranes having lower spans i.e. compressor house crane, flexible copper cable will be used.

5.22.03 Sufficient allowance (minimum 20%) for wear and tear shall be provided over the calculated conductor size.

5.22.04 The runway conductors shall be supported on brackets and insulators from the crane girder with sufficient spacing in between the conductors.

5.22.05 The collector system per conductor shall be top-running type having spring loaded cast iron/carbon metallic shoes to maintain adequate contact pressure.

5.23.00 **Cross-Conductors on Bridge**

5.23.01 Cross conductors on bridge shall be flexible trailing cable system mounted on retracting supports (festoon type).

5.23.02 Alternatively cross conductors of M.S. angles with shoe collectors, similar to the arrangement of runway conductors may be offered.

5.24.00 **Power Distribution Equipment**

5.24.01 From the main collector shoes, wiring shall be extended to two (2) nos., 3-pole, load-break, safety disconnect switches -one at the bridge near the collector and the other in operator's cabin within easy reach.

5.24.02 The safety switches shall be capable of cutting-off the supply to all power driven and associated equipment of the crane but not the auxiliary loads such as fans, lights etc.

5.24.03 From the safety disconnect switches, wiring shall be extended to a protective panel, containing the following as a minimum :

a) One triple pole incoming supply disconnect switch.

b) One triple pole main magnetic contactor with HRC fuse backup, ON-OFF push buttons and RED-GREEN indication lamps (LED type).

c) Motor feeders, each comprising of triple pole fuse switch unit with thermal overload (hand reset) relays for short circuit and over load protection in all three phases of the motor.

d) Outgoing feeders with double-pole switch fuse units for auxiliary loads such as control supply, lights, fans, etc. with atleast one spare feeder.

5.25.00 **Voltage Drop**

5.25.01 All conductors and cables/wires shall be so sized that the voltage drop measured between the main disconnect switch and motor terminals shall not exceed 3% of rated voltage.

5.25.02 The voltage drop shall be computed using the total running current of all crane motors that can operate simultaneously and with rated crane load.

5.26.00 **Safety Interlocks**

5.26.01 Disconnect Switch

a) The operating handle of the main/ safety disconnect switch shall be mechanically interlocked with enclosure cover such that the same can not be opened unless the switch is in OFF position.

b) Main/ safety disconnect switch shall have provision of pad-locking in OFF position.

5.26.02 Main Contactors

a) The main contactor shall be electrically interlocked so that it can not close unless all the motor overload relays are RESET and all controllers are in OFF position.

b) The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

5.27.00 **Emergency Switch**

Mushroom type emergency STOP push buttons to open the main contactor shall be furnished - at least one in operator's cabin and two on bridge platform within easy reach.

5.28.00 **Crane Controls**

Fully magnetic control shall be furnished complete with master controller (applicable for cab operated cranes only and not for pendent controlled cranes) for each motion, complete with contactors, time lag relays, plugging protections, resistors and other accessories to meet the following control requirement :

5.28.01 Hoist Motions (both main and auxiliary)

a) VVVF drive motor control or Conventional rotor resistance control shall be used in both hoisting and lowering directions, with a minimum of five (5) speed steps in each direction. VVVF controlled by voltage and frequency is also acceptable in such case reliable and proven design shall be provided by the Bidder.

b) Hoist control shall be designed to achieve "Inching Speed" of 10% the rated speed in both hoisting and lowering directions with loads (no-load to full-load) on hook.

5.28.02 Travel Motions (both bridge and trolley)

Conventional rotor resistance control shall be used in both forward and reverse directions, with a minimum of four (4) speed steps in each direction.

However, the clause no. 5.28.01 & 5.28.02 is applicable for all cabin operated cranes. For double girder cranes having slip ring hoist, CT & LT motors, the speed steps are basically occurring during starting. In normal operation, there are no speed steps in between rated speed & micro speed in hoist motion and no speed steps in CT/LT motion. For single girder cranes, there are no speed steps in CT/LT motion and no speed steps between rated speed and micro speed in hoist motion.

5.28.03 General

a) All controls shall be designed to be fail-safe on loss of power.

b) Control circuits shall be suitable for 240V 1ph 50Hz supply and complete with suitable dry type control transformer with isolation facility and primary/secondary fuses.

c) Individual control/resistor panel shall be furnished for each motion for ease of inspection and maintenance.

5.29.00 **Controllers**

5.29.01 Master controllers for all motions shall be so arranged in the operator's cabin as to provide maximum convenience and view of the operator.

5.29.02 All controllers shall be provided with spring return to OFF position feature. When in OFF position, the controller shall disconnect power supply to the respective motor.

5.29.03 Each controller shall bear suitably engraved inscription of motions controlled in English & Hindi and of direction of motions by arrows.

5.30.00 **Resistors**

5.30.01 The resistors shall be heavy duty, punch-grid type of stainless steel. Resistors shall be rated for 10 minutes and the maximum temperature at any time shall not exceed 250ºC.

The resistor grids shall be housed in expanded metal enclosures IP-23 and shall be so mounted as to prevent vibration. Sufficient space shall be provided around the resistors to ensure adequate cooling air flow. Adequate weatherproof protection shall be provided for resistor enclosure.

5.31.00 **Limit Switches**

5.31.01 The limit switches shall be totally enclosed type IP-55 with properly designed actuators and shall be readily accessible for adjustment and repair.

5.31.02 Each hoist shall be furnished with two (2) limit switches :

a) A screw type limit switch with self resetting features which will act in case of over hoisting.

b) A gravity operated hand-reset type limit switch as a back-up protection against over-hoisting.

5.31.03 Track type limit switches shall be provided on the bridge and trolley to prevent over-traveling in either directions.

5.32.00 **Panels**

5.32.01 Protective and control panels shall have IP-54 gasketed enclosure, fabricated from sheet steel, minimum 2 mm thick, suitably reinforced to provide structural rigidity.

5.32.02 The panels shall be front connected type with front hinged door for access to wiring and terminals. Engraved name plates shall be furnished for all panels and also for the equipment and device mounted thereon.

5.32.03 All panels shall be factory wired and terminated on suitable terminal blocks for external cable connection. All internal wiring shall be identified with numbering ferrules at both ends as per relevant wiring diagram. Terminal blocks shall have 20% spare terminals.

5.32.04 Control wiring shall be carried out with 1100 Volt grade flexible, heat resistant, insulated switchboard wires with minimum 2.5 sq.mm stranded copper conductor.

5.32.05 Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater, suitable for operation on 240V 1-ph 50 Hz supply. Lamps and heater circuits shall have individual ON-OFF switches.

5.33.00 **Switch**

5.33.01 All switches shall be hand operated, air break, heavy duty, quick make-quick break type, capable of safely breaking the full load current of connected motor/feeder.

5.33.02 Incoming supply disconnect switch shall be interlocked with panel door so that the same can not be opened unless the switch is in OFF position. Device to defeat this interlock shall also be included.

5.34.00 **Fuse**

5.34.01 All fuses shall be of HRC cartridge type, mounted on plug-in fuse base and provided with visible operation indicator.

3.34.02 All accessible live parts shall be adequately shrouded so as to eliminate the danger of accidental contacts with live parts while changing the fuse.

5.35.00 **Contactors**

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

5.35.02 Contactors shall have facility for easy inspection and replacement of parts. Arc chutes shall be provided where necessary.

5.35.03 Each contactor shall be provided with three positive acting, ambient temperature compensated, thermal overload relays with adjustable settings to suit the motor current.

5.35.04 The relays shall be hand-reset type, suitable for resetting with compartment door closed.

5.36.00 **Push Button and Lamp**

5.36.01 Push button shall be spring return type, with 2 NO + 2 NC contacts, rated 10A 240V A.C.

5.36.02 Indicating lamps shall be LED type with series resistor. Lamps and lens shall be replaceable from front.

5.37.00 **Illumination**

5.37.01 Crane lighting and space heating systems shall be designed for 240V 1ph 50 Hz supply and receptacle system 24V 1ph 50 Hz supply. Suitable dry type transformers (2x100%) shall be furnished for the purpose, complete with isolation facility and primary/secondary protection using Moulded Case Circuit Breaker (MCCB).

5.37.02 The lighting distribution board shall be located in the operator's cabin. Branch circuits for lighting and receptacles shall be individually protected by switch fuse units.

5.37.03 CFL fixtures shall be used for lighting operator's cabin and bridge platform. Four (4) 250W high-bay sodium vapour fixtures shall be provided below bridge for illumination of the working zones.

5.37.04 All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.

5.37.05 24V - 5A - 3 pin industrial socket outlets shall be provided – two (2) in operator's cabin and minimum four (4) on the bridge along the walkway.

5.37.06 One (1) portable 40W hand lamp with plug shall be furnished with adequate length of flexible cable for inspection of crane components.

5.37.07 Operator's cabin shall be provided with one (1) electric fan.

5.37.08 One (1) heavy duty type industrial siren shall be provided with each crane. The siren shall be operated from foot-switch in the operator’s cabin.

5.37.09 Conduit wiring system shall be used for lighting circuits.

5.38.00 **Wiring**

5.38.01 All power, control and auxiliary circuit wiring shall be furnished and installed as per best installation practice. The design shall be such as to maximise shop wiring and minimise field wiring.

5.38.02 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.

5.38.03 Conductors shall be stranded aluminium for power and stranded copper for control. Minimum conductor size shall be not less than 2.5 sq.mm copper or equivalent.

5.38.04 Conduits shall be heavy gauge, rigid steel, hot-dip galvanised, cut square, reamed, threaded and screwed tight at all joints. Conduit entry to pull box or enclosure shall have double locknuts and insulating bushing. No running thread shall be used.

5.38.05 Solderless connectors shall be used for all connections. No splices shall be permitted in wire or cable. No taps or connections shall be made in fittings or junction boxes.

5.38.06 All wires and cables shall be identified with permanent markers at terminations as per approved wiring diagram.

5.39.00 **Grounding**

5.39.01 The crane rails, structures, motor frames, metal enclosures of all electrical equipment, conduit and tray system shall be effectively grounded in accordance with Indian Electricity Rules.

5.39.02 Bonding of structures and crane rails shall be provided as required to ensure electrical continuity.

5.39.03 The crane grounding system shall be connected to station ground mat. For this purpose, the Purchaser will provide ground conductor (50 x 6mm M.S. flat) at two agreed locations.

6.00.00 **INSPECTION AND TESTING**

6.01.00 **Tests at shop**

6.01.01 The cranes shall be subject to full load and overload tests as per IS-3177.

6.01.02 The crane shall be subject to deflection test as per IS : 3177.

6.01.03 If the hoisting drum offered is of welded construction. The seams shall be fully radiographed.

6.01.04 The inspection and testing of butt welded joints shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. But welded joints subject to direct tension shall be 100% radiographed. All 'T' joints shall be covered with spot radiography. Should any of the spots be found defective then radiography to be extended to 100% area.

6.01.05 All electrical equipment and components thereof shall be subject to routine tests as per relevant Indian Standards. Type test certificate on any electrical equipment shall be submitted if desired by the Purchaser. Otherwise, type tests shall have to be performed on the equipment to prove the design.

6.01.06 Reports of all shop tests shall be submitted to the Purchaser/ Consulting Engineer for review.

6.02.00 **Tests at site**

6.02.01 After assembly and erection at site, the crane shall be subject to the following tests :

a) All tests as per IS-3177, including insulation test and tests for operation.

b) Deflection tests as per IS-3177

c) Overload tests at 125% of working load as per IS-3177

6.02.02 Dead loads as required for conducting the tests at site shall have to be arranged by the Contractor at his own cost.

6.03.00 **Erection and Commissioning**

All cranes shall be erected and commissioned after satisfactory shop & site test.

7.00.00 **DRAWINGS, DATA AND INFORMATION**

7.01.00 The following drawings and data are required with the proposal.

7.01.01 Crane clearance diagram filling in the various dimensions.

7.01.02 General Arrangement Drawings of the E.O.T. crane assembly.

7.01.03 Detail drawing showing the features of the components of the crane bridge and trolley.

7.01.04 Drawings and data on the crane runway rail, and its method of attachment to runway main girder and general arrangement of runway rail end stops.

7.01.05 Schematic drawings of hoisting mechanism, cross travel mechanism and long travel mechanism indicating all components as well as rope receiving arrangement and relative positions of equaliser sheaves.

7.01.06 A detailed write-up on the crane control system operation including tandem operation. Drawings and data sheets showing the particulars of the controllers, switches, contactors, relays, other control devices and limit switches.

7.01.07 A comprehensive write-up and/or Brochures on the details of the manufacturing facilities and the test facilities in the shop of the supplier.

7.01.08 For Mandatory Spares, Spares required for erection and commissioning, Recommended Spares, Special Tools And Tackles, fixtures etc., as required for regular operation and maintenance of the equipment offered and supply of first charge of lubricating oil, inhibitor oil and also adequate quantity of the consumables, please refer Technical Specification Volume-II A.

7.01.09 Other relevant data and particulars.

7.02.00 The following drawings and data shall be submitted for review of Owner/ Consulting Engineers by the successful bidder.

7.02.01 Drawings showing general arrangement, clearance requirement, assembly, cross sectional data and materials of construction for :

a) E.O.T. Crane Unit

b) Bridge Assembly and Components

c) Bridge End Trucks and Wheel Assembly

d) Trolley

e) Trolley Wheel Assembly

f) Drive and Transmission Unit for Bridge Travel, Trolley Travel, Main Hoist and Auxiliary Hoist.

g) Suspension Unit for Main Hook Block and Auxiliary Hook Block.

h) Main Hook Block

i) Auxiliary Hook Block

7.02.02 Drawing showing layout of controllers and protective panels inside the operator's cabin/pendant station.

7.02.03 Leaflets on proprietary items such as motors, brakes, gear box, coupling etc.

7.02.04 Design calculation of the following :

Bridge girder, Rope drum, Machinery shafts, Gear box, Motor rating, Brake capacity, Bearing life, Wheel loading etc.

7.02.05 Drawings, characteristics curves and other data for each drive motor.

7.02.06 Drawings on runway rails and their end stops showing fixtures to fix them on Purchaser's runway girder.

7.02.07 Material test certificates for all items including hooks and wire rope.

7.02.08 Reports on various tests at shop and at site.

7.02.09 Control and protection scheme along with crane wiring drawing as well as a schematic drawing of control wiring indicating ratings and specifications for motors, contactors, resistors, fuses, etc.

7.02.10 As built drawing/electrical control schematic including tandem operation features of turbine hall cranes.

7.03.00 **Instruction Manual**

7.03.01 The Instruction manuals shall present the following basic categories of information in a comprehensive manner prepared for use by operating and/or maintenance personnel :

i) Instruction for erection

ii) Instruction for pre-commissioning check up, operation, abnormal conditions, maintenance, repair and protection.

iii) A detail write up on the crane control system including tandem operation for tubine hall cranes and also on the interlocks provided.

iv) Recommended inspection points and periods of inspection.

v) Schedule of preventive maintenance.

vi) Replaceable part's list with ordering information.

vii) Recommendation for type of lubricants, lubricating points, frequency of lubrication and lubricant changing schedule.

ANNEXURE-II

DATA SPECIFICATION SHEET

GENERAL INFORMATION

Location : As per Annexure I.

Working condition : Indoor

GUARANTEED PERFORMANCE REQUIRED

Capacity :

(Safe working load)

a) Main Hoist (T) ** By bidder

b) Aux. Hoist (T) ** By Bidder

** Refer Cl. No. 4.01.01 for safe working load.

Rated Speed (Turbine Hall) : (for any load from zero to SWL)

Main hoist	1 m/min.
Aux. hoist	3 m/min.
Trolley travel	10 m/min.
Bridge travel	15 m/min.
Range of speed control for main and auxiliary hoist and for each motions (for any load from zero to SWL)	Down to 10% of corresponding rated speed.

