NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT
(3 X 40 MW)

TECHNICAL SPECIFICATION
FOR

DOUBLE GIRDER EOT CRANES
FOR BUTTERFLY VALVE HOUSE (50/10/5 T)

SPECIFICATION No. **PE-TS-414-501-A002**

REV NO. 00

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

		TECHNICAL SPECIFICATION RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANE FOR BUTTERFLY VALVE HOUSE (50/10/5 T)	PE-TS-414-501-A002 Rev. No. 00 Date: 08.02.2024

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PROJECT INFORMATION

SL.NO	DESCRIPTION	DETAILS
1	**CUSTOMER**	NTPC LTD.
2	**CUSTOMER CONSULTANT**	NA
	LOCATION	Darjeeling Dist.. West Bengal state. The project site can be accessed from Siliguri via Ghoom.
3	**METEOROLOGICAL DATA**	
3.1	MAXIMUM TEMPERATURE	30 °C
3.2	MINIMUM TEMPERATURE	3 °C
3.3	MAXIMUM RELATIVE HUMIDITY	<95 %
3.4	MINIMUM RELATIVE HUMIDITY	>35 %
3.5	AVERAGE ANNUAL RAINFALL	2800 mm
3.6	SEISMIC ZONE (AS PER IS 1893)	At the margin of Zone-IV and Zone-V of the seismic zoning map of India.
3.7	HEIGHT ABOVE MSL	EL 861.5m (FFL of BFV House)
4	**ELECTRICAL DATA**	
4.1	AMBIENT TEMPERATURE FOR DESIGN OF ELECTRICAL EQUIPMENT	40°C
4.2	RATED FREQUENCY	50Hz
4.3	FREQUENCY VARIATION	(+)3% to (-) 5%
4.4	AC VOLTAGE	415V AC
4.5	AC VOLTAGE VARIATION	(±)10%
4.6	COMBINED VARIATION IN FREQUENCY & VOLTAGE	0.1
4.7	DC VOLTAGE	
4.8	DC VOLTAGE VARIATION	
4.9	FAULT LEVEL (KA/SEC)	45kA RMS
5	**OTHER INFORMATION**	
5.1	THE BASIC WIND SPEED “Vb” AT TEN METERS ABOVE THE MEAN GROUND LEVEL.	-
5.2	THE RISK COEFFICIENT “K1”	-
5.3	CATEGORY OF TERRAIN	-
5.4	OTHER FACTORS	-

	SCOPE		
	SCOPE OF THIS PACKAGE COVERS THE FOLLOWING:		
	SL.NO	**PARAMETERS**	**REQUIREMENT**
	1	Supply including Design, Engineering, Manufacturing of	
	a)	Main Supply	YES
	b)	Commissioning Spares	YES
	2	Painting	YES
	3	Inspection & Testing	YES
	4	Packing	YES
	5	Transportation & Delivery To Site	YES
	6	Erection & Commissioning	YES
	7	Supervision of Erection & Commissioning	NO
	8	Performance Guarantee (PG) Test	YES
	9	Mandatory Spares	YES
	10	O & M Service	NO
	11	O & M Spares	NO
	12	Storage	NO
	EXCLUSIONS		
	1	Two (2) nos. power supply feeders.	
	2	RCC gantry girders & handrails over gantryt girder.	
	3	Support arrangement for DSL mounting.Refer Compliance drawing “BFV HOUSE EOT (50/10/5T): FIRST STAGE EMBEDMENT PART FOR RAIL FIXING AND	
	4	Foundation bolts & grouting template for sole plate and rails clamping. Refer input drawing “BFV HOUSE EOT (50/10/5T): FIRST STAGE EMBEDMENT PART FOR RAIL FIXING AND DSL”	
	5	Loads for load testing shall be provided by BHEL.	
	6	Cradle for load testing shall be provided by BHEL.	
	7	Storage and further transportation of the materials from store to the erection site.	

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	GENERAL TECHNICAL REQUIREMENT	
1.0	It is not the intent to specify herein all the details of design and manufacturing. Bidder shall ensure that the offered equipment confirms in all respects to high standards of design, engineering and workmanship.	
2.0	The equipment shall comply with all applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed.	
3.0	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.	
4.0	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.	
5.0	Drawing/document submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and training for the same. Bidder to ensure proper internet connectivity at their end.	
6.0	The first revision drawings/ documents submitted by vendor shall be complete in all respects.Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place as per the requirement for across the table discussions/ finalizations/ submissions of drawings.	
7.0	In case of any change in Codes, Standards & Regulations between the date of bid opening (12.01.2015) and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.	
8.0	All equipment to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for the Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/owners representative and submit the reports for approval.	
9.0	Bidder shall submit stamped Manufacturing Quality Plan on compliance route in the event of order. In case, the bidder is supplying the item from outside India, the third party inspection shall be arranged and considered by the bidder in their offer.	
10.0	Sub vendor list is attached. Any additional sub - vendors proposed by biddder during contract stage shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.	
11.0	Document approval by BHEL / Customer shall not absolve the supplier of their contractual obligations of completing the work as per specification requirement without any commercial and delivery impact.	

12.0	One Set is defined as the total number required for one crane. If any item is not applicable due to vendor's specific design, its equivalent spare/s shall be quoted. Any item which is quoted as “not applicable” and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.
13.0	**Transport Limit:** Maximum weight allowed is 15T inclusive of lorry/trailer weight with maximum dimension of 8mx 3m x 6m (LxBxH). The bidder shall inform himself fully as to all relevant transport facilities and requirements, loading gauges and other limitations and shall ensure that the equipment as prepared for transport shall conform to such limitations. The Bidder shall also be responsible for obtaining from the Indian railway or highway authorities any permit that may be required for the transport of loads exceeding the normal gauges.
15.0	**Training:** Vendor shall provide training to customer’s staff at project site during erection & commissioning of the equipment as per the programme decided mutually. The training, to be organised on the equipment, shall cover but not to be limited to following aspects: Informing operators on the specific use for which an item of lifting equipment is intended, ensuring access to operating instructions. Correct method of use of equipment and warning on incorrect & dangerous practices. Identifying and understanding equipments workings. Identification of hazards, assessment of the associated risks and method of controlling the risks. Training on pre-lift checks, such as load & angle estimation and identification & reporting of basic equipment defects. Correct method of attaching load, slings & other accessories. Lifting & lowering procedures are to be followed, signal to be used between staffs, possible faults that can occur, appropriate storage of equipments & slings after use.
16.0	If more than 20 % of the total surface area of a given zone shall be touched-up, the Contractor shall replace the surface treatment over the entire surface.

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TECHNICAL DATA SHEET A

Sr. No.		DESCRIPTION	TECHNICAL PARTICULARS	
1.0.0		**General**		
1.1.0		**Basic Details**		
	a.	EOT Crane	Double Girder EOT crane	
	b.	Location	BUTTERFLY VALVE HOUSE	
1.2.0		**Design, fabrication and testing of the crane confirm to standard / code number**	Mechanical and Electrical as per IS: 3177 & Structure design in accordance to IS 807.	
1.3.0		**Number of crane**	One (1)	
1.4.0		**Crane classification**	M4 duty overall, For Crane travel –Mechanism class M4, For Trolley travel –Mechanism class M5, For 50T hoist - Mechanism class M4, For 10T hoist - Mechanism class M4, For 5T hoist - Mechanism class M4.	
1.5.0		**Suitable for outdoor or indoor duty**	Indoor	
1.6.0		**Capacity**	SWL = Safe working load	
1.6.1		**Main hoist**		
	a.	Rated SWL – tonnes	50T	
	b.	Test load SWL – tonnes	Rated SWL and over load test : 125% of SWL	
	c.	Lift	9 Mtrs	
1.6.2		**Aux. hoists**		
	a.	Rated SWL – tonnes	25T	
	b.	Test load SWL – tonnes	Rated SWL and over load test : 125% of SWL	
	c.	Lift	9.5 Mtrs	
1.6.3		**Electric hoist**		
	a.	Rated SWL – tonnes	5T (1 no. at one of bridge girder) with ISMB	
	b.	Test load SWL – tonnes	Rated SWL and over load test : 125% of SWL	
	c.	Lift	8 Mtrs	
1.7.0		**Span of crane**	8.3 Mtrs	
1.8.0		Operation from	Cabin & Radio remote control operated	
2.0		**CRANE PERFORMANCE**		
2.1.0		**Crane speed with full load**	Full speed m/min	Creep speed m/min
	a.	Main hoist	1	(10% of main speed thru' VVVF drives)
	b.	Aux. hoist	8	(10% of main speed thru' VVVF drives)
	c.	Trolley travel (CT)	10	(10% of main speed thru' VVVF drives)
	d.	Longitudinal bridge travel (LT)	20	(10% of main speed thru' VVVF drives)
	e.	Electric hoist -Hoisting	4.5	(10% of main speed thru' VVVF drives)
	f.	Electric hoist – Cross Travel motion	12	(10% of main speed thru' VVVF drives)
2.2.0		**Acceleration values for LT motion (bridge travel) and CT motion (trolley travel)**	0.2 m/s^2	
2.3.0		**Hook Approaches from centreline of rail**		
	a.	Main hook (non cabin side)	2200 mm	
	b.	Aux. Hook (non cabin side)	1200 mm	
	c.	Main hook (cabin side)	1200 mm	
	d.	Aux. Hook (cabin side)	2200 mm	
2.4.0		**Hand Rail Pipes**	32 mm NB Medium class of IS: 1161 having top and bottom rail at height of 1000 mm and 450 mm respectively and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick)	
3.0.0		**COMPONENT DETAILS**		
3.1.0		**Trolley**		
	a.	Type	Fabricated	
	b.	Method of fabrication	Fusion welded	
	c.	Material	Rolled Structural steel as per IS 2062.	
	d.	Other requirements	Upper pulley block shall be approachable for maintenance.	
	e.	Jacking pads	Yes.	