Rated Speed (Other than Turbine Hall) :
(for any load from zero to SWL)

Main hoist	3 m/min
Aux. hoist	NA
Trolley travel	15 m/min
Bridge travel	25 m/min

GUARANTEED PERFORMANCE REQUIRED (Contd.)

Range of speed control for main and auxiliary hoist and for each motions (for any load from zero to SWL)	:Down to 10% of corresponding rated speed.

SCOPE OF SUPPLY

Crane structures complete	:	Yes
All drive motors and driving gears	:	Yes
Running rails including all clamps, anchors, bolts, nuts, sheams, inserts, end stops and other fixtures	:	Yes
~~Operator's Cabin~~	:	~~Yes, For Turbine Hall crane~~
Pendant Station	:	Yes, For other cranes
~~Portable fire extinguisher/CO_2~~ bottle in operator's cabin	:	~~Yes~~
Runway conductors (d.s.l.) and power collectors complete with all supports, insulators, brackets, fixtures etc.	:	Yes
Complete electrical work including main disconnect switch, all controls and interlocks, with necessary wiring, grounding, protective panels etc.	:	Yes
Lower limit switches for hoists	:	Yes
~~Air Conditioning in operator's cabin~~	:	~~Yes~~
Lifting lugs, eye bolts etc. for handling of crane parts	:	Yes
~~Erection and commissioning service~~	:	~~Yes~~
All equipment, accessories and consumables required for erection, testing and commissioning	:	Yes
Final painting	:	Yes
First charge of oil, lubricants, grease etc.	:	Yes

DESIGN AND CONSTRUCTION

Duty Class (Turbine Hall) : Mechanism class - 2 as per IS-3177 and IS-807
Electrical Service class .

Duty Class (Other than Turbine Hall) : Mechanism class - M5 as per IS-3177 and IS-807
Electrical Service class

Operation : ~~Cabin for Turbine Hall~~
Pendant station for others.

DESIGN AND CONSTRUCTION

Runway conductors -

a)	Material	:	As specified earlier
b)	Maximum allowable current density	:	Bidder to indicate

Permissible tolerance -

a)	Difference in levels of crane rail top measured between two adjacent columns	:	2.0 mm
b)	Crane rail gauge	:	± 3.0 mm
c)	Relative shift of ends of adjacent rails in plan and elevation after welding	:	1.0 mm
d)	Deviation of crane rail axis from centre line of web of supporting girder	:	± 3.0 mm

Schedule of Brakes

Holding torque for control brakes shall be 150% of rated torque and that of service brake shall be 125%. The schedule of brakes shall be as under :

Sl. No.	Service	Type & No. (Turbine Hall)
1.	Main Hoist	Two (2) nos. Electro-hydraulic thruster type brake.
2.	Auxiliary Hoist	Two (2) nos. Electro-hydraulic thruster type brake.
3.	Cross Traverse	Two (2) nos. Electro-hydraulic thruster type brake.
4.	Long Traverse	Two (2) nos. Electro-hydraulic thruster type brake. Two (2) nos. Hydraulic thruster (foot operated)
5.	Main Hoist (creep)	One (1) no. Electro-hydraulic thruster type brake.
6.	Auxiliary Hoist (creep)	One (1) nos. Electro-hydraulic thruster type brake.

Sl. No.	Service	Type & No. (Other than Turbine Hall)
1.	Main Hoist	Two (2) nos. (1DCEM + 1EHT brakes)
2.	Auxiliary Hoist	N.A.
3.	Cross Traverse	One (1) no. Electro-hydraulic thruster type brake..
4.	Long Traverse	One (1) no. Electro-hydraulic thruster type brake..
5.	Main Hoist (creep)	One (1) no. Electro-hydraulic thruster type brake.
6.	Auxiliary Hoist (creep)	N.A.

The aforesaid brake schedule is applicable for double girder either cabin or pendent operated crane. For single girder cranes and single girder under slung cranes, one (1) electromagnetic disc brake for each motion shall be provided.

MATERIAL OF CONSTRUCTION

Bridge girder	:	IS-2062
Other structural members	:	IS-2062
Sheaves, drums	:	C.I. (IS-210, FG-260)

GENERAL TECHNICAL REQUIREMENTS

CONTENT

GENERAL TECHNICAL REQUIREMENTS (As Applicable)

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 All latest codes & standards shall be considered upto the base date. The base date to be considered for codes and standards is fifteen (15) days prior to opening of price bid.

1.06.00 Successful Bidder to furnish two (2) sets of latest International Codes and Standards which have been used for their plants, equipments and system. IS Codes, ASME codes, ASTM codes need not to be furnished. However, International Performance Test Codes shall be furnished as applicable.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.

2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.

2.04.00 Bidder shall comply with the requirements of CPCB and MOEF along with specification requirements whichever is stringent.

2.05.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.

2.06.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.00.00 NAME PLATES (RATING PLATES)

3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.

3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.

4.00.00 SAFETY AND SECURITY

4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

5.00.00 GUARDS

5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

a) The minimum width of clear access corridors around equipment shall be one (1) meter.

b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.

c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of two (2) meters shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.

f) All rail/road crossings for pipe/cable racks shall be done with minimum 7 meters clear headroom. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.

g) Cubicle for operating personnel shall be located at safe place near the equipment.

h) All underground cables in the plant shall be placed in covered reinforced concrete cable trenches. Pipes shall in general be routed above ground and on pedestals, and at road crossings, pipe racks shall be provided. Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.

i) Concept of various mechanical and electrical equipment location and building dimensions as shown in Plot Plan/Floor Plan drawing are to be adhered to.

However, size of buildings & facilities as stated above, shall be finalized by EPC Contractor considering the basic design criteria of layout as indicated in the specification.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 MATERIALS

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 LUBRICATION

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00 LUBRICANTS AND CONTROL FLUIDS

10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of respective units.

10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 OPERATION AND MAINTENANCE

11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.

The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.

11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 PLANT LIFE AND MODE OF OPERATION

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

Cold start-up (>50 hrs. shutdown)	:	20 per year
Warm start-up (between 10 to 50 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	180 per year

13.00.00 PACKAGING & 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. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

a)	Width of the Package (from centre-line of rails - 1.6 metres on both sides)	:	3.2 Meters
b)	Height of the package from rail top	:	4.47 Meters

The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services if the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

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.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 PAINTING

15.01.00 General

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35 Deg.C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C.

The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

15.02.00 **Preparation**

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

15.03.00 **Damaged Paintwork**

Any damaged paintwork shall be made good as follows :

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.

b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.

c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

15.04.00 **Painting Systems**

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

a) Surfaces Subject To Weathering

All surfaces shall have a minimum of four coats of paint made up as follows :

Primer coat	:	35 micron DFT
Tie coat	:	35 micron DFT

Finishing coat (2 Nos.) : 35 micron DFT per coat

The total minimum DFT shall be 140 micron.

b) Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

Primer coat : 35 micron DFT

Tie coat : 35 micron DFT

Finishing coat (2 Nos.) : 25 micron DFT per coat

The total minimum DFT shall be 120 micron.

The type and colour of primer & finish coat shall be selected by the Contractor after approval by the Owner.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this specification.

16.00.00 COLOUR CO-ORDINATION & FINISH

16.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

16.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

16.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

16.04.00 Final colours and finishes shall be to the Approval of the Engineer.

17.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.01.00 Environment Protection

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

17.01.01 For Liquid Effluent

a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.

b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

17.01.02 For Air Emission

a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm^3 (with worst coal and one field out).

b) NO_x - 365 ppm Max. or 750 mg/Nm^3 (Equivalent NO_2).

c) SO_2 - Concentration based standard 2000 mg/Nm^3 Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

NO_x and SO_2 limitations are based on the World Bank Norms.

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

17.02.00 **Noise Level Requirement**

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

18.00.00 INSPECTION AND TESTING

18.01.00 Inspection and Tests during Manufacture

18.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

18.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

18.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

18.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

18.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

18.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.

18.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser as per Owner's approved QAP. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

18.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

18.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

18.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.

18.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

18.02.00 **Performance Tests at Site**

18.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

18.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

18.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

18.03.00 For details of specific tests required on individual equipment refers to respective section of this specification.

19.00.00 **TRAINING OF OWNER'S PERSONNEL**

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

19.01.00 **Training at Contractor's Premises**

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2
	60 heads	60

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to :

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.

2. Plant operation and systems training for operators including simulator training as applicable.

3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Contractor shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

19.02.00 **Operation and Maintenance Training at Site**

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

a) One (1) for Steam Generator and Auxiliaries ;

b) One (1) for Turbine Generator and Auxiliaries ;

c) One (1) for Electrical Works ;

d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;

e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

19.03.00 **On-the-Job Training**

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

20.00.00 **DEVIATIONS**

The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.

Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

a) International Standards Organisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers (ASME).

d) American National Standards Institute (ANSI).

e) American Society for Testing and Materials (ASTM).

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

j) National Electrical Manufacturer's Association (NEMA).

k) Japanese Electro-technical Committee (JEC).

l) Institute of Electrical and Electronics Engineers (IEEE).

m) Federal Occupational Safety and Health Regulations (OSHA).

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

q) Tubular Exchanger Manufacturer's Association (TEMA).

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission (IEC) Publications.

t) Power Test Code for Steam Turbines (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

x) Electric Power Research Institute (EPRI).

y) Standards of Manufacturer's Standardization Society (MSS).

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

ff) Emission regulation of Central Pollution Control Board (CPCB).

gg) Pollution Control regulations of Dept. of Environment, Govt. of India

hh) Central Board of Irrigation and Power (CBIP) Publications.

ii) The Air Prevention and Control of Pollution Act.

jj) The Environmental Protection Act

kk) The Public Liability Insurance Act.

ll) The Forest Conservation Act

mm) The Wildlife protection Act.

nn) The EIA Notification, 1994.

oo) IS: 14665-Specification for Electric Traction Lift

pp) Any other statutory Codes/Standards/Regulations

ANNEXURE-II

SCHEDULE OF PERMITS & CLEARANCES

Sl. No.	Clearances	Authority	Responsibility
1.0	**STATUTORY CLEARANCES**		
1.1	Pollution clearance, water and air [Sec.25 of the Water (Prevention & Control of Pollution) Act, 1974 as amended in 1988, and Sec. 21 of the Air (Prevention & Control of Pollution) Act, 1981 as amended in 1987]	Gujarat State Pollution Control Board	Owner-Consent to establish the project. Contractor - Permission for operation
1.2	Environmental clearance	Ministry of Environment & Forest, Government of India	Owner
1.3	Aviation Clearance	Airport Authority of India, New Delhi.	Owner
2.0	**NON-STATUTORY CLEARANCES**		
2.1	Land availability at Plant area	Govt. of Gujarat / Private land Owner, if any	Owner
2.2	Land for Transportation of Coal	Govt. of Gujarat / Private Land Owner, if any	Owner
2.3	Transportation of Fuel (Secondary Fuel)	Department of Petroleum and Natural Gas, Ministry of Railways, Shipping and Surface Transport	Owner
2.4	Rights & right to access of all public roads from manufacturer's works to site,	Concerned Authorities	Contractor
3.0	**OTHER CLEARANCES/ APPROVALS**		
3.1	Approval and Registration of steam generator as per Indian Boiler Regulation	Chief Inspectorate of Boilers	Contractor
3.2	Approval as per Indian Electricity Act and Rules for Electrical Installation	Electrical Inspectorate	Contractor
3.3	Approval as per Indian Petroleum Act and Petroleum Rules for storage of petroleum products.	Chief Controller of Explosives	Contractor
3.4	Approval as per gas cylinder rules and handling and transport of compressed gases	Chief Controller of Explosives	Contractor
3.5	a) Collection, storage and disposal of waste during construction till handing over of the project.	Gujarat State Pollution Control Board	Contractor

Sl. No.	Clearances	Authority	Responsibility
	b) Site clearances, safe report and safety audit during construction till handing over of the project.	Gujarat State Pollution Control Board	Contractor
3.6	Approval of Fire Protection Scheme	Authorised Agencies approved by Insurance Regulatory Development Authority, New Delhi (IRDA)	Contractor
3.7	Consent for use of the site for the construction and operation of the Power Station and Fuel Facility	Directorate of Town and Planning of Government of Gujarat	Owner
3.8	Consent for the development of Project Site and the Township site	Directorate of Town and Planning of Government of Gujarat	Owner
3.9	Approval of the proposed design and construction of power station	Chief Inspector of Factories of Government of Gujarat	Contractor
3.10	Allocation / approval of electric supply for bulk construction power	Gujarat State Electricity Dept.	Owner
3.11	Carriage entrance to property	Municipal Corporation: Assistant Engineer, Roads or concerned authorities	Contractor
3.12	Approval of building layout with fire safety concerns and receipt of No Objection Certificate	Municipal Corporation: Chief Fire Officer or concerned authorities	Contractor
3.13	No Objection Certificate regarding air & fugitive emissions	Municipal Corporation: Executive Engineer and Gujarat Pollution Control Board	Contractor
3.14	No objection Certificate for Chimney and Registration	Inspector of Smoke Nuisance	Contractor
3.15	No Objection Certificate for sewage water treatment and associated plumbing	Municipal Corporation: Executive Engineer, Sewerage and Planning or concerned authorities	Contractor
3.16	To review the frequency used for Power Line Carrier Communication (PLCC) system to ensure no interference with other power line users	Postal Tele communication Coordination Committee (PTCC)	Owner-PLCC Contractor- Wireless equipment (postal telecommunication)
3.17	No objection certificate for plant layout with regard to electrical equipment, operational safety	Chief Electrical Engineer of Gujarat	Contractor
3.18	No Objection Certificate for storage of construction Materials and chemicals, etc.	Municipal Corporation: Assistant Engineer, Factory Department	Contractor

Sl. No.	Clearances	Authority	Responsibility
3.19	No Objection Certificate for storage of construction fuel oils and chemicals, etc.	Commissioner of Police	Contractor
3.20	No Objection Certificate for storage of Distillate Oil	Chief Controller of Explosives	Contractor
3.21	No Objection Certificate for road opening and asphalting Work including traffic Work.	Municipal Corporation: Assistant Engineer, Roads or concerned authorities	Contractor
3.22	Local approval for operating the plant	Municipal Corporation: Ward Office or concerned authorities	Not applicable
3.23	Local approval of Architectural plans for township	Municipal Corporation or concerned authorities	Owner
3.24	Consent under the Factories Act, 1948 relating to fire fighting capacities	Directorate of Town and Planning of Government of Gujarat	Contractor
3.25	Clearance of Lifts	Inspector of Lifts, Govt. of Gujarat	Contractor
3.26	Approvals / clearances for labour / man power like License from labour commissioner for Construction labour, Registration of Workers or exemption to be claimed if group insurance taken for some, etc.	Concerned Authorities	Contractor
3.27	Any other clearances	Appropriate Authorities	Contractor
3.28	Export Authorisation (Export license)	Appropriate Authorities of exporting country	Contractor

ANNEXURE-III

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

	ITEM	SPECIFICATION REQUIREMENT
A.	Site conditions to be considered	
1.	Prevalent wind direction	See wind-rose in plot plan. Also refer Metrological Data.
B.	Layout Requirements	
1.	Maximum permissible slope in	
a)	Rail track	1 in 400
b)	Road	1 in 30
c)	Sides of unpaved embankment	1 in 2
2.	Required road width	
a)	Main roads Refer Vol. II-G.	
b)	Auxiliary interconnections Refer Vol. II-G.	
c)	Road to the power house unloading bay :	
	• Only for entry to the unloading bay	Yes
	• To pass through the unloading bay	No
3.	Required minimum horizontal distance between the nearest points of	
a)	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b)	Electrical transformer and any other building/facility	As per the Tariff Advisory Committee Rules
c)	Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules
d)	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code

	ITEM	SPECIFICATION REQUIREMENT
4.	Required minimum vertical clearance	
a)	Under pipes/cable racks at road crossings	7.0 Metres
b)	Soil coverage over underground pipes	1.0 Metre (minimum)
c)	Pipe/Cable trench	Not Acceptable
5.	Railway Wagon clearance	Rules of the Indian Railways
6.	Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres
7.	Required level, above the local developed grade level, of	
a)	top of all roads	150 mm
b)	all outdoor paved areas	150 mm
c)	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
d)	Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.
BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS		
A.	Minimum clear space required at all working and walking areas for operating & maintenance personnel	
1.	Horizontal, in all directions	
a)	Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C.	1200 mm
b)	Adjacent to any other plant facilities (including walls/structures)	1000 mm
2.	Vertical (head-room clearance)	
a)	Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.0 Metre
b)	Under any other plant facilities (including structures, pipes etc.)	2.0 Metre

	ITEM	SPECIFICATION REQUIREMENT
3.	For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment
4.	Minimum clear hand space required for	
a)	The application of thermal insulation	100 mm
b)	Welding work	150 mm
c)	Bolt tightening	150 mm
B.	Floors, platforms, staircase, ladders, walls, doors & windows	
1.	Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2.	Operation & Maintenance Requirement	
a)	Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b)	Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3.	Plinth level of all buildings, above the local developed for power house building.	300 mm, however, 500 mm grade level
4.	Minimum access opening required (with rolling shutter) transportation,	3.5M wide x 4M high or, wherever entry of truck, for material more depending upon the is envisaged equipment size to be handled.

	ITEM	SPECIFICATION REQUIREMENT
C.	Other Maintenance Requirement	
1.	Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes
2.	Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, compressors, blowers, heat exchangers, fuel air oil pumps, filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3.	Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4.	Crane Approach Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D.	Central Control Room All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
	The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration. However, as a guide line, following features are given :	
a)	False ceiling and false flooring shall be provided.	
b)	Uniform height, colouring schemes for cabinets etc. shall be available.	

ITEM		SPECIFICATION REQUIREMENT
c)	The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d)	No opening shall be provided from Boiler side.	
e)	Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
f)	Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	
g)	The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
h)	Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
i)	Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
E.	Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.

GUJARAT STATE ELECTRICITY CORPORATION LTD
VADODRA, GUJARAT, INDIA

1x800 MW WANAKBORI TPS UNIT#8

SINGLE GIRDER CRANE

TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT,
NOIDA, U.P., INDIA

CONTENTS

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

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.
Electrical load requirement for SINGLE GIRDER CRANE AND ELECTRIC HOISTS
d) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
e) 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
f) 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.
g) Motor shall meet minimum requirement of motor specification.
h) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
i) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

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

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Technical specification for motors.
c) Technical specification for cables.
d) Datasheets & quality plan for motors.
e) Electrical Load data format (Annexure –II)
f) BHEL cable listing format (Annexure –III)
g) Electrical mandatory spares (As per spec.)

REV: 00 DATE: 25.08.2015

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

PACKAGE: SINGLE GIRDER EOT CRANES & ELECTRIC HOISTS

SCOPE OF VENDOR: SUPPLY

PROJECT : SINGLE GIRDER CRANE

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	Isolating Switch	Vendor	BHEL	BHEL will provide one number 415 V(3ph, 4W) supply feeder only up to isolating switches for cranes/hoists. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane/ hoist control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	BHEL	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	BHEL	
4	Equipment Earthing	BHEL	BHEL	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	BHEL	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & 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.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
ANNEXURE-II																				

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	408	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	1x800 MW WANAKBORI TPS	NAME		DATA FILLED UP ON	
	SYSTEM	SINGLE GIRDER CRANE AND ELECTRIC HOISTS	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto 160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP55
5.0	Cooling	:	TEFC
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (withvariation)	:	50 Hz (Variation: +5% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal box	:	50 kA for 0.25 sec
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated volta0.ge)	:	80% of rated voltage
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply(30KW & ABOVE)	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
13.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
14.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615
	b) Permissible tolerance, if any	:	
15.0	Additional tests	:	As per QP
16.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
	c) Degree of protection	:	IP65
17.0	Makes	:	AS PER ANNUXURE-I
18.0	Terminal box	:	Suitable to rotate at 90 degrees

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

	TITLE	SPECIFICATION NO.
	LV MOTOR	VOLUME II B
	DATA SHEET - C	SECTION D
		REV NO. 00 DATE
		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			

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 ≥ 55KW)		
	a) Torque speed characteristic		
	b) Thermal withstand characteristic		
	c) Current vs time		
	d) Speed vs time		

NAME OF VENDOR					
				REV.	
NAME	SIGNATURE	DATE	SEAL		

ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
	SHEET 1 OF 2		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION 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 P	AGENCY W	AGENCY V	REMARKS
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	MANUFR'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 :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
	SHEET 2 OF 2	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 P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

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

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 1 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT 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						BIDDER'S/VENDORS COMPANY SEAL			

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

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 3 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

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

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 4 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 6 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 7 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-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'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 8 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	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
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	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
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
	SHEET 9 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION	VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. 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.

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

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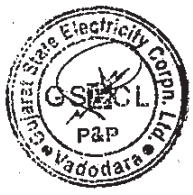
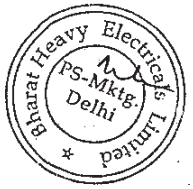
SECTION-II

TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS





CONTENT

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SECTION-II

TECHNICAL SPECIFICATION FOR A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 STANDARDS

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed :

IS-325

IS-12615

IEC-34

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 **TYPE AND RATING**

4.01.00 **A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment and 15% for LT driven equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 All HT & LT motors shall be energy efficient type as per IS. However for HT motors, if the same is not specified in IS, minimum efficiency of all HT motors shall be considered as 90%.

4.02.00 **D.C. Motors**

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type. All DC motors shall be energy efficient type with minimum efficiency of 80%.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 **Starting Requirements**

Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all HT motors except boiler feed pump motor where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above

for HT motors. For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall be 80% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 80% rated voltage at motor terminals. However for mill motors if the minimum starting voltage is more than 80% rated voltage at motor terminal and within 90% rated voltage, bidder shall provide necessary arrangement to keep the motor terminal voltage above that voltage to achieve smooth start of the motor.

5.02.03
a) Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

b) Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.

c) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

5.02.04 HT pump motors shall be suitable to start with forward rotation.

5.02.05 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

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6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 Motors for circulating water pumps of large output ratings, located indoor and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.03 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA) or totally enclosed tube ventilated (TETV) type. Totally enclosed tube ventilated (TETV) type motors shall be acceptable for HT motors only.

6.02.02 For large capacity motors, closed air circuit water cooled (CACW) may be considered for acceptance.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 **Tropical Protection**

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardwares shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.05.05 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.

6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.06.00 **Noise & Vibration**

6.06.01 The noise level shall not exceed 85db (A) at 1.5 metres from the motor at no load condition.

6.06.02 The peak amplitude of the vibration shall be within IS/IEC specified limits.

6.07.00 **Motor Terminal Box**

6.07.01 HT Motor terminal box (Phase side) shall be Phase Segregated (PSTB) type and LT motor terminal box shall be non-phase segregated type. Both HT & LT motor terminal box shall be located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.

6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.07.05 Motor main terminal box shall be located right hand side of motor body looking from driving end.

6.07.06 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.07 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.08 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.09 HT motor phase side terminal box shall be phase-segregated type and HT motor neutral leads shall be brought out in a separate terminal box preferably

opposite side of phase terminal box & may not be necessarily phase segregated type with shorting links for star connection.

6.07.10 Motor terminal box shall be furnished with suitable cable lugs and nickel plated double compression brass glands to match with cable used.

6.07.11 The gland plate for single core cable shall be non-magnetic type.

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows :

HT Motor (11kV, 6.6kV & 3.3 kV)	:	75 X 10 mm GS Flat
LT Motor above 90 KW	:	50 x 6 mm GS Flat
Motor above 30 KW up to 90 KW	:	35 x 6 mm GS Flat
Motor above 5 KW up to 30 KW	:	25 x 3 mm GS Flat
Motor up to 5 KW	:	8 SWG GI Wire

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 **ACCESSORIES**

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30 KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

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7.02.02 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 **Temperature Detectors**

7.03.01 All 11000V, 6600V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase. Six (6) nos. duplex type winding temperature detectors, two (2) nos. per phase shall only be acceptable for special application motors only subject to approval of owner.

7.03.02 11000V, 6600V and 3300V motor bearing shall be provided with duplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.

7.03.05 Five numbers of Temperature detectors / thermisters shall be provided for L.T. motors above 90 KW (3 nos. winding temperatures & 2 nos. bearing temperatures)

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000 V, 6600V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints of colour battle ship grey shade 632 of IS-5.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/6.6kV/11kV motors.

a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
6.6 kV	31 kV peak
11 kV	49 kV peak

b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

c. Polarization Index Test as per IS:7816 as routine test

d. Test for suitability of IPW– 55 (Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied.

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Second numeral test shall be carried out on one motor of each type and rating.

e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.

f. Test for noise level as routine test.

g. Test for vibration as routine test.

h. Tan delta measurement on coils.

i. Surge withstand test for inter turn insulation.

Tests indicated at (h), (i), shall be carried out during manufacture of the coils and shall be furnished for verification.

Furnished type test certificates of motor shall not be older than five (5) years from the date of Inspection, otherwise type test shall be conducted without any price implication.

9.00.00 **DRAWINGS, DATA & MANUALS**

Drawings, data & manuals for the motors shall be submitted as indicated below:

9.01.00 **Along with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write up on forced lubrication system, if any

d) Type test report

9.02.00 **After Award of the Contract**

a) Dimensional General Arrangement drawing

b) Foundation Plan & Loading

c) Cable end box details

d) Space requirement for rotor removal

e) Thermal withstand curves hot & cold

f) Starting and speed torque characteristics at 80% & 100% voltage

g) Complete motor data

h) Erection & Maintenance Manual

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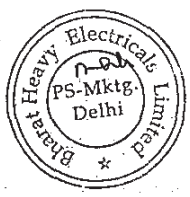
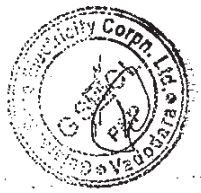
i) Test reports

j) Data sheets to be enclosed





ANNEXURE-A
DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 2000 KW & all mill motors
	Fault level 44 KA symm.	
	3300 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 160 KW upto and including 2000 KW
	6600 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors of CHP system and Water System above 160kW
	Fault level 40 KA symm for 3300V & 6600V	
L.T. Supply	415V, 3Ø, 3W, 50 Hz effectively earthed	Motors upto and including160KW
	Fault level 50 KA symm.	
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed	D.C. alarm, control & protective devices
	Fault level 25* KA.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage : ± 10% Frequency : ± 5% Combined Volt : 10% (absolute sum) + frequency

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage : 187 to 242 Volt

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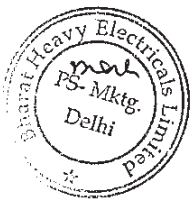
SECTION-IV

TECHNICAL SPECIFICATION FOR CABLES



CONTENT

ATTACHMENTS

Bharat Heavy Electricals Limited PS Mktg. Delhi

Gujarat State Electricity Corpn. Ltd. GSECL P&P Vadodara

SECTION-IV

TECHNICAL SPECIFICATION FOR CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Power and Control Cables shall cover the requirement of entire Plant including the switchyard. The cables shall be furnished in accordance with this specification and annexure.

Other cables including special cables if any which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures :

a)	11 kV, 6.6kV & 3.3 kV Power cables	:	Annexure - A
b)	1100V Power Cables	:	Annexure – B
c)	Control Cables	:	Annexure – C
d)	Fire Survival Cables	:	Annexure – D & E
e)	Flexible Trailing cable	:	Annexure – F

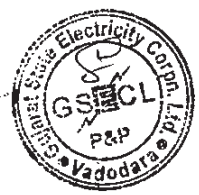
1.03.00 All relevant drawings, data and instruction manuals

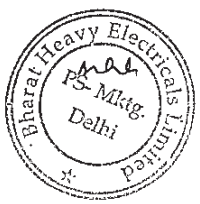
2.00.00 CODES & STANDARDS

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Cable and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.





3.00.00 **DESIGN CRITERIA**

3.01.00 Cables will be generally laid on ladder type trays, perforated type cable trays or drawn through rigid steel conduits [Rigid steel conduits shall be used for interconnection of cables from near-by cable tray to equipment where cable tray cannot be installed as well as to prevent mechanical damage of cables for critical equipment. Moreover in dust prone area the lay out of cable tray shall be in vertical plane].

3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.

3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

3.05.00 The outer sheath shall have flame retardant low smoke halogen evolution (FRLS) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.

3.06.00 Core identification for multicore cable shall be provided by colour coding.

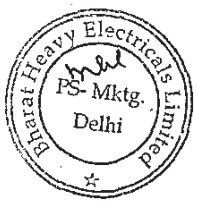
3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **General Description**

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 **Drum Length and Tolerance**



The cables shall be supplied in non-returnable packing steel drum for 11 kV, 6.6 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is ±5%.

4.03.00 **Non-Standard Length**

Non-standard lengths upto 5% of the total ordered quantity may be accepted. However the Contractor will be required to obtain approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.04.00 **Cable identification**

Cable identification shall be provided by embossing on every meter on the outer sheath the following :

a) GSECL

b) Manufacturer's name or trade mark

c) Voltage grade

d) Year of manufacture

e) Type of insulation, e.g. XLPE/PVC/HR85/IE2 etc.

f) No. of core and size of cables.

g) Type of improved fire performance, e.g. FR/FRLS/FS

h) IS number

4.05.00 **Packing**

4.05.01 Cables shall be supplied in non returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

4.05.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.05.03 The cable drums should carry the following details in printed form:

a) MSPGCL

b) Manufacturer's name or trade make

c) Type of cable & voltage grade

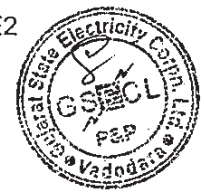
d) Year of manufacture

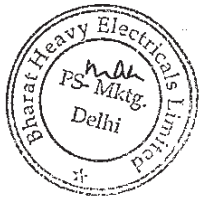
e) Type of insulation e.g. XLPE/HRPVC/IE2

f) No. of core and size of cables

g) Cable code e.g. FRLS/FS

h) Length of cable on drum





i) No. of length on drum, if more than one

j) Direction of rotation, by arrow

k) Approx. gross mass.

l) IS/IEC number and ISI mark

4.06.00 **Joints and Terminations**

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.07.00 **Selection Criteria**

4.07.01 a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.

b) While sizing power cables, following aspects shall be reckoned:

i) Ground/Ambient Air temperature

ii) Depth of Laying.

iii) Power Cables touching each other.

c) Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time. 0.2 Sec.

d) HT cables shall be sized based on the following considerations:

Rated current of the equipment and ground/ambient temperature.

Touching/spacing of cable.

Depth of laying.

The voltage drop of the cable , during motor starting condition , shall be limited to 15% and during full load running condition shall be limited to 3 % rated voltage. Other outgoing feeder /transformer feeder shall be limited to 3% rated voltage.