3.2.0		**Rope drums**	**Main Hoist (MH)**	**Aux Hoist (AH)**
	a.	Material (Indicate IS)	Rolled steel, welded construction.	
	b.	Flange / flangeless	Flanged	
	c.	Numbers provided	One for each hoist	
	d.	Type of grooves	Identical Right hand and Left hand.	
3.3.0		**Rope details**	**Main Hoist (MH)**	**Aux Hoist (AH)**
	a.	Construction	Extra flexible plough steel/alloy steel , 6X 36, 6 X 37, Right Hand Ordinary (RHO) lay construction.	
	b.	Standard conforming to	IS: 2266 (latest edition)	
	c.	Factor of safety	6	
3.4.0		**Sheaves details**	Main hoist	Aux hoist
	a.	Material	Manufactured from cast steel or welded steel construction	
	b.	Type of guards provided	Fabricated from rolled steel plate	
3.5.0		**Gear box details**		
3.5.1		**Hoist Motions**	**Main Hoist (MH)**	**Aux Hoist (AH)**
	a.	Type of mounting of gear box	Horizontal / Vertical	
	b.	Classification	M5 duty	
	c.	Type of lubrication (grease / splash / pump lubrication)	Grease / Splash Lubrication	
	d.	Materials (gear/pinions)	Forged carbon steel or alloy steel	
	e.	Casings	Casing shall be fabricated from tested quality cast steel or welded steel plates and duly stress relieved. The casing shall be effectively sealed against oil leakage.	
	f.	Noise level	85 db	
	g.	Standard conforming to	IS: 4460 / AGMA	
3.5.2		**Travel Motions**	**Cross Travel (CT)**	**Long Travel (LT)**
	a.	Type of mounting gear box	Vertical/ Horizontal	
	b.	Classification	M5 duty	
	c.	Type of lubrication (grease / splash / pump lubrication)	Grease / Splash Lubrication	
	d.	Materials (gear / pinions)	Forged carbon steel or alloy steel	
	e.	Casings	Casing shall be fabricated from tested quality cast steel or welded steel plates and duly stress relieved. The casing shall be effectively sealed against oil leakage.	
	f.	Noise level	85 db	
	g.	Standard conforming to	IS: 4460 / AGMA	
3.6.0		**Lifting hooks**	**Main Hoist (MH)**	**Aux Hoist (AH)/ Electric hoist**
	a.	Type	Ramshorn shank with safety latch swiveling type	Shank, plain
	b.	Material	Forged annealed alloy or carbon steel	
	c.	Standard conforming to	IS: 5749	IS: 15560
	d.	Hook can rotate	Yes	
	e.	Safety latch on hook provided	Yes	
	f.	Locking device on swivelling hook required or not	Provided	
3.7.0		**Motors**		
	a.	CODES AND STANDARDS	IEC:60034 ,IS 12615	
	b.	Voltage level	415V, Three Phase AC	
	c.	Efficiency class	Conforming to IS 12615	
	d.	OPERATIONAL REQUIREMENTS		
		Starting Time	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.	
		Torque Requirements	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.	
		Starting voltage	85% of rated voltage	
	e.	Winding and Insulation	Thermal Class 130(B) or better	
		Type	Non-hygroscopic, oil resistant, flame resistant	
		Starting duty	Two hot starts in succession, with motor initially at normal running temperature	
	f.	Noise level	Limited to 85dB(A)	

	g.	Earthing points	Motor body shall have two earthing points on opposite sides	
	h	Ratio of locked rotor KVA at rated voltage to rated KW	11	
	i.	DIMENSIONS OF TERMINAL BOXES	Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
			UP to 3 KW	As per manufacturer's practice.
			Above 3 KW - upto 7 KW	85
			Above 7 KW - upto 13 KW	115
			Above 13 KW - upto 24 KW	167
	j	PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE	Motor MCR in KW	Clearance
			UP to 110 KW	10mm
	k	Type	Squirrel cage induction motor suitable for direct-on-line starting.	
	l.	Enclosure	Totally enclosed fan cooled (TEFC)	
	m	Voltage, phase and frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +3%/-5% occurring separately or combined voltage and frequency variation of 10%.	
	n	Class of protection for motor including terminal box	IP – 55	
	o	Maximum continuous motor ratings	At least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.	
	p	Duration factor/duty	S4 duty, 40% cyclic duration factor.	
	q	TEMPERATURE RISE	70 deg. C by resistance method for both thermal class 130(B) & 155(F)	
	l.	Overload protection for motors provided	Yes	
	m	Space heater requirements	For motors of rating 20 KW and above	
3.8.0		**Drive system for hoisting**		
	a.	Arrangement of drive from motor to rope drum (main)	Through geared coupling and gear box	
	b.	Arrangement of drive from pony motor to rope drum (creep speed)	Creep speed through VVVF drive.	
3.9.0		**Rails**		
	a.	Type / section	Rails sections shall be CR-80.	
	b.	Standard conforming to	IS: 3443	
3.10.0	a.	Ventilation in operator's cabin	A non-oscillating ventilation fan of 240 V AC, single phase and with suitable guard shall be provided in the cabin. The fan shall have 300 mm sweep and equipped with toggle switch and an independent regulator.	
3.11.0		**Fire Extinguisher**		
	a.	Type and size	4.5 kg CO2 type	
	b.	Location	One in cabin and Three on bridge	
3.12.0		**Maintenance cage**	Suitable inspection cages to accommodate two persons to facilitate inspection of down shop lead.	
3.13.0		**LT POWER CABLES AND CONTROL CABLES**		
	a.	GENERAL	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady State and transient operating conditions. Conductors shall be multi stranded.	
			Aluminium conductor used in power cables shall have tensile strength of more then 100 N/ sq.mm	
			XLPE insulation shall be suitable for continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C.	
			PVC insulation shall be suitable for continuous conductor temperature of 70 deg. C and short circuit conductor temperature of 160 deg C.	
			All cables shall meet the fire resistance requirement as per Category-B of IEC 60332 Part – 3.	

	b.	**CABLE SELECTION AND SIZING**	LT Power Cables shall be sized based on the following considerations: a) Rated current of the equipment b) The voltage drop in cable, during motor starting condition, shall be limited to 10% and during full load running condition, it shall be limited to 3% of the rated voltage c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.	
			Control Cables Control cables shall be sized based on the following considerations: a) The minimum conductor cross section shall be 1.5sq.mm. b) The minimum no.of spare cores in control cables shall be as follows :	
			No of cores in cable	Min.No. of spare cores
			2C,3C	NIL
			5C	1
			7C-12C	2
			14C & above	3
	c.	**CONSTRUCTIONAL FEATURES**		
		LT Power Cables	a) 1.1kV Grade XLPE power cables shall have compacted aluminium conductors XLPE insulated, PVC inner sheathed (as applicable), armoured / unarmoured, FRLS PVC outer sheathed conforming to IS :7098. (part-1) b) 1.1kV Grade PVC power cables shall have aluminum conductor (compacted type for sizes above 10sq.mm), PVC insulated, PVC innersheathed (as applicable) armoured / unarmoured, FRLS PVC outersheathed conforming to IS :1554 (Part-I)	
		Control Cables	1.1kV Grade Control cables shall have stranded copper conductor multicore PVC insulated, PVC inner sheath, armoured / unarmoured, FRLS/ PVC outer sheathed conforming to IS :1554.(Part-I).	

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TECHNICAL DATA SHEET - B			
Sr. No.		**DESCRIPTION**	**TECHNICAL PARTICULARS**
A.		**Schedule of Major Technical Particulars**	
1.0.0.00		**Capacity (in tonnes)**	
		a)Main Building hoist	
		b)Auxiliary lifting hoist	
		c)Under slung hoist	
2.0.0.00		**Span**	
3.0.0.00		**Duty/class of cranes**	
4.00.00		**Normal speed & micro speeds (inching) with full loads**	
	a)	Main hoist (Hoisting or Lowering)	
	i)	Normal speed	
	ii)	Micro speed	
	b)	Aux. Hoist (Hoisting or Lowering	
	i)	Normal speed	
	ii)	Micro speed	
	c)	Under slung hoist	
	i)	Normal speed	
	ii)	Micro speed	
	d)	Trolley Travel	
	e)	Bridge Travel	
	f)	¼ load throw off to zero load	
5.00.00	a)	Acceleration in long travel motion	
	b)	Cross travel	
6.00.00		**Hook Total Vertical Reach Travel**	
	a)	Main lifting hook	
	b)	Aux. lifting hook	
	c)	Under slung hook	
7.00.00		**Hook reaches for power house**	
	a)	Main	
	b)	Auxiliary	
	c)	Under slung	
8.00.00		**Number of wheels for**	
	a)	Bridge	
	b)	Trolley	
9.00.00		**Minimum factors of safety for**	
	a)	Structural Parts	
	b)	Wire Ropes	
10.00.00		**Numbers of motors for long travel**	
11.00.00		**Number of motors for cross travel**	
12.00.00		**Number of motors for under slung travel**	
13.00.00		**Number of motors for hoisting**	
	a)	Main lifting hook	

	b)	Aux. lifting hook	
	c)	Under slung hoist	
B.		**Schedule of Other Technical Particulars**	
1.00.00		**Name of the manufacturer**	
2.00.00		**Type and class of crane**	
3.00.00		**Standard to which crane conforms**	
4.00.00		**Effective span (centre to centre of runway rails)**	
5.00.00		**Weight of crane**	
	a)	Total weight of crane including electrical equipment & trolley	
	b)	Weight of each Bridge including electrical equipment & trolley	
	c)	Total weight of Trolley including electrical equipment & trolley	
	d)	Weight of each end carriage including electrical equipment & trolley	
6.00.00		**Full load speed (Mtrs / min) for**	
	a)	Bridge travel	
	b)	Trolley cross travel	
	c)	Hook Hoisting / Lowering at	
	i)	Full load	
	ii)	Half load	
	iii)	No load	
7.00.00		**Minimum possible travel of**	
	a)	Bridge drive	
	b)	Trolley drive	
	c)	Under slung hoist drive	
	d)	Main lifting hoist	
	e)	Aux. lifting hoist	
	f)	Under slung hoist	
8.00.00	a)	**Distance from machine hall floor to top of crane rail for power house cranes**	
	b)	**Distance from B.F. valve house floor to top of crane rail**	

9.00.00		**Minimum working clearance required**	
	a)	Between centre of crane rail and the nearest side obstruction in the	
	i)	Upstream side of power house / B.F. Valve house	
	ii)	Downstream side of power house / B.F. Valve house	
	b)	Between the top of crane rail and the lower overhead obstruction (mm)	
10.00.00		**Terminal Position of**	
	a)	Main lifting hook from centre of crane rails on the	
	i)	Upstream side	
	ii)	Downstream side	
	b)	Aux. hook from the centre of crane rail on the	
	i)	Upstream side	
	ii)	Downstream side	
	c)	Under slung hook from crane rail on the	
	i)	Upstream side	
	ii)	Downstream side	
	d)	Main lifting hook from the inner edge of walls at the	
	i)	Service bay end	
	ii)	Power house end	
	e)	For B.F. Valve house crane	
	i)	Upstream	
	ii)	Downstream	
	f)	Hook at maximum lift	
	i)	Main hook	
	ii)	Aux Hook	
11.00.00		**Operator's Cabin**	
	a)	Distance between centres of crane rails to the cabin end wall nearer to the rails	
	b)	Cabin width at the base	
	c)	Base of cabin from top of crane rails	
	d)	Size of cabin (l x b x h)	
12.00.00		**Crane Bridge**	
	a)	Type of main girders	
	b)	Material	
	c)	Details of construction	
	d)	Slenderness ratio	
	i)	Main compression members	
	ii)	Bracing and secondary members	
	iii)	Ratio of unsupported length of the horizontal protection of any riveted tension members to the least radius of gyration	
	iv)	Particulars of unit stresses assumed on various components	

13.00.00		**End Trucks**	
	a)	Type and number	
	b)	Material	
	c)	Details of construction	
	d)	Number of wheels per truck	
	e)	Centre to centre distance of wheels	
	f)	Maximum load excluding impact on travelling wheels	
	g)	Type of drive system	
14.00.00		**Trolley**	
	a)	Type and number	
	b)	Material	
	c)	Details of construction	
	d)	Number of wheels	
15.00.00		**Wheels (To be indicated separately for Trucks & Trolley)**	
	a)	Type	
	b)	Number	
	c)	Number of drive wheels	
	d)	Diameter	
	e)	Width	
	g)	Material/chemical composition	
	h)	Type of bearings	
	i)	Name of manufacturer	
	j)	Centre to centre distance between each wheel	
	k)	Max. wheel load without impact	
	l)	Max. wheel load with impact	
16.00.00		**Rails (To be indicated separately for Main runway & Trolley runway)**	
	a)	Rail size (like CR 100)	
	b)	Section	
	c)	Length	
	d)	Weight / Metre	
	e)	Name of manufacturer	
17.00.00		**Winding Drum (To be indicated separately for Main and Aux. Hoist & Under slung hoist)**	
	a)	No. of drums	
	b)	Material and type of construction	
	c)	Diameter and length (mm)	
	d)	Depth of grooves	
	e)	Pitch diameter of rope grooves	
	f)	Thickness of drum bottom of grooves	
	g)	Crushing and bending (kg/cm2) stresses for hoist drums	
	h)	Name of manufacturer	
	i)	Drum to rope dia. Ratio	
18.00.00		**Sheaves (To be indicated separately for Main and Aux. Hoist & Under slung hoist)**	
	a)	Material	
	b)	Groove diameter	
	c)	Number of rope sheaves	

	d)	Bearing arrangement	
	e)	Name of manufacturer	
	f)	Diameter of sheaves	
	g)	Number of pulleys	
19.00.00		**Hoisting Ropes (To be indicated separately for Main and Aux. Hoist & Under slung hoist)**	
	a)	Construction	
	i)	No. of wires	
	ii)	No. of stands	
	b)	Diameter of rope	
	c)	Number of falls	
	d)	Minimum factor of safety (ultimate strength =minimum breaking load)	
	e)	Quality of steel	
	f)	Name of manufacturer	
20.00.00		**Crane hooks and bottom blocks (To be indicated separately for Main and Aux. Hoist & Under slung hoist)**	
	a)	Type	
	b)	Lifting capacity	
	c)	Material	
	d)	Bearing arrangement	
	e)	Name of manufacturer	
21.00.00		**Gears (Give details for each type)**	
	a)	Type of drive	
	b)	Material	
	c)	Type of lubrication	
	d)	Type of enclosure	
	e)	Name of manufacturer	
22.00.00		**Make and Type of couplings (indicate separately for each travel)**	
		Between motor and gear box	
		Between gear box and shaft	
23.00.00		**Motors**	
		Particular of motors (To be indicated separately for Long and Cross Travel, Main and Aux. Hoist, Inching, under slung hoist)	Long travel Cross travel Main hoist Aux. Hoist Under slung hoist
	a)	Number	
	b)	Type and manufacturer	
	c)	Voltage, Phase & frequency	
	d)	Rating in KW	
	e)	Class of insulation	
	f)	Rating in minutes of	
	g)	Speed in rpm	
	h)	Starting torque	
	i)	Break down torque	
	j)	Locked rotor current	
	k)	Max. temperature rise	
	l)	Type of enclosures	
	m)	Size	

24.00.00		**Brakes**	
		(To be indicated separately for Bridge and Trolley Travel, Main and Aux. hoist and Inching for Main & Aux. hoist, under slung hoist)	
	a)	Type of brakes used	
	b)	Total number of brakes and	
	c)	Braking torque	
	d)	Dynamic braking for	
	e)	Name of manufacturer	
25.00.00		**Limit Switches (To be indicated separately for Main and Aux. Hoist and Long & Cross Travel, under slung hoist & travel)**	
	a)	Number	
	b)	Type & size	
	c)	Material of contact	
	d)	Current and voltage rating	
	e)	Name of manufacturer	
26.00.00		**Controller and Resistor (To be indicated separately for Main and Aux. Hoist, Long and Cross Travel, under slung hoist & travel)**	
	a)	Type of controller	
	b)	Number of steps	
	c)	Type of resistors	
	d)	Continuous rating of resistors	
	e)	Ohmic value	
	f)	Name of manufacturer	
27.00.00		**Conductors / Collectors / Cables (To be indicated separately for Main & Trolley Runway, under slung hoist & travel)**	
	a)	Type of conductors	
	b)	Size	
	c)	Current carrying capacity	
	d)	Voltage drop	
	e)	Type of collectors	
28.00.00		**Lubrication system**	
29.00.00	a)	**Frequency Converter**	
	i)	Number	
	ii)	Type	
	iii)	Power size	
		Main hoist : KW	
		Aux. hoist : KW	
		Under slung hoist:KW	
		Cat drive : KW	
		Bridge drive : KW	
	iv)	Power : 415 V.AC. 50 Hz	
	v)	Cabinet size :APC	
	vi)	Joysticks	

	vii)	Type	
	b)	Motors	
	i)	Number	
	ii)	Type	
	a)	Rating : KW	
	b)	Speed : rpm	
	c)	Power : 415 VAC 50 Hz	
30.00.00		**Write-up on remote radio control system giving details of various controls, functions and other details**	
31.00.00		**Pendent control provided**	
32.00.00		**Bearings**	
		Details for different bearings	
33.00.00		**Lifting beam**	
	a)	Weight (in tonnes)	
	b)	Lifting capacity (in tonnes)	
	c)	Material of construction &	
	d)	Outline dimensions (Lx BxH)	
	e)	Name of manufacturer	
	f)	Other details	
34.00.00		**Power supply requirements**	
	a)	Total load of one crane	
	b)	Voltage	
35.00.00		**Protective Panel**	
	a)	Main conductor	
	i)	Type	
	ii)	Location	
	iii)	Standard to which conforms	
	iv)	Low voltage protection provided	
	b)	Overload protection	
	i)	Manufacturer	
	ii)	Type	
	iii)	Range of settings	
	c)	Emergency push button	
	I)	Manufacturer	
	ii)	Location	
36.00.00		**Illumination**	
	a)	Illumination in cabin	
	i)	Manufacturer	
	ii)	Number and type of fixtures	
	iii)	Voltage	
	b)	Illumination of bridge	
	i)	Manufacturer	
	ii)	Number and type of fixtures	
	iii)	Voltage	
	c)	Portable hand lamp with wiring furnished (yes / no)	
	d)	Supply transformer and all other accessories required included (yes / no)	
37.00.00		**Particular of safety devices**	

38.00.00		**Wiring**	
	a)	Type and size of cables used for power wiring	
	b)	Type and size of cables used for control and aux. circuit wiring	
	c)	Method of wiring	
39.00.00		**Standards adopted for**	
	a)	Materials	
	i)	Structural steel	
	ii)	Steel plate	
	iii)	Cold finished steel	
	iv)	Cast steel	
	v)	Forged steel	
	vi)	Cast iron	
	vii)	Bronze	
	viii)	Brass	
	ix)	Bolts, nuts and studs	
	x)	Other miscellaneous items	
	b)	Equipment	
	i)	Rope drum	
	ii)	Sheaves	
	iii)	Hooks	
	iv)	Bearings	
	v)	Couplings	
	vi)	Gears	
	vii)	Shaft	
	viii)	Wheels	
	ix)	Wire ropes	
	x)	Keys and keyways	
	xi)	Motors	
	xii)	Resistors	
	xiii)	Brakes	
	xiv)	switchgear	
40.00.00		**Minimum factor of safety for each major component**	
41.00.00		**Tools and accessories supplied**	
42.00.00		**Heaviest package for shipment**	
	a)	Name	
	b)	Weight	
	c)	Dimension (l x b x h)	
43.00.00		**Largest package for shipment**	
	a)	Name	
	b)	Weight	
	c)	Dimension (l x b x h)	
44.00.00		**Any information not included above but considered useful may kindly be added**	

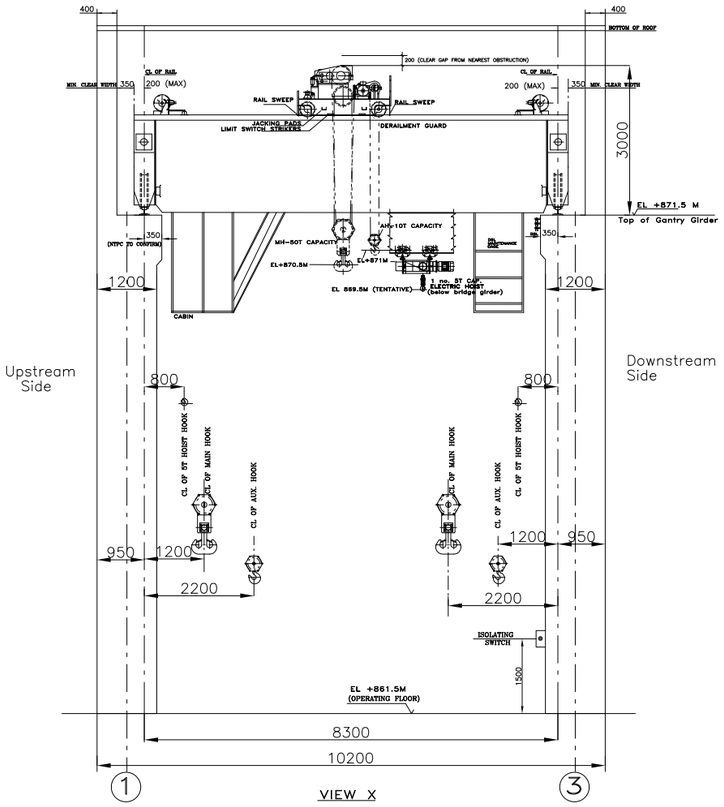
	TECHNICAL SPECIFICATION RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANE FOR BUTTERFLY VALVE HOUSE (50/10/5 T)	PE-TS-508-501-A501 Rev. No. 00 Date: 08.02.2024