Short circuits withstand capability

e) For fuse/MCCB/Breaker protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered

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for loads fed from 415V PMCC. Incase of other out going line feeder voltage drop shall be limited to 3%.

f) For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.

g) As per national electric code (NEC) current rating capacity of motor feeder/cables should be 125% of full load current.

h) For welding receptacle, 3% running drop shall only be considered.

The minimum sizes of L.T cable to be chosen are as below:

AL - 16 mm^2 (3 core) & 16mm^2 (2 core); Cu - 2.5 mm^2

4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4.07.03 The standard cable sizes, amp capacities, derating factors. as given in IS/IEC will be generally followed.

4.07.04 a) For breaker protected circuits minimum size of the cable shall be as follows:

1100V Power Cable	:	240 Sq mm XLPE AL
6600V & 3300V Power Cable	:	185 Sq mm XLPE AL
11000V Power Cable	:	240 Sq mm XLPE AL

b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.07.05 For fuse/MCCB protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below :

a)	Aluminium	:	16 Sq mm.
b)	Copper	:	2.5 Sq mm.

4.07.06 All control cables shall be 2.5 Sq mm stranded copper cable.

4.07.07 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C

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7 or 8	1-9/C
9 or 10	1-12/C
Above 10	Two or more of above cables

4.07.08 Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

a) Power.

b) Control, interlock and indication.

c) Metering and measuring.

d) Alarm and annunciation.

e) C.T. Cables.

f) V.T. Cables.

4.08.00 **Cable Identification**

Cable identification shall be provided by embossing on the outer sheath the following :

a) Manufacturer's name or trade mark

b) Manufacturer's name or trade mark

c) Voltage grade

d) Year of manufacture

e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc.

f) No. of core & size of cables

g) Type of outer sheath e.g. FRLS, FS etc.

4.09.00 Selected sizes of power and control cables are given in Annexure-G.

4.10.00 Fire Survival Cables shall be used for important auxiliaries / area as recommended by Standard Technical Specification by CEA as below for the following :

Fire Survival Power & Control Cables shall be used for important auxiliaries/ areas like:

i. DC emergency lube oil pump

ii. DC hydrogen seal pump

iii. Turbine lube oil pump/barring gear

iv. DC emergency lighting for main building and service building

v. DC cables for battery to charger & DC distribution boards

vi. Jacking oil pump

vii. Emergency turbine trip in control room

viii. Boiler Turbine : Generator inter trip which include the interconnection between

- Boiler master fuel trip and turbine trip relays
- Generator trip relays & turbine trip relays
- Generator trip relays & generator breaker
- Generator trip relays & field breaker
- Generator trip relays & unit auxiliary transformer breaker
- Incomer cables for DG board, emergency board, DC lighting board etc.

5.00.00 **TESTS**

5.01.00 **Shop Tests**

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below:

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance Tests on 1 drum out of every 10 drums chosen at random for acceptance of the lot for every size.

5.01.03 Type test on each type and size of cable, inclusive of measurement of armour DC resistance of power cables on one drum out of every 10 drums of cable.

5.02.00 **Additional Tests**

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (Type FRLS, FS):

5.02.01 Oxygen index test

The Oxygen index shall not be less than 29.

5.02.02 Temperature Index Test

The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables

5.02.03 Flame Retardance test on single cable and on bunched cables

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After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC331

5.02.04 Halogen acid gas evolution test

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not be exceed 2% for FS cable.

5.02.05 Smoke density test

The test shall be smoke generation by the outer sheath under fire as per ASTM D 2843. The FRLS cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for Fire Survival cables.

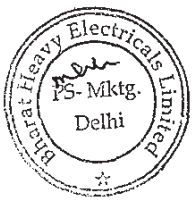
5.02.06 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

Flammability test shall be carried on finished cables as per following standards-



a) Swedish Chimney test – SS: 424-14-75

b) IEEE std.383 – 1974 latest

c) IEC std. 332-1 and IEC 331

5.03.00 **Test Witness**

Tests shall be performed in presence of Owner/Purchaser's representative. The Contractor shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

5.04.00 **Test Certificates**

5.04.01 Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner/Purchaser.

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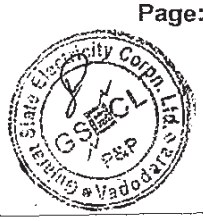

5.04.02 Test reports shall be completed with all details and shall also contain IS/IEC specified limit values, wherever applicable, to facilitate review.

5.04.03 The cables shall be dispatched from works only after receipt of Owner/ Purchaser's written approval of the test reports.

6.00.00 DRAWINGS, DATA & MANUALS

6.01.00 Drawings, Data and Manuals shall be submitted with the bid and for approval/ reference and subsequent distribution after the issue of Letter of Intent in quantities and procedures as specified in General condition of contract and/or elsewhere in this specification.

6.02.00 **To be submitted with the Bid**

a) Manufacturer's catalogues giving cable construction details and characteristics.

b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.

c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.

d) Type test reports on 11 KV, 6.6KV, 3.3 KV Power, LT FRLS Power & control, FS power and control cables

e) Filled-up proposal particulars.

6.03.00 **To be submitted after award of contract**

6.03.01 Guaranteed Technical Particulars

6.03.02 Quality assurance plan

6.03.03 Shop Test reports

6.03.04 **Instruction manuals**

The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.

6.04.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.

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ANNEXURE-A

RATINGS AND REQUIREMENTS
HV POWER CABLES (11 KV, 6.6KV & 3.3 KV)

1.0 11000/11000V, 6600/6600V & 3300/3300V grade 90°C continuous rating under normal condition and 250°C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V/6600V/3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen.

1.1	Conductor	:	Stranded and compacted aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS: 8130.
1.2	Conductor Screen	:	Extruded semi-conducting compound.
1.3	Insulation	:	Extruded cross linked polyethylene (XLPE) conforming to IS: 7098 (Part-2)
1.4	Insulation Screen	:	Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
1.5	Core Identification	:	By coloured strips applied on (For three core cables) cores or by numerals.
1.6	Inner Sheath	:	Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC.
1.7	Armour	:	Galvanised single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
1.8	Overall Sheath	:	Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
1.9	Drum	:	Steel Drum

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ANNEXURE-B

RATINGS AND REQUIREMENTS
LV POWER CABLES [1.1KV (XLPE TYPE)]

1.0 1100 V grade, 90°C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.

1.1	Conductor	:	Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm^2 conforming to IS:8130.
1.2	Insulation	:	Extruded cross-linked polyethylene (XLPE) conforming to IS: 7098 (Part-1)
1.3	Core Identification	:	By color coding
1.4	Inner Sheath	:	Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
1.5	Armour	:	Galvanized single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
1.6	Overall Sheath	:	Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
1.7	Drum	:	Conforming to IS-10418 (Wooden drum)

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ANNEXURE-C

RATINGS AND REQUIREMENTS
CONTROL CABLES

1.0 1100 V grade 85°C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.

1.1	Conductor	:	Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
1.2	Insulation	:	Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5 x 10^{14} ohm-cm at 27°C and 3.5 x 10^{11} OHM-CM at 85°C.
1.3	Core Identification	:	By color coding and numbering at interval of 100mm or less
1.4	Inner sheath	:	Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
1.5	Armour	:	Galvanised single round steel wire for twin and multicore cables.
1.6	Overall sheath	:	Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
1.7	Drum	:	conforming to IS: 10418 (Wooden drum)

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ANNEXURE-D

RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES)

1.1	Conductor	:	Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper wires conforming to Class-II of IS 8130. A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.
1.2	Insulation	:	The insulation shall consist of heat resisting electrometric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS: 6380/1984 amended up to date.
1.3	Laying up of cores (For multicore cables only)	:	The core shall be suitably identified in accordance with IS: 9968 (Part-I). The suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass fibre binder tape shall be applied over the laid up cores.
1.4	Inner Sheath	:	An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour conforming to Type SE-3 of IS – 6380/1984,ammended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fibre tape over the insulation.
1.5	Armour	:	For Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire. For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

1.6	Outer Sheath	The extruded outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision. Minimum value of 'Tensile Strength' and 'Percentage elongation rat rupture' shall be 8 Newton/sq.mm. and 250% respectively. The colour of outer sheath shall be black or any other colour agreed mutually between Owner & Contractor.

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ANNEXURE-E

RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES)

1.1	Conductor	:	It shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS:8130 / 1984 amended upto date. A suitable heat barrier tape, preferably glass mica tape shall be provided over conductor.
1.2	Insulation	:	The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethelene Propylene rubber) and shall conform to type IE-2 of IS: 6380/1984 latest revision.
1.3	Laying up of cores (For multicore cables only) :		The core shall be suitably identified in accordance with IS: 9968 (Part-I) The suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass fiber binder tape shall be applied over the laid up cores.
1.4	Inner Sheath	:	An inner sheath of extruded very low halogen (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE3 of IS 6380 / 1984 amended upto date shall be provided over the laid up cores.
1.5	Armour	:	The armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date.
1.6	Outer Sheath	:	The outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS:6380 latest revision. The colour of outer sheath shall be black or any other natural colour with prior approval of the Owner.

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ANNEXURE-F

RATINGS AND REQUIREMENTS
FLEXIBLE TRAILING CABLES

i) 6600 V Unearthed Grade

Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLS HD CSP sheathed overall, conforming to IS:9968. Alternatively PCP sheathing may be acceptable.

ii) 1100 V Grade

1100 V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLS CSP outer sheath.

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ANNEXURE-G

CABLE SIZES

Sl. No.	Cable Size	Conductor	Insulation
1.0	**H. T. CABLES (11kV)**		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 400 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	1 core 70 Sq.mm	AL	XLPE (FRLS)
1.0	**H. T. CABLES (6.6kV & 3.3kV)**		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 300 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	3 core 185 Sq.mm	AL	XLPE (FRLS)
1.5	1 core 70 Sq.mm	AL	XLPE (FRLS)
2.0	**L. T. POWER CABLES**		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLS)
2.2	3 or 4 core 4.0 Sq. mm	CU	XLPE (FRLS)
2.3	3 or 4 core 10 Sq.mm	CU	XLPE (FRLS)
2.4	2 core 16 Sq.mm	AL	XLPE (FRLS)
2.5	3 core 16 Sq.mm	AL	XLPE (FRLS)
2.6	4 core 16 Sq.mm	AL	XLPE (FRLS)
2.7	2 core 35 Sq.mm	AL	XLPE (FRLS)
2.8	3 core 35 Sq.mm	AL	XLPE (FRLS)
2.9	4 core 35 Sq.mm	AL	XLPE (FRLS)
2.10	3 core 70 Sq.mm	AL	XLPE (FRLS)

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Sl. No.	Cable Size	Conductor	Insulation
2.11	3.1/2 core 70 Sq.mm	AL	XLPE (FRLS)
2.12	3 core 95 Sq.mm	AL	XLPE (FRLS)
2.13	3.1/2 core 95 Sq.mm	AL	XLPE (FRLS)
2.14	3 core 185 Sq.mm	AL	XLPE (FRLS)
2.15	3.1/2 core 185 Sq.mm	AL	XLPE (FRLS)
2.16	3 core 240 Sq.mm	AL	XLPE (FRLS)
2.17	3.1/2 core 240 Sq.mm	AL	XLPE (FRLS)
2.18	3 core 300 Sq.mm	AL	XLPE (FRLS)
2.19	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)
2.20	1 core 630 Sq.mm	AL	XLPE (FRLS)
3.0	**CONTROL CABLE**		
3.1	2 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.2	3 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.3	5 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.4	7 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.5	9 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.6	12 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.7	20 core 2.5 Sq.mm	CU	HRPVC (FRLS)
4.0	**FS POWER CABLES**		
4.1	3 core 2.5 Sq.mm	CU	EPR
4.2	2 core 16 Sq.mm	CU	EPR
4.3	3 core 16 Sq.mm	CU	EPR
4.4	4 core 16 Sq.mm	CU	EPR
4.5	2 core 35 Sq.mm	CU	EPR

Sl. No.	Cable Size	Conductor	Insulation
4.6	3 core 35 Sq.mm	CU	EPR
4.7	4 core 35 Sq.mm	CU	EPR
4.8	3 core 95 Sq.mm	CU	EPR
4.9	3.1/2 core 95 Sq.mm	CU	EPR
5.0	**FS CONTROL CABLE**		
5.1	2 core 2.5 Sq.mm	CU	EPR
5.2	3 core 2.5 Sq.mm	CU	EPR
5.3	5 core 2.5 Sq.mm	CU	EPR
5.4	7 core 2.5 Sq.mm	CU	EPR
5.5	9 core 2.5 Sq.mm	CU	EPR
5.6	12 core 2.5 Sq.mm	CU	EPR

Gujarat State Electricity Corpn. Ltd. GSECL P&P Vadodara

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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SECTION – C4

ANNEXURES

ANNEXURE I
SCOPE OF SINGLE GIRDER CRANE

Sl. No	Area / Equipment description	Qty. (nos.)	Capacity (T)	Span (m)	Lift (m)	Travel (m)	Type of crane
1	Compressor House	1	8T	10.3	6	33.0	Underslung/Indoor Duty
2	New Clarified Water PH	1	5T	5.3	3	27	Underslung/Indoor Duty
3	DG Building	1	8T	12.15	6	19.1	Underslung/Indoor Duty
4	Fire Cum Clarified Water PH	1	5T	5.3	4	52	Underslung/Indoor Duty
5	CWPH Screen & Gate Handling	1	8T	5.5	14.5	33.6	Semi-gantry/Outdoor Duty

Annexure II

PAINTING SPECIFICATION

A) Structural

Surface preparation: De greasing and Mechanical cleaning with wire brush or hand tool. (SA 1/ ST 2 / ST 3, as applicable).

Primer : Red oxide Zinc chromate as per IS: 2074 (Alkyd medium) - 2 coat, DFT35 µ per coat.

Finish Coat : Synthetic enamel (Alkyd medium) as per IS: 2932- 2 coats, DFT 25 µ per coat.

Total DFT : 120µ

B) Electrical /Control Panel

Surface preparation : Seven tank process

Primer : Zinc phosphate (Alkyd medium) - 2 coat, Minimum DFT 25- 35 µ per coat.

Finish Coat : Synthetic enamel (Alkyd medium) as per IS: 2932- 3 coats, Minimum DFT 20-25 µ per coat.