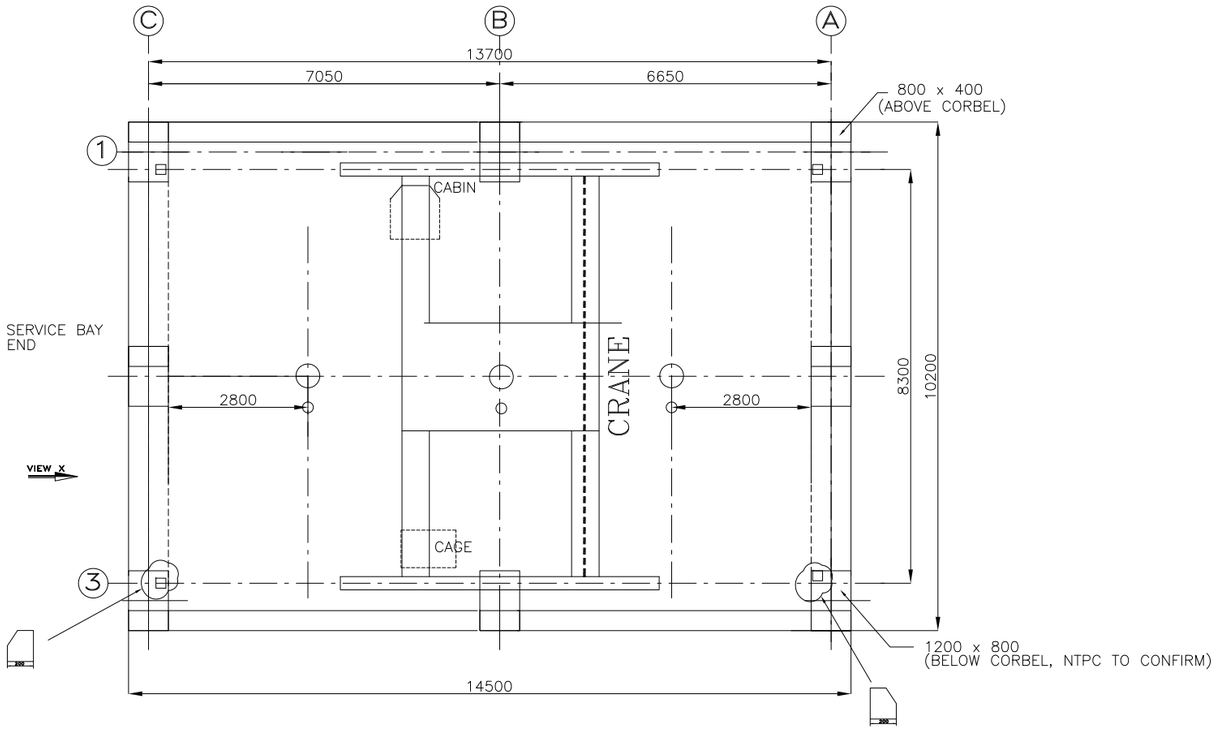
COMPLIANCE DRAWINGS

Sr. No.	Dwg. Title	Dwg. No.
1	BFV HOUSE EOT (50/10/5T): CRANE CLEARANCE & WHEEL LOADING DIAGRAM	PE-DG-414-501-A002
2	BFV HOUSE EOT (50/10/5T): FIRST STAGE EMBEDMENT PART FOR RAIL FIXING AND DSL	PE-DG-414-501-A003
3	CUSTOMER SPECIFIC REQUIREMENT	PE-DC-414-501-A004
4	PAINTING REQUIREMENT	PE-DC-414-501-A005

COMPUTER FILE NAME : TAL5

CUSTOMER'S DRAWING No.





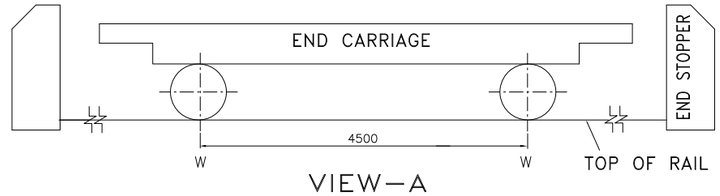
CRANE WEIGHT INCLUDING TROLLEY WEIGHT– 30 TONS(APPROX)
TROLLEY WEIGHT– 10 TONS(APPROX)

SL NO.	TECHNICAL SPECIFICATION	
12.	SPEED REGULATION	BY VVVF DRIVE
11.	HOOK APPROACH: MONORAIL HOISTS	1950 MM FROM GRID–1 1950 MM FROM GRID–3 1850 MM FROM C–LINE
10.	HOOK APPROACHES: AUX HOIST	3250 MM FROM GRID–1 2250 MM FROM GRID–3 3550 MM FROM A–LINE 3550 MM FROM C–LINE
9.	HOOK APPROACHES: MAIN HOIST	2250 MM FROM GRID–1 3250 MM FROM GRID–3 3550 MM FROM A–LINE 3550 MM FROM C–LINE
8.	LIFT OF ELECTRIC HOIST	8.0 METER
7.	LIFT OF MAIN HOIST & AUX HOIST	9.0 METER FOR MH 9.5 METER FOR AH
6.	ELECTRIC MONORAIL HOIST HOISTING SPEED/ TRAVEL SPEED	4.5/0.45 (CREEP) M/Min 12 M/Min
5.	LT SPEED/CREEP SPEED	20 M/Min
4.	CT SPEED/CREEP SPEED	10 M/Min
3.	AH HOISTING/CREEP SPEED	8/0.8 M/Min
2.	MH HOISTING/CREEP SPEED	1/0.1 M/Min
1.	DESIGN STANDARD	IS 3177 & IS 807. IS 3938 for electric hoist

NOTES

1) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.

2) FOR RAIL AND DSL FIXING ARRANGEMENT AND SCOPE OF SUPPLY REFER DRG 5602–003–H143–PVM–B–076A BFV HOUSE EOT (50/10/5T): FIRST STAGE EMBEDMENT PART FOR RAIL FIXING AND DSL.



VIEW–A

LT WHEEL LOAD DIAGRAM WITHOUT IMPACT, W = 32 TONS APPROX

LT WHEEL LOAD DIAGRAM WITH IMPACT, W = 42.2 TONS APPROX

DRG NO.	5602-003-H143-PVM-W-074
CUSTOMER	NTPC LIMITED
PROJECT	RAMMAM STAGE-III HYDROELECTRIC PROJECT (3X40 MW)
PACKAGE	ELECTRO-MECHANICAL WORKS EPC CONTRACT PACKAGE

PRINT SCALE 0 2 4 6 8 10 20 30 40 50

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
A	DRN	BS		29/11/16
	DESN	BS		29/11/16
	CHD	PKK		29/11/16
	APPD	GB		29/11/16

REV.	DATE	ALTD	CHD	APPD
01	29/11/16	BS	PKK	GB
02	03/01/17	PC	PKK	GB

SUB-CONTRACTOR

TITLE: BFV HOUSE EOT (50/10/5T) : CRANE CLEARANCE & WHEEL LOADING DIAGRAM

DEPT. | SCALE | DRAWING NO PE-DG-414-501-A002

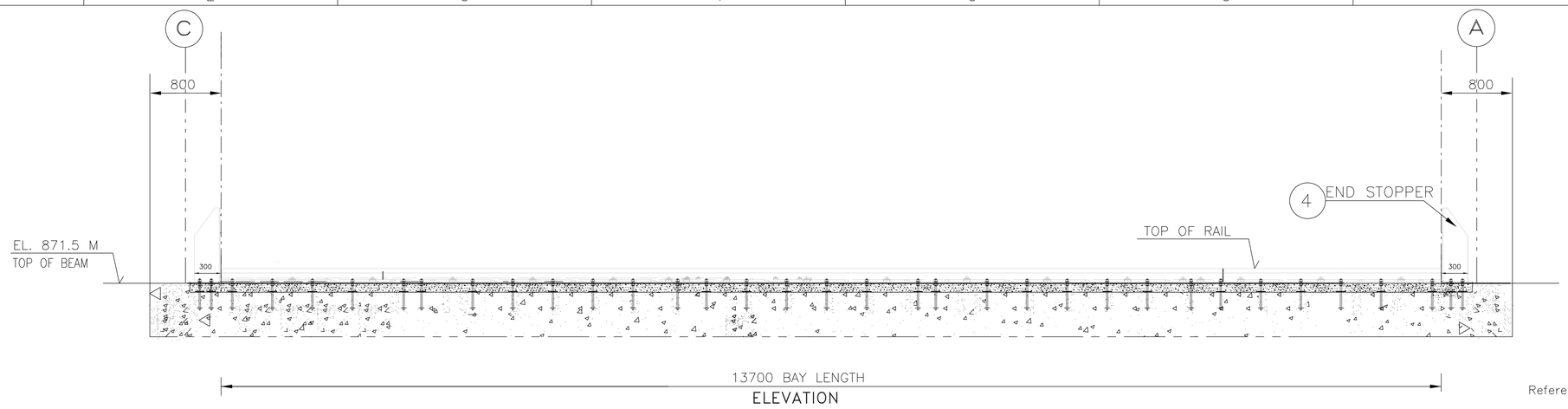
SIGN | DATE

SHEET 1 OF 1 | REV. 1

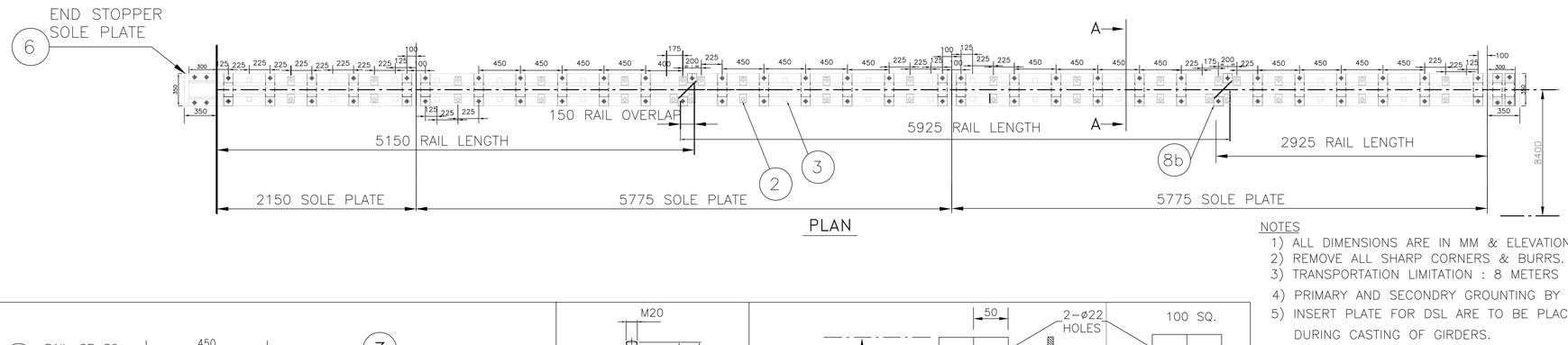
SIZE-A2

ALL DIMENSIONS ARE IN MM FIRST ANGLE PROJECTION

CUSTOMER'S DRAWING No.