Total DFT : 110 - 145µ

COLOR SHADE

S. No	Item Description	Color Shade	Remarks
1	Crane Structure	Lemon yellow, shade 356 as per IS-5	
2	Bottom block assembly	Lemon yellow, shade 356 as per IS-5	
3	Hooks	Lemon yellow, shade 356 as per IS-5	With 100 mm wide black zebra strip
4	End carriage sweep	Lemon yellow, shade 356 as per IS-5	
5	Motors	Smoke Gray shade 692 as per IS-5	
6	Control Panels	Steel grey/ As per purchaser practice	

SUB-VENDOR LIST – SINGLE GIRDER CRANES **ANNEXURE-III**

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		
		ABB		
		LHP		
7.	BRAKES	ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DCEM BRAKES ONLY
		KAKKU		
8.	CONTACTOR	SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
		BCH		
9.	OVER LOAD RELAYS	SIEMENS		
		L&T		
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		

SUB-VENDOR LIST – SINGLE GIRDER CRANES **ANNEXURE-III**

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
16.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		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	

SUB-VENDOR LIST – SINGLE GIRDER CRANES **ANNEXURE-III**

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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	
17.	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	
		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	
		UNIVERSAL CABLES LTD	SATNA	
18.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	

SUB-VENDOR LIST – SINGLE GIRDER CRANES **ANNEXURE-III**

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
19.	XLPE POWER CABLES	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 INTERNATIONAL LIMITED	MUMBAI	
		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	
20.	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	NEW DELHI	

SUB-VENDOR LIST – SINGLE GIRDER CRANES **ANNEXURE-III**

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		LTD		
		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	
21.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
22.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		
23.	LIMIT SWITCHES	SPEED-O-CONTROL		
		ELECTROMAG		
24.	PENDENT PUSH BUTTON STATION	OEM		
25.	INDICATING LAMPS	TECKNIC		
		BCH		
		SIEMENS		
		STANDARD		
26.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER		
27.	PANELS	OEM		
		RITTAL		
		PYROTECH		
28.	RESISTANCE BOXES	ENAPROS		
		OEM		
		SAFEX FIRE SERVICES LTD		
		UNITED FIRE EQUIPMENTS PVT. LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
29.	VVVF	YASKAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
		FUJI ELECTRIC		

SUB-VENDOR LIST – SINGLE GIRDER CRANES **ANNEXURE-III**

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MITSUBISHI ELECTRIC		
30.	SHROUDED DSL	SUSHEEL		
		STROMAG		
31.	LOAD CELL	IPA		
		SARTORIUS		
32.	GEAR BOX	OEM		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		
		BONGFILIOLI*		
33.	RAIL	JSPL		
		SAIL		

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

   BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

1X800 MW WANAKBORI TPS (Single Girder Crane)		Annexure-IV
S. No	**DESCRIPTION OF EQUIPMENT / ITEM**	**Qty**
1	Mechanical (For Each Crane)	
1.1	**One set consisting of 2 nos. bearing for:**	
	a) CT wheel	1 set
	b) LT wheel	1 set
1.2	One set consisting of 2 nos. brake linings with rivets for :	
	a) MH brake	1 set
	b) CT brake	1 set
	c) LT brake	2 sets
1.3	One set consisting of 2 nos. brake shoes with lining for :	
	a) MH brake	1 set
	b) CT brake	1 set
	c) LT brake	2 sets
1.4	One set consisting of 6 nos. carbon brushes for :	
	a) MH motor	1 set
	b) CT motor	1 set
	c) LT motor	2 sets
1.5	One set consisting of 3 nos. brush holders for :	
	a) MH motor	1 set
	b) CT motor	1 set
	c) LT motor	2 sets
1.6	Fixed and moving contacts for each type of contactor	1 set
1.7	No volt coil for each type of contactor	1 set
1.8	Overload relay for	
	a) MH motor	1 No.
	b) CT motor	1 No.
	c) LT motor	2 Nos.
1.9	Motor bearings	
	a) MH motor	2 Nos.
	b) CT motor	2 Nos.
	c) LT motor	4 Nos.
1.1	Bearing for	
	a) MH Main Pulley	2 Nos
	b) MH Eq. Pulley	2 Nos
2	Electrical Items (For All Crane)	
2.1	415 Volt Motor (Upto 30 KW Rating)	
a	Driving End & Non-Driving End Bearing	3 Set for each type and rating of Motor
b	Cooling Fan	2 Nos. for each type and rating of Motor
c	Motor Terminal Block	5 Nos. for each type and rating of Motor
d	Complete Set of Coupling	1 Set of each application
3	C&I Items (For All Crane)	
3.1	Push Button	
3.2	Complete Assembly	5 Nos of each colour
3.3	Contact Element (1NO+1NC) Block	20 Nos.
3.4	Selector Switch	10 Nos of each type and rating
3.5	Meter (Analog or digital)	
3.6	Ammeter	10% for each type & range or minimum 1 no. whichever is more
3.7	Voltmeter	10% for each type & range or minimum 1 no. whichever is more
3.8	Frequency	10% for each type & range or minimum 1 no. whichever is more
3.9	MW	10% for each type & range or minimum 1 no. whichever is more
3.1	MVAR	10% for each type & range or minimum 1 no. whichever is more
3.11	Power Factor	10% for each type & range or minimum 1 no. whichever is more
3.12	Synchroscope	10% for each type & range or minimum 1 no. whichever is more
3.13	Indicating Lamps complete assembly	10 Nos. of each colour & type
3.14	Mimic Lamps	10 Nos. of each colour & type
3.15	MCB	2 Nos. for each type and rating
3.16	Door limit Switch	2 Nos.
3.17	Annunciation System	
3.18	Lamp Box with Facia & Lamps (LED Type)	25 Nos
3.19	Hooter	1 No.
3.2	Each Type of PCB (for non-PLC driven system)	1 No.
A.0.0	**Total (sl no. 1 to 3)**	

1	The lists of spares indicated are for the type equipment generally used in thermal power plants. If the design or type of equipment proposed by the bidder is different, then the bidder shall suit the spares list according to the type of equipment. However, the numers or quantity of spares, indicated shall not be reduced.
2	All essential spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is not applicable for particular equipment then suitable applicable alternate spare have been offered / shall be supplied without any financial implication.
3	Any change or variation in equipment or systems during detailed engineering stage which would cause changes / variations in the essential spares quantity, shall be supplied by Vendor without any commercial implications
4	For quantities indicated in percentage, fractions are to be rounded-off to next higher integer.
5	Any item which is “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by theVendor without any extra cost.
6	If any of the items of spares/tools & tackles ordered is found to be not applicable during detailed engineering stage/execution stage, the contractor will have to supply alternative items of spares/tools & tackles. The alternative items of spares/tools & tackles are to be mutually agreed between the PURCHASER and VENDOR

A: DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT ANNEXURE-V

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

Sl. No.	BHEL DRG.NO	DRAWING TITLE	SUBMISSION SCHEDULE - WEEK NUMBER FROM DATE OF P.O
1	PE-V0-408-524-A100	Manufacturing Quality Plan with sub vendor list	2
2	PE-V0-408-524-A101	Data sheet of Single Girder Crane with painting details	2
3	PE-V0-408-524-A102	G.A. of Single Girder CRANE with CT DSL arrangement	2
4	PE-V0-408-524-A103	Mechanism Sizing Calculation	2
5	PE-V0-408-524-A104	G.A. drg of Hoist with trolley wheel and bottom block assembly	3
6	PE-V0-408-524-A106	General arrangement for LT DSL for Single Girder crane	3
7	PE-V0-408-524-A107	Schematic Circuit Diagram for following a) Main Protective panel & BOM b) Main hoist panel & BOM c) Cross Traverse and Long Travel panel & BOM d) Pendent and earthing.	3
8	PE-V0-408-524-A108	Long travel Machinery Assembly with LT wheel assembly	4
9	PE-V0-408-524-A110	General arrangement of panel & pendent push button	4
10	PE-V0-408-524-A111	Cable sizing calculation and schedule.	3
11	PE-V0-408-524-A112	O & M Manual	8
12	PE-V0-408-524-A113	Mandatory spare parts list	6

Note:

1 VENDOR SHALL RESUBMIT THE REVISED DRAWINGS WITHIN 7 DAYS OF RECIEPT OF COMMENTS.

2 INCOMPLETE DRAWINGS/DOCUMENTS SHALL NOT BE TREATED AS SUBMITTED.

3 Document mention at sl.no.1,2,3,4 &7 shall be considered as basic documents for delay analysis purpose.

B: DOCUMENT MANAGEMENT SYSTEM

1.0 Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's Internal proxy setting should not block DMS application's link (http://124.124.36.198/wrenchwebaccess/login.aspx).

The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/ Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements.

The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

7.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

7.08.00 For review by the Consulting Engineer, the Contractor shall furnish soft copies of drawings & documents and three (3) prints of each drawing/ document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/ Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorised revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

7.09.00 11 copies of all approved drawings for Customer H.O., Site & Cons., 3 copies for BHEL Site shall be submitted

7.10.00 For details of documentation for Civil, Structural and Architectural works, Vol. II-G may be referred.

8.00.00 **TENDER STAGE DOCUMENT SUBMISSION**

8.01.00 The Bidder shall submit along with his bid all documents/drawings as requested in respective specifications. The documents shall include but not be limited to the following :

a) All Bid proposal sheets duly filled up.

b) Detailed experience list and financial resources of the prime bidder his collaborators/associates in this bid as well as the sub-vendors proposed.

c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.

d) List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.

GSECL P&P Gujarat State Electricity Corporation Ltd. Vadodara

Bharat Heavy Electricals Limited PS-Mktg. Delhi

VOLUME - IIB

SECTION – D

STANDARD TECHNICAL REQUIREMENTS

SINGLE GIRDER EOT CRANE

1.0.0 SCOPE

This specification covers the design, material, manufacture, assembly, inspection and testing at manufacturer works for single girder EOT crane. The equipment shall include all the accessories required for the trouble free operation.

The crane shall be complete with trolley and truck, wheels and axles, Drive mechanisms, Hoisting Drums, Brakes, Creep Speed Arrangement, and Lifting tackles, Buffers, Electric Motors, Controls, Switch Board and cabling, horns, warning lights, Limit switches etc. Any item not mentioned herein but required to make the system complete for the satisfactory performance of the crane shall also be included.

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.

a)	IS 807	Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists
b)	IS: 3177	Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes
c)	IS: 2266	Specification for steel wire ropes for general Engineering purposes.
d)	IS: 4029	Guide for testing induction motor (for temperature rise)
e)	IS: 15560	Steel hooks for standard shank design
f)	IS: 1554 Part I	PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts.
g)	IS: 325	Three phase induction motors.

h)	IS: 900	Code of practice for installation and maintenance of induction motors
i)	IS: 694 (Part-I)	Copper conductors PVC insulated cables for voltage up to 1000 V.
k)	IS: 434 (Pt I)	Copper conductors rubber insulated cables for voltage up to 1000V.
m)	IS: 691	Flexible trailing cables rubber insulated.
n)	IS 3043	Code of practice Earthing.
o)	IS: 3938	Electric Wire Rope Hoists.
p)	IS: 2147	Degree of protection provided by enclosures for Low voltage switchgear and control gear.
q)	IS: 1544	Polyethylene insulated PVC sheathed cables.

Indian electricity rules - 1956.

In the event of any conflict between the specification and standards mentioned above, the specification shall govern.

3.0.0 **SINGLE 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 & hoist block shall be as per IS-3938 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.

3.1.5 No cast iron part shall be used on the crane.

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

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

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

3.1.10 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.

3.1.11 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.

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

3.1.13 The crane shall be manufactured as per the tolerances specified below

a)	Span over LT wheels	± 3mm
b)	Diagonal on wheels	± 3mm
c)	Long travel wheel alignment	± 1mm
d)	Tilt of wheels or balancer axle	±1/1000mm(horizontal and vertical)
e)	Permissible variation in Speeds at full notch with rated load, voltage and frequency shall be as follows.	
	i) Travelling and traversing	±10%
	ii) Hoisting Lowering	±10%

3.1.14 Proper allowance shall be made for impact and wear in the design of the crane and in no case shall the factor of safety in any part be less than six (6), as per IS: 3177 based on the ultimate strength of the materials used at design duty.

3.2.0 **STRUCTURAL DETAILS**

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

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 Transverse filled welding on load carrying member shall be avoided.

3.2.1.5 All butt welds on structural members subjected to tensile stress shall be X - rayed.

3.2.1.6 Fillet welding on load carrying members shall be avoided.

3.2.1.7 Plates, angles and other rolled section used in the load bearing members of the structure shall not be less than 6mm thick.

3.2.1.8 The cranes working out door or in corrosive environment, an allowance of 1.5 mm shall be added to the calculated thickness.

3.2.1.9 Minimum thickness of chequered plates for platform shall be over 5mm over plain. Chequered plates shall not be considered for strength calculations of load carrying member.

3.1.1.10 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.

3.2.2 **Girder / Beam**

3.2.2.1 The girder / beam 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 with the following deletion / addition as applicable.

3.2.2.2 Minimum deflection of the bridge girder with safe working load shall not exceed 1/800 of span. The girder shall be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.

3.2.3 **End carriage**

3.2.3.1 End carriages shall be fabricated from rolled steel section or plates or as the case may be. 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.

3.3.0 **MECHANICAL**

3.3.1 **Rope drums**

Rope drums shall be of mild steel plate fabricated or of cast steel. 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 in 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. There shall be one spare groove for each rope lead 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 grove 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.

3.3.2 **Hoist ropes**

Ropes of steel core as specified in Data Sheet – A/B shall be of right hand lay, of 6x36 construction of best plough steel having minimum tensile strength as 160-180 kg/mm^2. Left hand lay wire ropes shall not be used (Reverse bend ropes shall be avoided as far as possible).

3.3.3 **Rope sheaves**

Sheaves shall be of cast 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 wheels shall be double flanged with tread to suit the rail. The wheels shall be capable of taking up misalignment in span as specified. Solid wheel shall either be of forged steel or as specified. The wheel shall be with hardness of BHN 300-350. Contact stresses between wheels and rails should be within permissible limits.

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 50% of the rated speed to zero speed.

3.3.6 **LT drive**

One pair of wheels in each end carriage shall be driven by motor through reduction gear.

3.3.7 **CT drive**

The CT mechanism of the electric hoist shall consist of 2pairs of wheels which shall be driven by motor through reduction gear.

3.3.8. **Gearing**

3.3.8.1 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. 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.

3.3.9.2 The gearboxes shall be of mild steel or cast steel. All fabricated gearboxes shall be stress relieved.

3.3.10 **Bearing**

3.3.10.1 Ball and roller antifriction bearing of FAG, SKF, NBC, NORMA 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 relevant codes. Life of bearing shall be calculated in accordance with manufacturers recommendations.

3.3.10.2 Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as possible to exclude dirt and prevent oil leakage.

3.3.11. **Couplings**

3.3.11.1 Motor shafts shall be connected to gear box input extension shafts through flexible gear coupling. Solid coupling shall be used for connecting intermediate lengths of long travel shafts, if applicable.

3.3.12 **Lifting hook**

Standard hooks shall be used unless otherwise specified. These hooks shall conform to the latest edition of IS 15560 as specified in the data sheet “A”.

3.3.13 **Brakes**

3.3.13.1 Selection and design of brakes shall be such as to meet the requirement. Electro mechanical brakes shall be provided for each motions. Brakes shall be designed to suit 150% FLT of motor for the hoist motion and 125 % FLT of motor for LT/CT motion. Brakes shall be provided as specified in Data Sheet ‘A’

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 isolating Switch fuse unit shall be provided at 1.5M above the operating floor level at one end of bay length or in the middle as specified in the data sheet A. Supply of 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 equipments 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 2%. Maintenance cradle for DSL shall be provided on crane if asked in Data Sheet 'A'. Sufficient allowance of min. 10% for wear & tear shall be considered while sizing the conductor. The runway conductors shall be supported on brackets and insulators.

3.4.1.3 The current collectors shall be of 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 be top-running type having spring loaded CI/carbon metallic shoes to maintain adequate contact pressure.

3.4.1.4 The cable, supplying power to crane trolley / electric hoist 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**

3.4.2.1 Crane motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The break down torque of the motors shall not be less than 225 percent of the full load torque with rated voltage and frequency applied and pull out torque shall not be less than 250% of the rated full load torque of motor.

3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending upon the ambient temperature and voltage /frequency variation shall be applied to derate the motors. The minimum margin of 15% or as specified in the section C of specification shall be considered over the calculated rating of the motor. The protection class of the motors shall be as per data sheet A. Motors shall be tested at manufacturers 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-325-1978 or as per the motor specification if enclosed here with.

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 withstanding 2.5 times the rated speed.

3.4.3 **Limit Switch**

The hoist mechanism of the crane shall be provided with rotary type limit switch to open the control circuit and 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 be provided. This switch shall operate in the event of failure of main limit switch if called for in data sheet “A”.

Lever operated limit switches shall be provided at both ends of longitude travel and cross traverse. These limit switches shall be self reset type.