ELEVATION



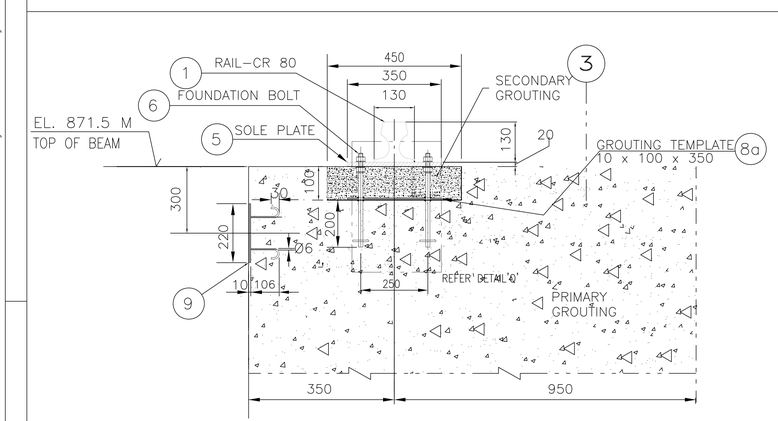
PLAN

Reference drawing number.

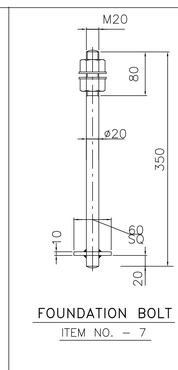
1. 5602-305R2-PEC-C-052 : Valve house – Concrete Plan & Sections
2. 5602-305R2-PEC-C-051 : Valve house – Concrete Plan & Sections

NOTES

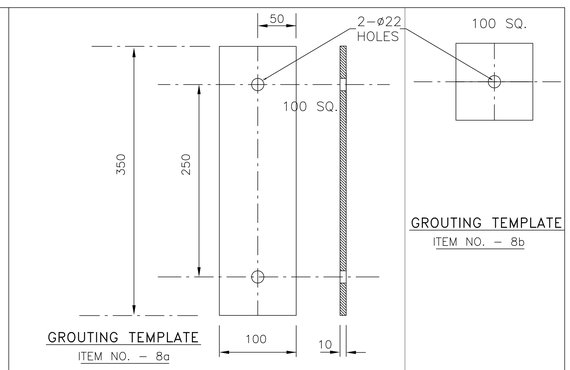
1) ALL DIMENSIONS ARE IN MM & ELEVATIONS ARE IN METERS.
2) REMOVE ALL SHARP CORNERS & BURRS.
3) TRANSPORTATION LIMITATION : 8 METERS LENGTH.
4) PRIMARY AND SECONDRY GROUNTING BY CIVIL AGENCY
5) INSERT PLATE FOR DSL ARE TO BE PLACED 1.5 MTR DISTANCE APART (AT ROW 3) DURING CASTING OF GIRDERS.
6) BOQ ITEMS 1 TO 6 SHALL BE SUPPLIED BY CRANE MANUFACTURER.
7) BOQ ITEMS 7,8a , 8b , 9 & 10 SHALL BE SUPPLIED BY BHEL–PSER THROUGH LOCAL SUPPLIER.
8) DRAWING IS SUBMITTED FOR DETAILS OF 1ST STAGE EMBEDDED PART ONLY. DETAILS OF 2ND STAGE EMBDEDMENT SHALL BE SUBMITTED AS A SEPERATE DRAWING (WITH EOT CRANE DRAWINGS)



SECTION A–A



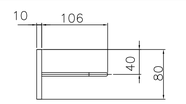
FOUNDATION BOLT
ITEM NO. – 7

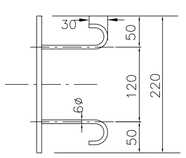


GROUTING TEMPLATE
ITEM NO. – 8a

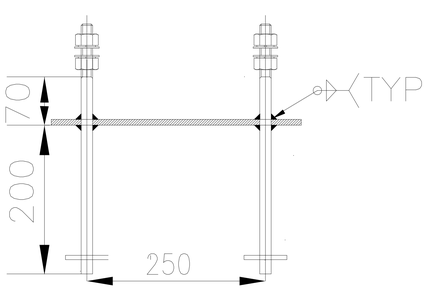
GROUTING TEMPLATE
ITEM NO. – 8b

SR. NO.	DESCRIPTION	QTY	MATERIAL	SCOPE OF SUPPLY
10	NUT– M20 WITH SPRING & PLAIN WASHERS	2X148 NOS	IS 1364	FIRST STAGE EMBEDEMENT (BY BHEL–PSER THROUGH LOCAL SUPPLIER)
9	EMBEDMENT ARRANGEMENT FOR DSL SUPPORT	11 NOS	E250 GR. B IS 2062	
8b	GROUTING TEMPLATE 100 x 10 THK x 100 LONG	2X4 NOS	E250 GR. B IS 2062	
8a	GROUTING TEMPLATE 350 x 10 THK x 100 LONG	2X35 NOS	E250 GR. B IS 2062	
7	FOUNDATION BOLT M20	2X74 NOS	20C8 IS:1875	
6	END STOPPER SOLE PLATE 350x10THKx350LONG	2X2NOS		SECOND STAGE EMBEDEMENT (BY CRANE MANUFACTURER) REFERENCE DRG NO. 5602–003–H143–PVM–B–076
5	RAIL SOLE PLATE 350x20 THK x ----LONG	1 LOT		
4	END STOPPERS	4 NOS		
3	ALIGNMENT BLOCK	1 LOT		
2	CLAMP WITH PAD , BOLTS , WASHER ETC	1 LOT		
1	RAIL CR 80 x ----LONG	1 LOT		

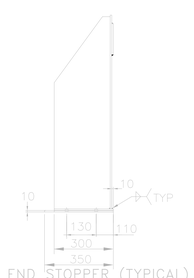




EMBEDMENT FOR DSL
(@ 1.5M AT ROW 3)
ITEM NO. – 9



DETAIL 'Q'



END STOPPER (TYPICAL)
ITEM NO. – 4 & 6

DRG NO.	5602–003–H143–PVM–B–076A
CUSTOMER	NTPC LIMITED
PROJECT	RAMMAM STAGE–III HYDROELECTRIC PROJECT (3X40 MW)
PACKAGE	ELECTRO–MECHANICAL WORKS EPC CONTRACT PACKAGE

PRINT SCALE 0 2 4 6 8 10 20 30 40 50

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
A	DRN	VVH		03/08/20
	DESN	VVH		04/08/20
	CHD	PKK		05/08/20
	APPD	PKK		05/08/20

REV.	DATE	ALTD	CHD	APPD
01	19–08–20	VVH	VVH	PKK
As per transmittal no CC: HYDRD:3:4114 Date :17–08–20				
02	31–08–20	VVH	VVH	PKK
As per transmittal no CC: HYDRD:3:4131 Date:26–08–20				

SUB–CONTRACTOR

TITLE
BFV HOUSE EOT (50/10/5T) : FIRST STAGE EMBEDEMENT PART FOR RAIL FIXING AND DSL

DEPT. | SCALE
SIGN
DATE

DRAWING NO PE–DG–414–501–A003

SHEET 1 OF 1 | REV. 02

SIZE–A2

COMPUTER FILE NAME : TAL5

CONTENTS

1.00.00 **GENERAL TECHNICAL CONDITIONS**

1.01.00 **Materials**

1.01.01 **General Requirements**

All materials forming the equipment shall be of first class commercial quality, as normally used for these type of equipment, considering strength, ductility, durability, best engineering practice and the normal or severe operating service to which the equipment will be subjected, free from any defects and imperfections, of recent manufacture and unused, and where indicated, of the classifications and grades designated therein. Materials not specifically described herein shall be the most suitable for the purpose and shall comply with the latest specifications of Bureau of Indian Standards or the American Society for Testing and Materials (ASTM), or approved equivalent standards. If the Contractor desires for any reason to deviate from or use materials not covered by these specifications he shall state the exact nature of the deviation or exception and shall submit for the approval of Employer complete specifications of the materials he proposes to use alongwith the reason of such deviation. All materials, supplies and articles not manufactured by the Contractor shall be the products of recognized reputable manufacturers.

1.02.00 **Design Stresses**

1.02.01 **General Criteria**

Liberal factors of safety shall be used throughout the design and especially in the design of all parts subject to alternating stresses or to shock loading or to most severe operational loadings. The Contractor shall furnish for record of Employer complete information, including computations, regarding the maximum unit stresses used in the design. The life of equipment supplied shall be not less than thirty five (35) years.

1.02.02 **Allowable Unit Stresses**

Under the most severe operating conditions, the unit stresses in the materials shall not exceed the values shown in Table 1-1.

TABLE - 1.1

MATERIAL	MAXIMUM ALLOWABLE STRESS
SG/ Grey Cast Iron	One tenth of (1/10) of UTS with a limit of 70 MPa in compression
Carbon cast steel & alloy cast steel	1/2 YS
Carbon or alloy steel forging	2/3 YS
Carbon or alloy steel plates	2/3 YS
Under seismic load condition, the maximum stresses shall not exceed 80% of the minimum yield strength of the material used.	

For other materials, not covered in Table 1.1, used in the construction of cranes and associated equipments, the maximum stresses in tension or compression, due to the most severe conditions occurring in normal operation, shall neither exceed one-third of the yield strength nor one-fifth of the ultimate strength of the material. Maximum stresses in shear shall not exceed 210 kg/cm^2 in components made from cast iron and shall not exceed 60 percent of the allowable stresses in tension for other materials.

The other sections of these specifications also contain the specific values of allowable stresses for various components of the cranes. These specific values, wherever given, will prevail for the design of corresponding components.

1.03.00 **Electrical Equipment**

1.03.01 **Electric Motors**

a) All motors shall comply with relevant National or International Standard.

b) Contractor shall be fully responsible for determining that the motor duty cycle, rating, performance, tests and mechanical arrangements are all entirely relevant and suitable for compliance with the above standards for the application at the station and in the extreme environmental and site conditions specified.

c) The preferred type of A.C. motor is squirrel cage, totally enclosed, fan-cooled, except for single-phase motor with rating under 0.5 kW where Manufacturer's standard types are acceptable, subject to approval of Employer. Motors above 1.0 kW shall be 3-phase type.

d) The stator insulation system shall be class-F but in each case, temperature rises shall be limited to Class-B on full continuous rated load.

e) All A.C. motors shall be capable of direct on-line starting and of continuous operation at rated output under abnormal frequency conditions. The starting current at full voltage shall not exceed six times the full load current. Each of the motors shall be tested at Manufacturer's works to confirm compliance with this requirement.

f) Ball or roller bearings shall be used. Vertical shaft motors shall have approved thrust bearings. Lubrication fittings shall be provided for the bearings.

g) The terminal box shall be weatherproof and firmly fixed to the motor frame. The terminal studs shall be so sized as to be adequate for the current duty required and shall be identified. All terminal boxes shall have approved cable adapter plates, sealing chambers or conduit entries.

h) The arrangement of the terminal box shall be such as to facilitate installation of cables and allow interchanging of any two phase leads without disturbing the sealing compound, if this is used at cable terminations.

i) Where practicable, the motor end cover shall be removable from the driving-end and shall have a removable plug to allow the speed to be checked by means of a portable tachometer.

j) All motors having a mass of 50 kg or more shall be fitted with lifting lugs.

1.03.02 **Starters and Contactors**

a) Motor starters and contactors shall be equipped with short circuit protection and local disconnected devices. Preferably, all starters shall be from one manufacturer. The control circuit voltage shall be obtained from a 415/110 V isolating transformer with primary circuit breaker and secondary fuse. The secondary winding of this transformer shall be grounded. The operating coils of the contactor shall be connected between the grounded side of the transformer and the control contacts.

b) Starters and contactors shall comply with applicable IS standard or IEC 292.1 or NEMA IC 1 and shall be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation, unless otherwise approved by the Employer. The enclosures shall be complete with the locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards and other necessary items as required by the duty of the starter or contactors.

c) Starters and contactors shall be of minimum size compatible with motor size and capable of satisfactory operation, without damage during under voltage condition.

d) Thermal type overload and phase failure relays shall be supplied with starters for motors of 7.5 kW or higher rating. For motors of less than 7.5 kW rating, suitable rated 3-phase thermal overloads will be acceptable. Ammeters to monitor current in one phase shall be provided for motors above 7.5 kW.

e) Each starter shall have sufficient number of auxiliary contacts required for interlocking and indication purposes plus two spare convertible contacts.

1.03.03 **Moulded Case Circuit Breakers (MCCB)**

All moulded case circuit breakers shall be 2-pole or 3-pole, as required, having thermal time delay and instantaneous trips with "On-Trip-Off" indicating / operating mechanism. Circuit breakers used in combination type motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover so that the cover cannot be opened unless the circuit breaker is open. The breakers shall comply with the applicable IS specification or IEC 157.1 or equivalent standards.

1.03.04 **Control Relays**

Relays used as auxiliary control devices in conjunction with motor starters and magnetic contactors shall be of the type designed for machine tool application featuring contact convertibility. All contacts shall have a minimum thermal current rating of 10 A over a range of 6 to 600 V AC.

1.03.05 **Pilot Devices**

a) Pilot devices such as selector switches, push-button stations and thermostats shall be of heavy duty type and where mounted outdoors, shall be housed in weatherproof enclosures specially designed for the extreme condition of environment.

b) All electrical contacts for control, alarm and shutdown shall have a thermal current rating of not less than 10A at 220 V DC.

1.03.06 **Instruments/ Meters**

a) Instruments mounted on panels, shall be of the semi flush type, back connected, matching pattern, shape, and of approved finish to present neat and fitting appearance consistent with functional requirements.

b) Mechanical quantity measuring instruments which are directly mounted on equipment shall have circular dials and shall be properly supported and guarded against accidental injury/breakage. These shall be placed in convenient location.

c) The instruments shall accurately measure and indicate the quantity under all conditions of operation with minimum instrument errors. Changes in ambient temperature within the range prevailing at site shall not affect the accuracy.

d) The reading scales on the dials shall be in metric units only and range shall be such that the normal operating values of the quantities are indicated in the middle 3rd of the scale.

e) Contact making instruments shall have contacts suitable for 240 V AC or 220 V DC circuits.

f) All instruments shall conform to relevant National or International applicable standards. They shall be subjected to tests prior to despatch. The instruments shall be shock, vibration and moisture proof. The electrical instruments shall withstand dielectric test of 2000 Vrms to ground for one (1) minute as per standards.

g) The coils of electrical instruments shall be designed for continuous operation at 110% of the full load current at instrument potential. The coil rating of the measuring instruments shall be co-ordinated with those of the associated Instrument transformers (i.e. CTS, PTs, etc.) by the Contractor. The VA burden of the instruments shall be as low as possible. The meters shall be of the first grade in respect of accuracy classification.

1.03.07 **Equipment Wiring**

a) Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilizing slip-on ferrules approved by the Employer.

b) Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.

c) Markers must withstand a tropical environment and high humidity and only fungus- proof materials will be accepted. Ferrules of adhesive type are not acceptable.

d) All trip circuits shall employ markers having a red background.

e) Sensitive control circuits shall be effectively shielded against extraneous signals and interference. A separate terminal shall be provided for termination of individual cable shields, which will be grounded at source end only.

f) All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.

g) Splices or tee connections between terminal points are not acceptable. Wire runs shall be neatly trunked inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipment.

h) Multi-conductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers or crimp type connectors shall be used to terminate all small wiring. Grommets or insulating bushings shall be installed, where necessary, to avoid chafing of wiring.

1.03.08 **Cubicles and Panels**

a) The enclosures of cubicle and panels shall be of sheet steel with minimum thickness of 2.5 mm, of rigid, self-supporting construction and supplied with channel bases.

b) Cubicles shall be fitted with close fitting, gasketted, hinged, lift-off doors capable of being opened through 180^0. The doors shall be provided with integral lock and master key.

c) Cubicles and panels shall be vermin-proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by Employer.

d) The cubicles and panels shall be adequately ventilated, if required, by vents or louvers and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

e) Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

f) Unless stated otherwise all cubicles and panels shall be provided with a ground bus with 40 mm copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120 mm^2.

g) The standard phase arrangement when facing the front of the motor control centres and switchboards shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipment involving 3-phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards including necessary high altitude correction factors and shall not require cutting away of adjacent framework.

h) The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the Contractor.

i) The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of Employer. The interior of all cubicles and panels shall have a matt white finish unless specified otherwise.

j) Switched interior light and socket outlets shall be provided for all cubicles and panels.

k) All cubicles and panels shall be provided with lamicoid name plates, identifying the purpose of the panel and all of its components.

1.03.09 **Terminal Blocks**

a) All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and the space between the bottom blocks and the cable gland plate being a minimum of 200 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors. In enclosed cubicles, the terminal blocks shall be provided which shall be inclined towards the door for facilitating terminations.

b) The smallest size to be used shall be designed for 2.5 mm^2 wire and not more than two conductors shall be connected under one terminal clamp.

c) Terminal identification shall be provided corresponding to wire number of connected leads.

d) Circuit terminals for 415V AC shall be segregated from other terminals and shall be equipped with non-inflammable, transparent covers to prevent contact with live parts. Standard warning labels with red lettering shall be mounted thereon in a conspicuous position.

e) Multi way terminal blocks of approved type, complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming / outgoing wires.

f) Each terminal block shall be suitable for terminating the conductors without affecting any damage to the conductor either due to bad sizing, workmanship, loose connections or any other reason. Terminal Block shall have preferably screw locking design.

g) Terminal blocks shall be of screw type meeting the requirements of IEC-60947-7-1. The insulating material of terminal blocks shall be polyamide 6.6, V0/V2 class, and unbreakable, fire retardant meeting inflammability requirement of UL94. All metal parts shall be of copper alloy, captive and touch proof. The terminal blocks shall be touch proof, suitable for Din and G-rail mounting.

1.03.10 **Earthing**

a) Earthing terminals for equipment of these specifications shall form part of equipment supplies. The Contractor shall connect the earthing conductors to these terminals.

b) Earthing conductors from the station earthing bus to the equipment will also be arranged by the Contractor.

1.03.11 All the electrical works shall be carried out as per the specification of electrical equipment indicated elsewhere in the specification.

2.00.00 DESIGN CRITERIA FOR CRANE EQUIPMENTS

2.01.00 **General Design Criteria**

2.01.01 **General**

a) The cranes shall be designed in compliance with requirements of latest version of IS: 13834 and IS: 3177. Where contained in the latest ISS requirements are stricter than those contained herein, the ISS requirements shall govern.

b) The cranes shall be supplied in accordance with the requirements of these specifications including the limiting and / or mandatory dimensions shown on the specification drawings (Part IV). All details shall be determined by the Contractor subject to customer's approval.

c) Any design feature or detail not specified herein shall be in accordance with IS: 807 and IS: 3177 or other equivalent approved standards which shall supplement these specifications.

2.01.02 **Safety Requirements**

In the design of the cranes, all safety regulations provided under the Factory Act, Indian Electricity Act and other applicable legislations shall be taken into consideration and provided for.

2.01.03 **Splices and Connections**

a) Shop Splices

All shop splices and connections shall be either welded or shall be made with ribbed fitted, or high-strength steel bolts and self-locking nuts, as applicable. Main members shall be assembled in the shop prior to reaming or drilling of holes for field connections.

b) Field Splices

Field connections shall be made either with ribbed or fitted bolts and self-locking nuts or with high-strength steel bolts; field welding will not be allowed. Shop assembled parts dismantled for shipping shall be clearly match-marked for field assembly. Field-bolted structural connection between girders and trucks shall be made with fitted bolts. Field-bolted connection between girder sections shall be made with high-strength steel bolts. All high-strength bolt connections shall use a sufficient quantity of fitted bolts to ensure proper alignment.

c) Lubricants

Grease, lubricating oil, and hydraulic brake fluid required for initial filling of all the equipment plus 100% reserve shall be furnished with each crane**.** This amount is exclusive of any oil or grease required for flushing or otherwise preparing the equipment for operation which shall also be provided. The selected materials for gears, bearings, and other items that come in contact with the oil or grease shall be compatible with the specified lubricants. The hydraulic brake fluid may be selected by the Contractor subject to approval by the customer.

2.02.00 **Allowable Stresses**

2.02.01 **General**

The maximum allowable stresses in materials used for various parts of the equipment are specified herein. However, the Contractor shall be responsible for

an adequate design based on factors proven in practice and shall use lower working stresses where conditions indicate.

2.02.02 **Maximum Allowable Stresses**

a) General

Adequate factors of safety shall be used throughout the design, especially in the design of parts subject to alternating stresses, vibration, impact, or shock.

Under Seismic Load Condition, the maximum stresses shall not exceed 80% of the minimum yield strength of the material used.

All wire hoisting ropes shall be selected on the basis of a factor of safety not less than six (6) based on the nominal breaking strength considering the weight of the rated load, load blocks, and lifting beam (if any) and considering the overall efficiency of the hoist reeling.