3.4.8 **Protective Panel / Controls**

3.4.8.1 The electrical protective panel shall be a cubicle fabricated from 2 mm thick sheet steel with lockable-hinged door. It shall be dust and vermin proof with degree of protection as IP-55 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 equipments and devices mounted there on.

The following minimum equipments 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.

c) Switch fuse unit with D.O.L. starter for each motion.

d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.

e) Contactors, timer and auxiliary contactors.

f) Control transformer with fuses.

g) Indicating lamps to indicate the live condition of all three phases.

h) Other equipments as per supplier’s standard practice. Air break contactors shall conform to category AC-4 duty. The contactor drop off voltage shall be between 45-50% of rated voltage.

i) All internal wiring shall be identified with numbering ferrules at both ends as per the relevant wiring diagram.

3.4.9 **Pendent Push button station**

It shall be suspended by wire rope to prevent pull on the cables. The following minimum push buttons key operated type.

a) Main” ON”, “OFF” push button key operated and lockable in “OFF” position.
This push button will operate the main contactor.

b) Hoist and lower directions. (2Nos.)

c) Trolley travels both directions. (2 Nos.)

d) Bridge travels both directions. (2 Nos.)

e) Inching speed for hoisting & lowering

f) Inching speed for bridge motion.

g) Inching speed for trolley motion.

h) Creep speeds

i) Emergency stop push button (mushroom type).

j) Alarm bell push button.

3.4.10 **Grounding**

3.4.10.1 The crane structure, motor frame and all other electrical equipments 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.

3.4.10.2 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.

3.4.10.3 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 SYSTEM**

a) The supplier shall furnish all power, control and auxiliary circuit wiring of the equipment and the panel located on the trolley or bridge.

b) The wiring shall be complete in all respect to ensure the proper functioning of the equipment.

c) Power wiring to any motor shall be done with 1100V grade Cu conductor, PVC insulated / armoured /FRLS cable of suitable sizes as specified in Data Sheet A.

d) 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.

e) All control and auxiliary external circuit wiring shall be done with PVC insulated FRLS type 2.5mm stranded copper conductor.

f) 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.

g) Each motor shall be wired independently. Power and control wiring shall be effectively separated.

h) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.

i) All wire termination to the panels shall be provided with clamp type connections screw. Type terminals with screw directly impinging on conductors are not acceptable.

j) Multi-way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring and outgoing.

k) 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

l) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

4.0.0 LOAD INDICATION:

The crane shall have a permanent inscription of English on each side, readily visible from the ground level, stating the safe working loads in tonnes, year of manufacture, crane serial number and manufacturer's name.

TECHNICAL SPECIFICATION
FOR
VARIABLE FREQUENCY DRIVES

1.00.00 CODES AND STANDARDS

DC reactor – IEC 289

HT Circuit Breaker – IEC 56

Motors – IS 325 / IEC 34 / IS 4722

Transformers – IS 2026

Bushings – IS 2099 / IEC 137

Bushing CT – IEC 185 / IS 2705

Semiconductor converter – IEC 146

AC Contactor – IEC 158-1 / VDE 0660

2.00.00 TYPE

System shall be load commutated invertor type, 12-pulse design, having two channels (each channel with six pulse design) for each motor.

3.00.00 PERFORMANCE REQUIREMENTS

3.01.00 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/ wear/ noise.

3.02.00 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the large fan drives like ID Fans and other motors as specified in the specification elsewhere as per requirement with input supply variation of ± 10% and frequency variation of ±5%. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit.

3.03.00 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment

i) Variable torque changing as a function of speed i.e. speed squared

ii) Constant torque over a specific speed range

iii) Constant power over a specific speed range where the torque decreases when speed increases

3.04.00 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field be separately programmable from 0.1 to 20 seconds.

3.05.00 Each channel and motor rating shall be rated to meet fan requirements. The system shall be designed for linear continuous speed control from 20% to 100% of fan rated speed and shall be of a modern proven design and fully compatible with excitation system offered.

3.06.00 The Total Harmonic Distortion (THD) of the voltage and current at inverter output shall be as per IEC 61800-4 and it shall be considered in the design of the motor.

3.07.00 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations in the latest edition of IEEE-519.

3.08.00 The overload capacity of the controller shall be 150% of rated current of motor for one minute for constant torque applications, and 115% of rated current for one minute for variable torque application at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If the load demand exceeds the current limit for more than one (1) minute, the drive shall shut down to prevent overheating of the motor and damage to the drive.

3.09.00 During operation, the system shall be capable of developing sufficient torque under all load condition to respond to a 20% alteration in speed set point within a time limit up to 60 seconds

3.10.00 The integrator action of the speed set point alteration shall be independently adjustable for both an upward and downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 second.

3.11.00 The drive shall trip incase the speed exceeds 105% of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 second.

3.12.00 Maximum noise level from the drive at 1meter distance, under rated load with all normal cooling fans operating shall not exceed 85dBA.

3.13.00 Variable frequency drive shall be arranged so that it can be operated in a circuit mode, disconnected from the motor for start up adjustment and troubleshooting/ maintenance.

3.14.00 Voltage at motor neutral terminal shall be floating and neutral shall be insulated adequately for Load Commuted Inverter (LCI) operation.

3.15.00 The drive system shall ensure following

a) Harmful VFD induced harmonics which can create motor heating are eliminated.

b) VFD induced torque pulsation are limited to maximum 1% (even at low speed) so there is minimal stress to the equipment

c) Motor is protected from dv/dt stresses.

d) No appreciable increase in motor audible noise.

3.16.00 Electrical performance of the system shall comply to IEEE, IEC and equivalent international standard.

4.00.00 **CONTROL REQUIREMENT**

4.01.00 The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.

4.02.00 Short time voltage dip up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.

4.03.00 The system shall also be equipped with a facility which will restart the system in case of voltage dip over 20% or power interrupter for less than 2 seconds, with recovery of the voltage to its normal value. The drive shall have the facility to block this feature, if required by operator. Upon restart the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds.

4.04.00 The power controller shall be controlled to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.

4.05.00 The drive motor shall be speed controlled corresponding to 4-20mA or 0-10V reference input signal. Unless otherwise specified, upon complete loss of the users speed reference signal, the drive shall automatically run at constant speed as at 8-100% of the last speed reference available prior to the loss of signal.

4.06.00 It shall be possible to vary the speed of the drive in either manual or auto mode.

Auto/manual selection shall be from VFD panel unless otherwise specified.

- With the selector switch in “manual” mode, the operator shall be able to set the speed through keypad, mounted on front of the drive panel or from speed increase/decrease push buttons from the field. Motor operated potentiometer shall be provided as a speed set point device.

- With selector switch in “auto” mode, speed of the motor shall be controlled from a 4-20mA signal, from PLC/DCS system. Necessary equipment like protocol converter as required for interfacing with PLC/DCS shall also be provided in the drive panel.

4.07.00 The required provision for the interface with remote DCS located at control room shall be either through hardwired connection (with potential free contacts and transducers as described elsewhere in this specification) or serial link.

4.08.00 Drive system shall have provision for interface with upper level automation such as substation monitoring system or electrical control system.

4.09.00 The closed loop control feedback for the drive system having output transformer shall be tapped from the secondary side of the output transformer.

5.00.00 **PANEL CONSTRUCTION**

5.01.00 The panel shall include suitable semi conducting power devices (line commuted thyristors/Diodes/IGBT). Modules with protective devices, reactors (if required), filters (if required), control circuit, control accessories, indication and annunciation etc, the construction of the panel shall provide effective protection against electromagnetic emissions and shall meet design requirement of integrated standards

5.02.00 Upstream breaker “ON/OFF/TRIP” indications and remote breaker closing and trip push button shall be provided on the front door.

5.03.00 Safety Interlock shall be provided so that power cabinet can’t be opened unless the up stream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.

5.04.00 Duplicate control supply with automatic changeover shall be provided. Protection shall be provided against AC/DC transients, voltage surge etc. of power and control device.

5.05.00 The drive shall be housed in sheet steel panels fabricated with 2mm thick cold rolled sheet steel. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-41. The maximum operating height shall be 1800mm approximately.

5.06.00 Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to $10mm^2$ and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 600mm clear from bottom of the cable gland plate.

5.07.00 Bus bars shall be of electrolytic copper, color coded separately for AC and DC system. All the live parts shall be sleeved/ shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate.

5.08.00 All the switches, component and accessories which are essential for normal and emergency operation shall be mounted on the door and shall be operable externally. All the analog instruments, where provided, shall be switchboard type, back connected; 72x72mm.Scale shall have red mark indicating maximum permissible operating rating.

5.09.00 Each panel shall be provided with illuminating lamp/11W CFL with switch and fuse. 5/15A, 240V power socket with switch and fuse shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat.

5.10.00 Copper earth bus of min. 50x6 mm size shall be provided in the panel with provision for connection to purchaser's plant earth grid. All the non-metallic components/parts shall be connected to the main earth bus bar. Separate earth bus bar and stud for electronic control system as required shall be provided.

5.11.00 All the metal parts shall be treated so as to ensure efficient anti-corrosive protection. Hard wares shall be zinc passivated or electrogalvanised. Panel enclosure and structure supports shall be thoroughly cleaned and degreased to remove mill scale and rust etc. External surface shall be painted Light grey (RAL – 7032) with two coats of synthetic enamel paint.

5.12.00 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.

5.13.00 All the control wiring shall be enclosed in plastic/metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes of PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, copper conductor wire. 1.5mm2 size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5mm2 size for control fuse rating above 16A for electrical circuits and 0.7 mm2 for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminal shall be provided.

5.14.00 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipment and power electronic equipments shall be used.

5.15.00 All low voltage compartment and cabling shall be electrically and physically separated from the high voltage compartment.

5.16.00 DC link capacitor and pre charging and discharging circuit shall be preferably mounted in the rear of the panel.

5.17.00 Suitable removable type hooks shall be provided for lifting the panel.

5.18.00 Perspex type transparent insulating material shall be used for covering live compartments.

5.19.00 Drive keypad, operator control panel required for control, monitoring and measurements shall be supplied and installed outside the panel on the front door. It shall be accessible for operation without opening the front door and shall be non-removable type.

5.20.00 All the equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively.

6.00.00 COOLING

6.01.00 The drive panel shall be naturally cooled type as per manufacturer's standards. If unavoidable, forced type cooling system shall be provided. Cooling system shall include well-dimensioned panel, adequate cooling airflow path, module cooling fan and if necessary, panel-cooling fan shall be considered. Vendor shall ensure that the panel dimensions and the flowpaths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N+1) shall be provided.

6.02.00 Necessary starters shall be provided within the VFD panels for the ventilation fans, any other auxiliary motor etc. The system provided shall be interfaced with drive starting and shut down such that safety interlocks such as start permit from cooling system to drive and trip signal from cooling system to drive in case of cooling system failure etc., shall be incorporated in the overall sequence logic.

6.03.00 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space etc. shall be included and mounted in easy accessible location.

7.00.00 EQUIPMENT/COMPONENT SPECIFICATION

7.01.00 Motor

i) The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.

ii) The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.

iii) The Motor shall be designed to operate continuously at any speed over the range 20-100 % of rated speed.

iv) The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.

v) Motors required to be transferred to DOL, by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL, bypass mode shall be limited to value in motor specifications.

vi) The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.

vii) The motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800-4.

viii) The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.

Other details shall be as given in specification of Electric motors.

8.00.00 POWER TRANSFORMER

Indoor dry type/Outdoor ONAN type, and shall be suitable for rating complying with system details. Other details as given in sub-section of LT Aux. Transformer specification

9.00.00 POWER CONVERTER

i) The static power shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type.

ii) Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.

iii) All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.

iv) The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range.

v) All power diodes shall be of silicon type with minimum Vbo rating as 2.5 times the rated operating voltage.

vi) The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise due to harmonic currents generated by the inverter operation.

vii) The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools.

viii) The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.

ix) Offered system shall also take in account the distance between drive panel and motor and system shall include all material and accessories to make system suitable for a distance of 350m.

10.00.00 **DC LINK REACTOR**

i) Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit.

ii) Reactor shall be air-core type, natural cooling and housed in a separate enclosure in ventilated room

iii) Reactor shall be suitable for withstanding earth fault continuously and for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.

iv) Noise level shall not exceed value specified in NEMA TR-1

11.00.00 **OUTPUT FILTER**

VFD output current waveform should be inherently sinusoidal at all speeds, with harmonic limits as specified in this specification. Output filter shall be provided if required. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 300 seconds after a loss of AC voltage. All capacitor shall be maintenance free and self-healing type.

The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

12.00.00 **BYPASS FEATURE**

i) Bypass breaker / contactor-HRC fuse complete with protection, annunciation and metering shall be provided.

ii) All Variable frequency drives (VFD) having bypass feature shall have motor protection relay along with necessary control and metering etc. Switching scheme shall be such that in case of drive mal-operation, the motor could be taken on bypass control manually, while the drive could be attended by opening its isolation devices.

iii) Safety interlock between inverter and bypass breaker/contactor shall be provided such that closing of healthy device is inhibited in case of external fault.

13.00.00 **CT/PT/METERS**

As required for the system offered and shall be suitable for variable frequency operation.

14.00.00 **LOCAL MOTOR CONTROL STATION**

i) The local motor control station is to be installed in the field near the motor. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.

ii) Meters in the local control station shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current. Further, the drives with bypass facility, the meters shall be capable of reading bypass full load and starting currents, as well as the drive current.

15.00.00 **PROTECTION, CONTROL, METERING, INDICATION & ANNUNCIATION**

15.01.00 The system vendor shall provide all the necessary system control, protection; alarm equipment and metering for the entire drive system and its auxiliary equipment.

15.02.00 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

16.00.00 **OPERATOR CONTROL PANEL**

i) Each drive shall be equipped with a front mounted operator control panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall be limited to Start/Stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc. Also local operation during maintenance should be possible & the same shall be provided inside the panel.

ii) All parameter names, fault messages, warnings and other information shall be displayed in complete English words or Standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However the parameters such as measurements, setting, and mode of drive etc. Shall be allowed to be viewed without any password.

iii) Operator console shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another identical drive for start up and operation.

iv) Drive system control also have facility to receive tripping signal from up stream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved.

v) User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.

17.00.00 **PROTECTIVE FEATURES**

The system offered shall incorporate adequate features, properly coordinated for the drive control and for motor but not limited to the following :

i) Incoming line surge protection.

ii) Under / Over voltage protection.

iii) Phase loss, phase reversal protection.

iv) Programmable Over current Protection and under load protection.

v) Inverter fault.

vi) Over frequency operation.

vii) Ventilation loss.

viii) Over temperature of equipment.

ix) Over speed of motor.

x) Specific motor protection, including motor winding, bearing temperatures, over current, Overload, negative phase sequence, locked rotor and earth fault protections etc.

xi) System Earth fault protection.

xii) Over and under frequency, rotor earth fault, field failure protection for synchronous motor

xiii) Additional protection for drive system

18.00.00 **CONTROL**

The following controls shall be provided as a part of the operators control Panel or through separate switches.

i) Start/Stop

ii) Speed Control (Raise/lower)

iii) Auto/Manual/Test mode

iv) Local/Remote

v) Emergency Stop

vi) Start/Stop for by pass starter (where specified)

vii) Trip-Remote Breaker

viii) Sequential switching of filters

19.00.00 **INDICATORS**

Vendor shall provide indications as required for normal operation and for easy maintenance, which shall be limited to the following indications :

i) Motor running

ii) Motor stopped

iii) VFD System Fault

iv) System ready to start

v) AC mains ON

vi) Motor over speed

vii) Rectifier output 'ON'

viii) Motor zero speed

ix) Rectifier breaker trip

Above indications may be provided as a part of the operator control panel, i.e., door mounted keypad or through hardwired indicating lamps/LEDS.

Potential free contacts of items i-iv shall be wired separately for remote indications in PLC/DCS system.

20.00.00 **METERING**

Digital display of the following parameters shall be as a part of the Operator Control Panel, selected by the operator.

i) Input AC voltage

ii) Input AC frequency

iii) Input AC current

iv) Output voltage

v) Output current VFD / Bypass

vi) Output frequency

vii) Motor thermal state

viii) Drive thermal state

ix) Motor speed

x) Motor energy meter

xi) DC Link voltage

xii) Hour Run

Necessary transducer shall be provided with 4-20mA output for indicating motor speed and motor current in PLC/DCS unless otherwise specified for other parameters.

21.00.00 AUDIO-VISUAL ANNUNCIATIONS

i) The system shall incorporate audio-visual annunciations for protection, for various fault conditions, for the Drive motor, Supply cables, DC Reactor and the Converter, output transformer etc.

ii) Alarms shall also be included for the failure of various auxiliaries together with identifications of the failing unit, loss of cooling system, various protections devices provided for converter transformer etc.

iii) Audio-visual window annunciations shall be provided on the front of the panel. All annunciations as required for normal and satisfactorily operation of the drive system shall be included as per vendor standards. These annunciations can be part of operator console panel or separately mounted type.

iv) Vendor shall include audio-visual alarm as required for normal operations and maintenance of the system but not limited to the following :

1. Rectifier fuse failure
2. Main AC failure
3. Inverter fuse failure
4. Inverter overload
5. Inverter high temperature
6. Cooling system failure
7. Motor failed to start
8. Transformer failure
9. Battery monitoring healthiness
10. Communication and measurement system unhealthy
11. Motor temperature high
12. Harmonic filters monitoring

Common potential free contacts shall be provided for above annunciations and these shall be wired up to terminal block for remote alarm and monitoring.

22.00.00 FAULT DIAGNOSTIC

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available for a period of minimum 4 days (96 hours) after a shut down even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

23.00.00 EXTERNAL POWER SUPPLY FOR AUXILIARY AND CONTROL CIRCUIT

Auxiliary power supply for devices external to VFD module, space heater supply for Motor, VFD panel space heater, auxiliary power supply for transformers, cubicle 11W CFL lamps etc. shall operate on 240 volts single phase AC provided by purchaser.

All control circuit shall operate at maximum voltage of 240V AC

Vendor shall include supply of all control transformers, protective devices, required accessories etc. and any other control supply voltage as required for the system shall be derived from the power supply made available by other.

24.00.00 RELIABILITY FEATURES

The expected lifetime of the drive system shall be 25 years. The system including all individual components forming part of the system shall have a minimum MTBF of 4 years.

25.00.00 MAINTENANCE FEATURES

The controller design shall incorporate the following maintenance features :

- Modular construction
- All components shall be easily accessible

Standard diagnostics to aid maintenance personnel. These shall include LED or alphanumeric displays, test or measurement points.

26.00.00 **PAINTING**

26.01.00 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat.

26.02.00 After preparation of the under surface, the panel shall be provided with epoxy based powder coating. Panel finish shall be free from imperfections like pinholes, orange peels, runoff painted.

26.03.00 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

26.04.00 Final paint shade shall be Siemens grey (RAL - 7032).

27.00.00 **INSPECTION, TESTING AND ACCEPTANCE**

27.01.00 During fabrication, the drive shall be subject to inspection by owner, or by an agency authorized by the owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to owner's inspectors.

27.02.00 All tests shall be carried out at the manufacturer's works under his care and expense. The tests shall be witnessed by an inspector of the owner or an agency authorized by the owner. Prior notice of minimum of 4 weeks shall be given to the inspector for witnessing the test.

27.03.00 The routine test shall be conducted on all the drive system. However type test shall be performed on one system of each rating and type unless otherwise agreed between purchaser and manufacturer. For the purpose of testing, drive system shall include input/output transformer (where applicable), switchgears, converter, filters etc.

27.04.00 The routine and type tests to be performed on the drive system shall be as follows :

Routine Tests

a. Visual Inspection

It involves checking of the various equipments/components fault diagnostic unit, wiring, terminals, earthing ratings etc, in line with the approved drawings and visual inspection shall not be limited to the following;

i) Dimensions and door layout Vis-à-vis the approved drawings

ii) Degree of protection of cubicles

iii) Simulation facility of control signals for testing purposes

iv) Memory function of fault diagnostic

v) Voltage/Current rating power semiconductor elements

vi) Cable termination size and number of terminals, cable-supporting etc.

vii) Accessibility of components

viii) External signals and indication/alarm signals on converter

ix) Earthing of cubicles and cubicle doors

b. Insulation Test

c. Light load and functional test

d. Load characteristics test

e. Load duty test

f. Checking of Auxiliary devices

g. Checking the properties of the control equipment

h. Checking the protective devices

i. Checking of control and functional requirements

j. High voltage test

k. Shaft current/bearing insulation

l. Automatic restart/re-acceleration

Type Tests

a. Allowable full load current versus speed

b. Efficiency

c. Temperature rise

d. EM Immunity

e. EM Emission

f. Current sharing

g. Voltage division

h. Line side current distortion content

i. Power factor

j. Audible noise

k. Torque pulsation

l. Motor vibration

m. Dynamic performance

n. Current limit and current loop test

o. Speed loop test capability to ride through voltage less than 80%

p. Test capability to restart the system and resynchronize converter onto running motor after a voltage interruption

Type test certificate from independent testing agency for similar equipment can be accepted if it is carried out within 5 years from the date of inspection.

VOLUME - III

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

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

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

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

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

PRE-BID CLARIFICATION SCHEDULE

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

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

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:- 1X800 MW WANAKBORI TPP

PACKAGE:- S/G CRANES

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

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

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

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

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

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

a) Signed & stamped Electrical load list

b) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation or No deviation in the format given under Vol.-III

c) Un priced copy of price format indicating quoted/ not quoted against each row/column

d) Copy of pre-bid clarifications, if any, duly signed & stamped

e) Signed/ Stamped copy of Compliance cum Confirmation Certificate (Vol.-III)

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 ACCORDINGLY WILL NOT BE CONSIDERED FOR BID EVALUATION.

DESIGN PARAMETERS	
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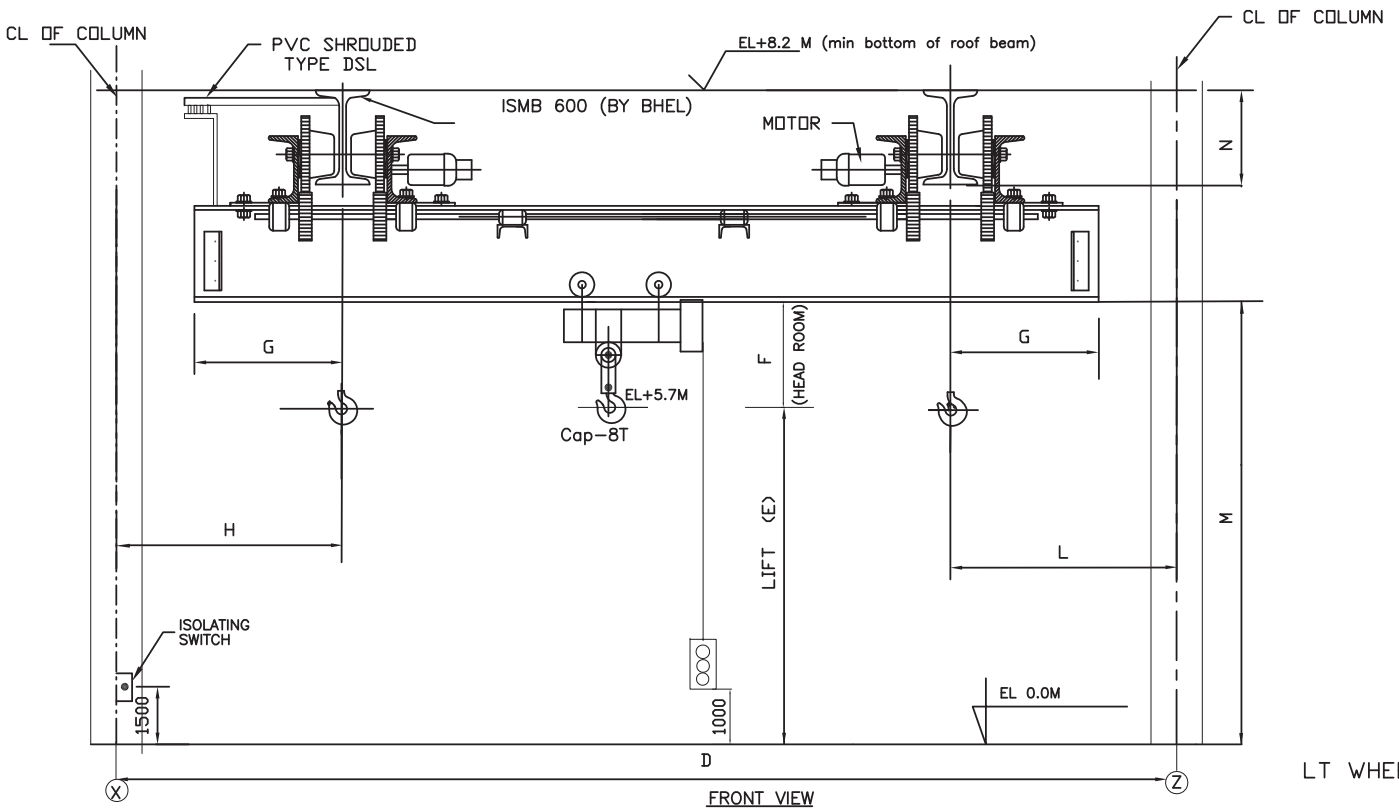
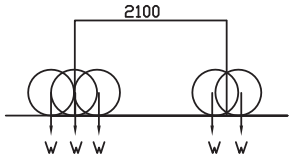
C	*
D	13000
E	5700
F	*
G	750
H	1350
L	1350
M	*
N	600



FRONT VIEW



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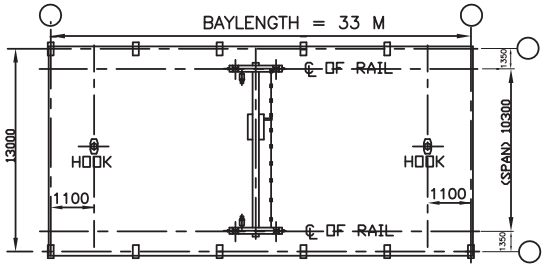

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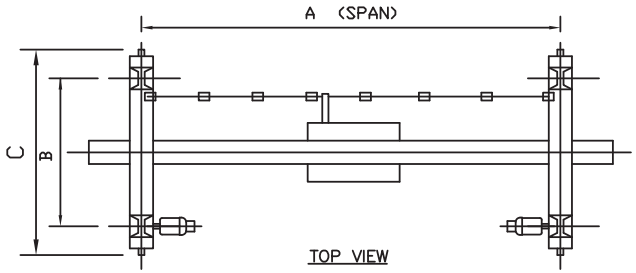

TOP VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MM.

REVIEWED											
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.

	NAME	SIGN	DATE
DRN.	DSR	---SD---	25.08.15
CHD.	VK/GBC	---SD---	25.08.15
APPD.	PK	---SD---	25.08.15

TITLE : CRANE_CLEARANCE_DIAGRAM_FOR COMPRESSOR_HOUSE_CRANES

UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-408-524-A001 | REV. R0

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

DESIGN PARAMETERS	
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C	*
D	14350
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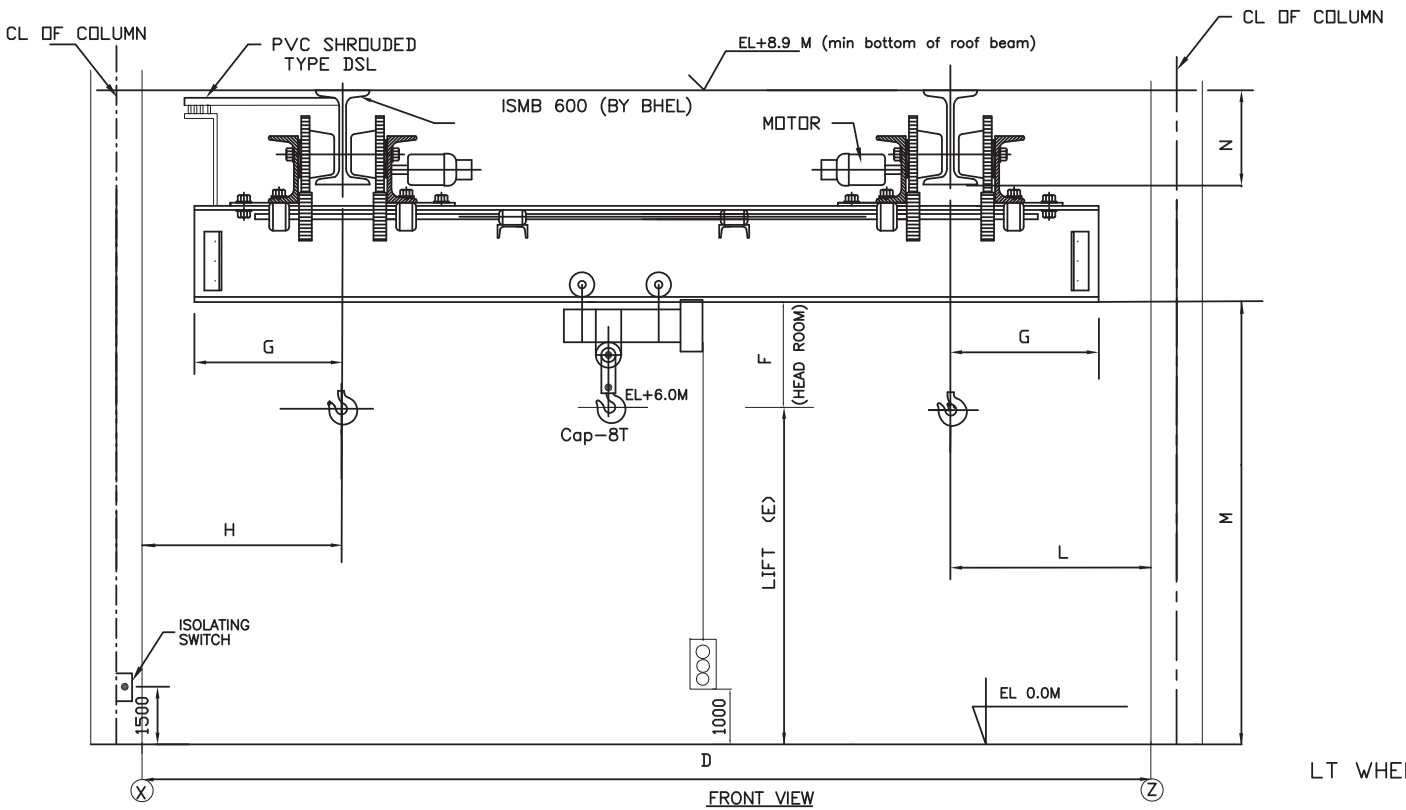
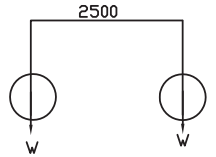
H	1100
L	1100
M	*
N	600



FRONT VIEW



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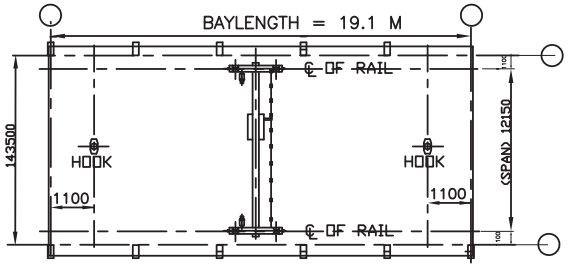

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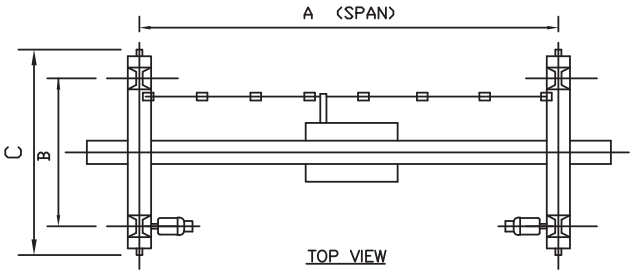

TOP VIEW

NOTES:

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REVIEWED											
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.