2.03.00 **Loading Conditions**

2.03.01 **Loads**

a) General

The definitions of the dead, live load, etc. shall be as given in applicable design standards, except as stated herein. All loading cases shall consider the trolley and / or live load in the position which causes the greatest stress.

b) Dead Load

The weight of all effective parts, the bridge structure, machinery parts and fixed equipment supported by the structure.

c) Live Load

Live loads shall include the weight of the ropes and lower load blocks.

d) Vertical Impact Load

Impact factor shall be as per IS for the applicable duty class of the cranes.

e) Braking and Horizontal Loads & Longitudinal Loads

Loads due to the sudden application of the bridge and trolley travel brakes shall be taken as the forces produced by locking the driven wheels with the crane carrying the rated load. The coefficient of friction for braking loads shall be taken as 0.15 in which case all driven wheels shall slide on the rail.

The coefficient of friction for tractive conditions shall be taken as 0.09 in which case no wheel shall slide on the rail.

The horizontal forces resulting from the acceleration or deceleration of the trolley tractive effort and bridge tractive effort shall be as follows:

i) As transverse load of Ten percent (10%) of the weight of trolley with rated load in such a position as to produce maximum stress due to moment or shear in the girders, applied equally on the two trolley rails.

ii) A longitudinal load of Ten percent (10%) of the total weight of the bridge less the weight of track wheels and trucks.

f) Earth-quake load

These shall be derived based on seismic accelerations as specified elsewhere in the specification.

g) Walkway Load

All walkways shall be designed for a live load of 250 kg/m^2 in addition to the weight of any equipment mounted thereon. All handrails shall be designed to withstand a 50kg horizontal load for every 1.0 m of top rail.

2.03.02 **Seismic Design Criteria**

a) General

Each crane shall be designed and constructed to withstand the earthquake loading defined in this specification.Stresses in the crane and trolley structure shall be analyzed according to the conditions specified herein. All equipment of the crane, such as bearing pedestals, machinery parts, components, and controls, shall be designed and fastened so that they do not suffer damage or misalignment and to permit operation of the crane without repairs following an earthquake.

b) Seismic Loading Conditions

i. The design for seismic loadings considerations shall be based on IS 1893 Part – I. All the design factor as per Zone – V shall be considered in the design of the crane.

ii. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act nonconcurrently. For horizontal acceleration and vertical acceleration relevant IS shall be used as per seismic data contained in Part - A of the tender specifications. The

seismic loads shall be equal to static loads corresponding to the weight of the parts multiplied by the acceleration. The following conditions shall also be considered :

Horizontal seismic load reactions between rail and wheels, in the direction of traveling, shall be limited by sliding of the wheels, considering all braked wheels blocked with friction coefficient of 0.25 between rail and wheel.

For upward vertical seismic loads, the weight of all parts shall be considered overcome by the earthquake and a 0.2 g net upward force shall be considered acting.

Horizontal seismic load reactions that are normal to the rails shall be considered distributed on the flanges of the wheels on one side of the crane. The positive upward vertical reactions shall be considered distributed over all rail clamps.

iii. A separate loading case shall be analyzed for the seismic acceleration in each of the following directions: horizontal parallel to the crane rail, horizontal normal to the crane rail (both directions), vertical downward, and vertical upward.

iv. For the seismic loading conditions, the allowable stresses for normal loading cases may be increased up to 80% of the minimum yield strength of the material, except for the design of the following parts for which the allowable stresses shall not be increased:

- Wheel flanges, rail clamps, and emergency guide shoes; and
- All bolts, pins, welds, and other means used for connecting above parts to the main structure and those used for mounting machinery parts, controls, or other hardware.

2.03.03 **Overall Loadings for Crane Design**

A. General

All the cranes and runway rails shall be designed for the specified combination of extreme loads acting on them during operation or standstill. Eccentricity of loading shall be taken into consideration in the design. The maximum stresses acting on the members of the cranes and runway rails shall not exceed the safe permissible stresses under any actual combination of loads.

The design of the crane shall also take into account the seismic forces as stated in the technical specifications.

B. Combination of Loadings on Crane

The loading considerations for design of cranes shall conform to clause 7.3 of IS: 3177.

2.04.00 **Structural Design Features**

2.04.01 **General**

All structural components shall be made from steel sections with following Minimum thickness of Structure Members:

a) Load Carrying members : 8 mm

(b) Tubes with both ends sealed : 4.9 mm (6 SWG)

(c) Tubes with unsealed ends : 8 mm

(d) Chequered plate : 6 mm O/P

2.04.02 **Crane Girders**

a) The crane girders shall be of welded structural steel-box section construction unless otherwise specified.

b) All crane girders shall be of proper width to ensure adequate lateral stiffness, shall be braced at each end, and shall be attached by ample gusset plates to the end trucks. The maximum vertical deflection of the crane girders resulting from the weight of the trolley plus the rated load shall not exceed 1/900 of the span of the crane. Girders shall be cambered an amount equal to the dead load deflection plus one half of the deflection caused by the design live load and trolley. In the design of girders the camber shall be nil or positive neutralizing the deflection.

c) Wherever possible, bridge crane girders shall be notched to rest on top of the end trucks and shall be connected to the end trucks with shelf angles and horizontal gusset plates of ample size to provide a stiff connection to the end truck. An adequate number of fitted bolts for reamed holes shall be provided for the end truck connection to accurately align the girders with the end truck during erection. Squaring marks shall be provided on each girder to facilitate erection and squaring of the bridge.

d) Suitable supports shall be provided at one end of the crane bridge for the placement of a temporary platform between the girders during crane erection and for use during the reeving and maintenance of the cranes trolley.

2.04.03 **Trucks**

a) Trucks for crane bridges shall be of the equalizing type which shall distribute the load evenly between the wheels. Trucks shall be of structural steel box section, heavily reinforced to provide a rigid structure and minimize deflection. The outside wheels on one side shall be spaced, center to center, not closer than 1/6 the span of the crane.

b) Safety lugs shall be provided to prevent a drop of more than 4.5 mm, in case of a broken wheel or axle**.** Truck wheels and safety lugs shall be designed to function properly on runway rails mounted as shown on the drawings. Trucks shall be equipped with rail sweeps, extending below the top of the rail and projecting in front of the truck wheels, which will push forward or off the track any object placed across the rail.

c) All trucks shall be designed to permit easy wheel removal. Jacking pads shall be provided on all trucks whenever the wheel reactions with no load on the hook exceed 6500 kg per wheel.

d) No part of the end truck shall project below the flange of the bridge wheel.

2.04.04 **Trolley Frame**

Trolley frames shall be of rigid, welded structural steel construction and shall provide equal distribution of the load on all wheels without excessive deflection. All machinery assemblies shall be mounted on machined surfaces. Shims may not be used except under brakes and motors. Trolleys shall be equipped with safety lugs, rail sweeps, and jacking pads as specified for trucks above. The trolley shall be completely floored-over without openings except as required for ropes.

2.04.05 **Bumpers and Stops**

a) Bumpers shall be rigidly mounted on end trucks and trolleys to contact bumper stops at both ends of each runway.

b) All bumpers shall be of the spring compression type except where the full load rated speed is less than 10 m / min. in which case they may be of elastomeric, hydraulic, or other shock absorbing material. Bumpers shall have sufficient energy absorbing capacity to stop the crane or trolley when traveling at 50% of the rated speed without exceeding the normal allowable stresses and to stop the crane or trolley when traveling at full rated speed without exceeding the yield strength of the materials involved.

c) All bumpers shall be designed so that there is no direct shear on bolts and shall be equipped with safety cables to prevent falling of parts from the crane in case of breakage.

d) Bumpers on bridge end trucks shall be capable of stopping the crane (not including lifted load) at a rate of deceleration not to exceed 10% of the acceleration of gravity when traveling in either direction at 20% of the rated speed.

e) Trolley bumpers shall be capable of stopping the trolley (not including lifted load) at a rate of deceleration not to exceed 15% of the acceleration of gravity when traveling in either direction at one-third of the rated speed.

f) In addition to the trolley bumpers specified above, all trolleys (including monorail trolleys) shall be provided with positive trolley stops at the limits of their travel. These stops shall be designed and fastened to resist the forces applied when contacted. Stops engaging the tread of the wheel will not be acceptable.

2.04.06 **Walkways and Ladders**

a) The access to the bridge walkway for maintenance or operation shall be from an access area as shown on the drawings and shall not require stepping over any gap exceeding 0.3 m. The crane shall be equipped with walkways and ladders to allow safe passage from the access point to the following:

- All bridge walkways,
- The trolley, and
- crane corbels

b) Equipment on the crane shall be located so as to give safe access to all points that must be reached for maintenance or operation. Fixed ladders shall be in accordance with applicable standard.

c) A walkway shall be provided on both sides along the entire length of the bridge. Ladders, platforms, and steps shall be provided to permit access for lubrication, inspection, and maintenance, wherever necessary.

d) Walkways should preferably be located to give headroom of not less than 2.0 m. but in no case it shall be less than 1.2 m.

e) All walkways and stairways shall be of rigid construction, with non-skid chequered plate treads or grating, toe-boards not less than 0.1 m high, and double-tiered structural steel handrails not less than 1.0 m high. Walkways shall be continuous and permanently secured. Walkways shall have a clear passageway at least 0.45m. wide except opposite the bridge motor where they shall be not less than 0.4m and except opposite electric cabinets where the passage shall not be less than 0.75m. Ladders shall be of steel construction with rungs welded to the ladder rails. Rails shall extend not

less than 1.1 m. above the landing at the top, for safety in getting on or off the ladder, and shall start on a landing platform.

2.04.07 **Seismic Requirements**

a) Rail Clamps

Each crane truck shall have 2 sets of rail clamps, and the trolley shall have 2 sets of automatic rail clamps for each crane girder rail. The rail clamps shall secure the crane bridge and the trolley against upward motion caused by seismic forces. Each clamp shall have a prong under each side of the railhead. Similar rail clamps shall be provided on all monorail trolleys to withstand seismic forces.

b) Emergency Guide Shoes

Emergency guide shoes shall be provided to limit the lateral displacement of Crane Bridge and trolley so as to prevent derailing if wheel flanges are damaged.

c) Equipment Mountings

Crane components shall be securely mounted to the crane to withstand all normal and seismic loads. Fitted pins or welded locating lugs shall be used where required.

2.05.00 **Mechanical Design Features**

2.05.01 **General**

All parts which can be worn or damaged by dust shall be totally enclosed in dustproof housings. All units and housings weighing more than 45 kg and all housing parts weighing more than 10 kg shall be provided with suitable lugs or eyebolts for handling. All bolts and capscrews shall be provided with lock washers or locknuts. All machined units shall be thoroughly cleaned to ensure that they are free of cuttings and other abrasive material.