	NAME	SIGN	DATE
DRN.	DSR	---SD---	25.08.15
CHD.	VK/GBC	---SD---	25.08.15
APPD.	PK	---SD---	25.08.15

TITLE : CRANE_CLEARANCE_DIAGRAM_FOR DG_BUILDING_CRANES

UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-408-524-A002 | REV. R0

DESIGN PARAMETERS	
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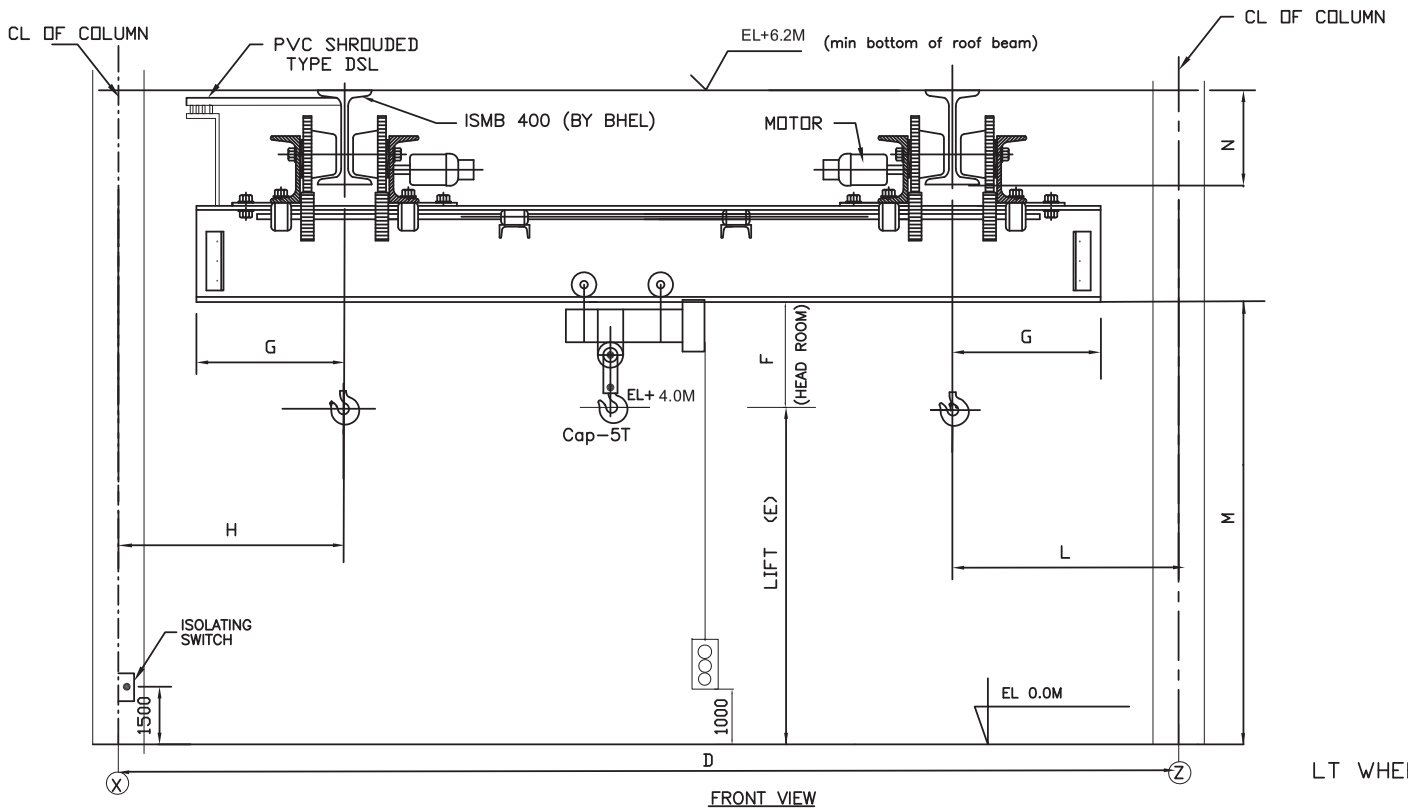
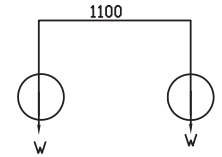
M	*
N	400



FRONT VIEW



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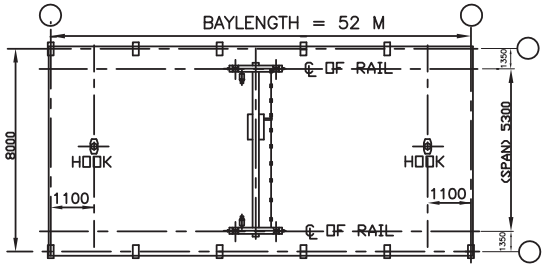

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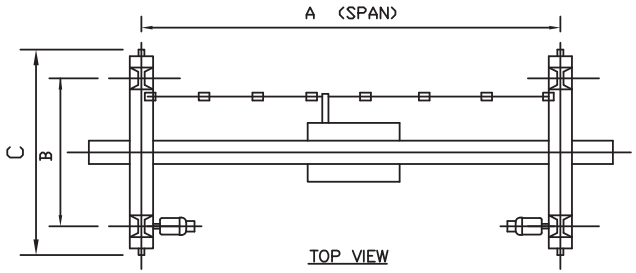


TOP VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MM.

REVIEWED											
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

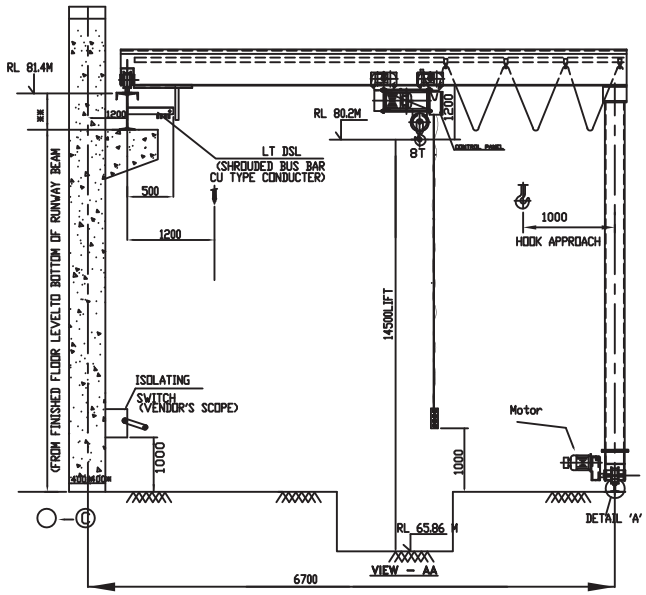
BHARAT HEAVY ELECTRICALS LTD.

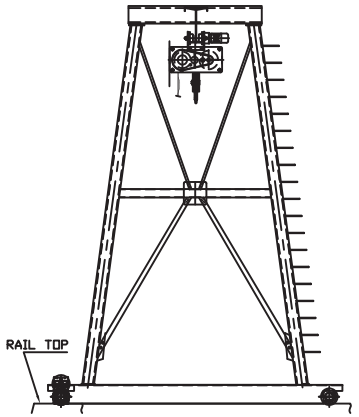
	NAME	SIGN	DATE
DRN.	DSR	---SD---	14.01.16
CHD.	VK/GBC	---SD---	14.01.16
APPD.	PK	---SD---	14.01.16

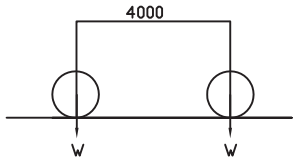
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR FIRE_CUM_CLARIFIED_PH_CRANES

UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-408-524-A003 | REV. R0

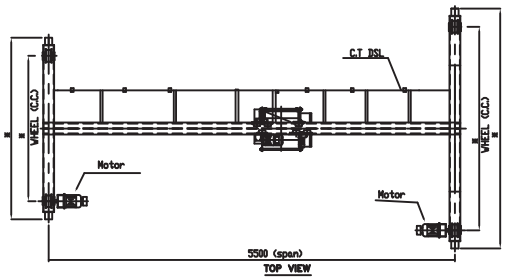
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

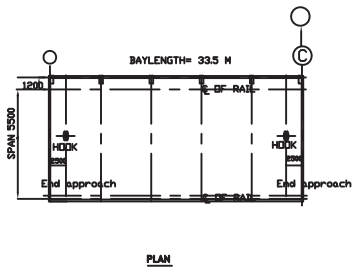






LT WHEEL LOAD WITH OUT IMPACT (W=5.5 T)





NOTE-

1 - ALL DIMENSIONS ARE IN MM.
2 - DSL(LT) => SHROUDED BUS BAR CONDUCTOR
3 - ** SUBJECT TO FINALISATION OF STRUCTURE
4 - DIMENSION MARKED AS(*) IS TO BE GIVEN BY THE VENDOR
5 - CRANE SHALL BE OUTDOOR TYPE

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REVIEWED	APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.

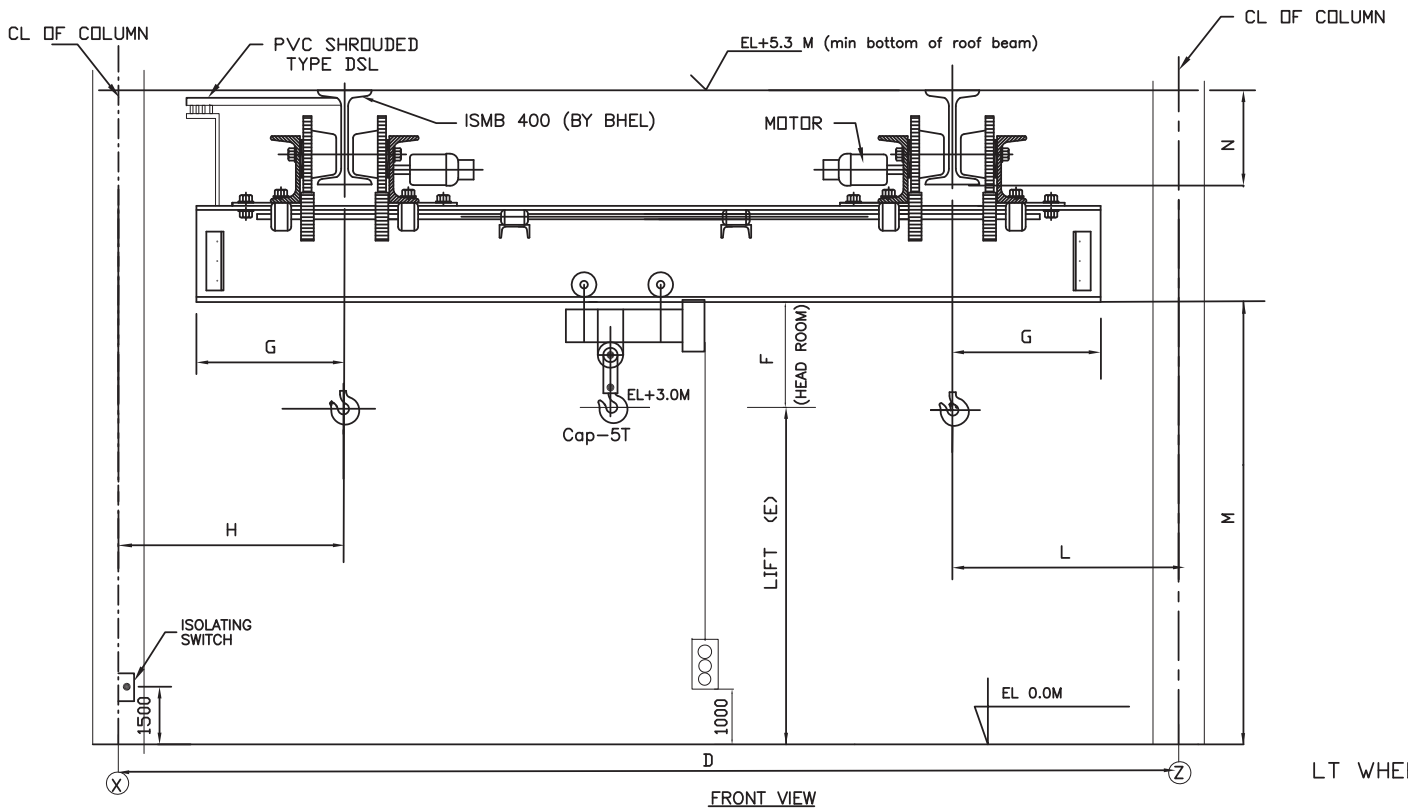
	NAME	SIGN	DATE
DRN.	DSR	---SD---	14.01.16
CHD.	VK/GBC	---SD---	14.01.16
APPD.	PK	---SD---	14.01.16

TITLE : CRANE_CLEARANCE_DIAGRAM_FOR CW_PH_CRANES

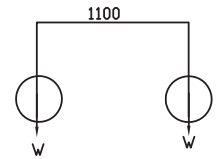
UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-408-524-A004 | REV. R0

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

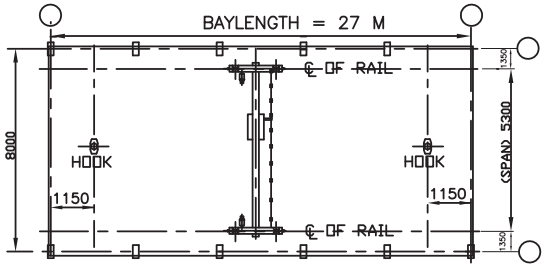
DESIGN PARAMETERS	
A	5300
B	*
C	*
D	8000
E	3000
F	*
G	750
H	1350
L	1350
M	*
N	400



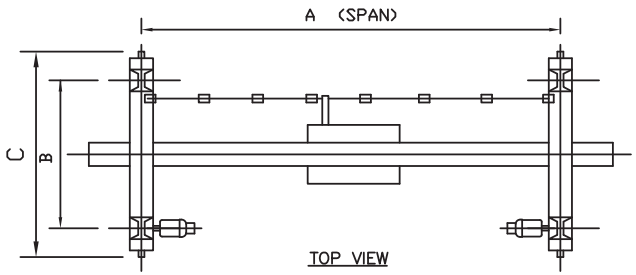
FRONT VIEW



LT WHEEL LOAD WITH OUT IMPACT (W=3.3 T)



KEY PLAN



TOP VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MM.

REVIEWED											
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.

	NAME	SIGN	DATE
DRN.	DSR	---SD---	14.01.16
CHD.	VK/GBC	---SD---	14.01.16
APPD.	PK	---SD---	14.01.16

TITLE : CRANE_CLEARANCE_DIAGRAM_FOR NEW_CLARIFIED_PH_CRANES

UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-408-524-A005 | REV. R0