2.05.02 **Guards**

a) Exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components which might constitute a hazard under normal operating conditions shall be guarded. Guards shall be fastened securely. Each guard shall be capable of supporting without permanent distortion the weight of 80 kg person unless the guard is located where it is impossible for a person to step on it.

b) If hoisting ropes run near enough to other parts to make fouling or chafing possible, guards shall be installed to prevent this condition. A guard shall be provided to prevent contact between bridge conductors and hoisting ropes if they could come into contact when the load block is swung 6 degrees from the normal vertical position.

2.05.03 **Bridge Drive**

a) Not less than 25% of the bridge wheels on each rail shall be driven. Bridge drive could be a single or dual or quadruple motor arrangement as best suited. All bridge drive gearing shall be enclosed in gear reduction housings and mounted on the bridge girder structure.

b) If a single motor drive arrangement is provided, the travel motor shall be mounted near the center of the bridge girder and connected through suitable gearing and line shafting to the driving wheels. Flexible couplings shall be provided at each output shaft of the gear reducer and also adjacent to the truck drive pinion or to the truck wheel shaft end.

c) If a dual motor drive arrangement is provided, the motors shall be located near each end of the bridge and connected to separate gear reduction units.

d) The driving mechanism shall be designed and constructed so that travel will be steady and free from objectionable vibration, sluing, and racking in any part of the structure at any speed and load combination up to and including the rated speed and load.

e) All gear reducers and drive mechanisms shall be designed and located to enable easy bridge wheel replacement within the confines of the powerhouse or other space limitations shown on the drawings.

2.05.04 **Trolley Drive Mechanism**

Trolley drive could be a single or dual motor arrangement as best suited. The trolley drive motor shall be mounted on the trolley frame and connected to at least one driving wheel on each side of the trolley through gearing and shafting. Flexible couplings shall be provided at each output shaft of the gear reducer and near the trolley drive wheel.

2.05.05 **Hoists**

All hoists shall be mounted on a trolley frame, and each shall be driven by a suitable motor with VVVF drive and gears to obtain the required hoisting speeds. The tangent of the maximum lead angel of wire ropes relative to drums and sheaves shall not exceed 1/12 unless sufficient evidence is submitted to justify a greater angle. Hoists shall not utilize cross-reeving rope arrangements. Equalizers shall be included to assure that the tension in the ropes is equalized.

2.05.06 **Wheels**

All wheels shall be double flanged, made from forged or rolled steel wheel blanks, and accurately turned or ground to the required diameters. All bridge and trolley wheels shall be doubly supported with a bearing on each side of the wheel. Cantilevered wheel arrangements are not acceptable. Drive wheels shall be matched pairs with less than 0.25 mm difference in diameters. Wheels shall be designed to carry the maximum rated load under normal conditions without excessive wear. Maximum wheel loads shall be as given in applicable standard specification unless otherwise approved. All wheel flanges shall be not less than 25 mm high, and where seismic design criteria apply, they shall extend not less than 15 mm below the top of the rails head when the wheel is lifted free of the rail so that the rail clamps contact the underside of the rail head. Wheel flanges shall have adequate-strength to resist the specified earthquake loads without exceeding the allowable stresses for normal operation.

2.05.07 **Axles**

The axles shall be heat-treated steel forgings, accurately turned and ground. Rotating axles shall be fitted to the wheels with a force fit. Driving wheels shall be keyed to the rotating axle in addition to the force fit.

2.05.08 **Sheaves**

a) Rope sheaves shall be of cast steel or welded steel construction with machined rope grooves.

b) The pitch diameter for running and idler sheaves shall be not less than 24 times the outside rope diameter when 6 x 37 class rope is furnished or 30 times the rope diameter when 6 x 19 class rope is furnished.

c) Sheave grooves shall be smooth and free from surface defects which could cause rope damage. The cross sectional radius at the bottom of the groove shall be such as to form a close fitting saddle for the size of rope used, and the sides of the groove shall be tapered outward to facilitate entrance of the rope into the groove. Flange corners shall be rounded, and the rims shall run true about the axis of rotation.

d) The sheave pins shall be made of annealed carbon or alloy steel (except as otherwise specified). All revolving sheaves shall be equipped with standard replaceable roller bearings with dust seals. The load sheave rpm at full rated speed shall be used to size all sheave bearings. Each sheave shall be lubricated by an individual grease fitting. All revolving sheaves shall be statically balanced.

e) Drums, sheaves, bottom blocks, and hoisting rope shall be designed so that when raising or lowering no crossover reeving will occur. Idler sheave arrangements shall be designed to minimize any twist in the rope.

2.05.09 **Load Blocks**

Load blocks shall be provided with close-fitting guards or other suitable devices to prevent ropes from becoming wedged in small openings when the ropes are momentarily unloaded and to guide the rope back into the groove when the load is applied again. The guards shall be of cast steel or welded construction and shall be fitted close to the periphery of the sheaves.

2.05.10 **Hooks**

a) Hooks and lifting eyes shall be made of forged annealed alloy or carbon steel. All hooks and lifting eyes shall swivel freely on grease lubricated roller or ball bearings and all hook beams shall be able to rotate. Bearings shall be totally enclosed, dust-tight, and constructed to prevent grease leakage. Load on roller bearings shall not exceed the static bearing capacity established by the bearing manufacturer, using a load factor of 1.0.

b) Hooks shall be designed such that the resultant load on the hook passes through the centerline of the shank. The maximum stress in the hook at its rated load shall not exceed 20% of the ultimate strength of the material.

c) Elevations specified for hooks refer to the bottom of the valley of the hook.

d) Prior to machining, all hooks shall be given an ultrasonic test and a wet magnetic particle inspection of all surfaces of the forging in accordance with applicable Indian standards specifications.

e) After machining, all machine surfaces shall be given either a wet magnetic particle inspection as above or a dry magnetic particle inspection in accordance with applicable Indian standard specifications.

f) All cracks, linear indications, or aligned porosity exceeding 6 mm in length are unacceptable and shall be rejected or repaired in an approved manner. All repairs shall be reinspected using both ultrasonic and wet magnetic particle inspection.

g) All hooks shall be buffed and center punched with a low stress center punch on the hook tops. The hooks shall also be center punched for recording the original dimensions of the throat opening measurements and later during the crane tests.

2.05.11 **Hoist drums**

Hoist drums shall be made of cast steel or welded steel of sufficient strength to sustain the combined crushing and bending loads of the rope pull. Allowance shall be made for fabrication and machining tolerances to assure adequate drum shell thickness under the machined groove. Each drum shall have right-hand and left-hand machined grooves to receive the hoisting rope. Grooves shall be smooth and

well rounded. Grooves shall have minimum depth of 0.35 times the rope diameter. The minimum groove pitch shall be the rope diameter plus 3 mm. The drums shall be designed so that not less than 2.5 wraps of each part of hoisting rope will remain in the grooves when the hook is at the lowest position for the lift specified and atleast ¾ reserve turn is available, without overlapping of the rope, when the block is in the uppermost position corresponding to tripping of the block operated limit switch. The pitch diameter of the drums shall be not less than 24 times the rope diameter when 6 x 37 class rope in furnished and 30 times the rope diameter when 6 x 19 class rope is furnished. Drum flange height shall be not less than 2.5 times the rope diameter and shall be arranged so as to prevent the rope from touching gears.

2.05.12 **Shafting**

Shafts shall be machined to close tolerances at bearing and gearing fits. Shafting shall be of rolled or forged steel, amply supported to prevent excessive deflection.

2.05.13 **Gearing**

a) Gears shall be of the worm, helical, bevel, herringbone, or spur type. Herringbone gearing shall be of the continuous type. Worms and pinions shall be made of forged carbon or alloy steel. Gears shall be designed in accordance with applicable standards.

b) Gear cases shall be oil tight and sealed. Input and output shafts of gear cases shall have seals to prevent oil leakage. The top section of each gear case shall be easily removable for inspection. Openings shall be provided in the top section for inspection of the gearing at the mesh lines. Covers for these inspection Openings shall be sealed to prevent oil leakage. Gear cases shall be made of cast steel or welded steel and shall have drain plugs, breathers, and oil level gauges. Gear cases shall be mounted on machined surfaces. Shims shall not be used .All Gears shall have guards to prevent injury to anyone while the gears are in service.

c) Magnetic particle and dye penetrant inspections shall be performed, as applicable on the load holding gear trains of all hoist .These test shall be performed in accordance with the applicable IS Code.

2.05.14 **Bearings**

Bearings shall be of the ball or roller type, except as otherwise specified, and shall be designed to permit easy removal of the shaft. Bridge and trolley wheel bearings shall be of the roller type .Bearings shall be designed to exclude dirt, prevent leakage of oil or grease, and to eliminate the need for frequent lubrication .Shaft Bearings shall be placed as close as possible to points of loading. Bearings shall be easily replaceable. Bearing housings shall be of cast iron, cast steel, or welded steel construction. The service life of all bearings shall be not less than 10,000 hr at

the design speed and power. These service hours shall represent the life that 90% of the bearings will complete or exceed.

2.05.15 **Lubrication**

a) Provisions shall be made for proper lubrication of all parts. High speed gears and pinions shall be provided with forced oil lubrication. Low-speed drum gears shall be lubricated by soft grease or as recommended by the gear manufacturer.

b) Bearings shall be provided with means of pressure lubrication. The crane shall be provided with all necessary lubrication fittings. Lubricating points shall be located for easy and safe access without the necessity of removing guards or other parts. Lubrication lines shall be securely fastened to the cranes structure and shall be located to provide the maximum protection and so that ordinary repairs can be made without removing the lines.

c) The crane shall be provided with a centralized lubrication system of reputed make. This system shall be manually operated, complete with a manual pump, reservoir, supply lines, metering valves, and discharge lines to all bearings. Either one system, mounted on the crane bridge with a quick/disconnect fitting on the supply line for connection to a flexible hose leading to the trolley, or two separate lubricating systems, one for the bridge and one for the trolley, shall be provided. Metering valves with indicators shall be provided for all points of grease application and shall be mounted at readily visible and accessible locations. All piping shall be made of suitable polymer, with flexible hoses where required.

2.05.16 **Couplings**

Couplings shall be of the flanged type with recessed bolts or suitable guards. Couplings shall be designed so that their strength equals the shaft strength and shall be of the flexible, spacer, or geared type.

2.05.17 **Keyways**

Connections subject to torsion such as couplings, driving wheels, and drive gears shall be keyed to the shafts with rectangular keys. The keys shall be sized to be within safe bearing and shearing limits of the materials in contact.

2.05.18 **Wire Rope**

Each rope shall be of sufficient length to provide the specified lift, the additional wraps, and the length required for mounting the rope. The rope shall be of 6/19, 6/36 or 6/37 class with tensile designation as 1960 (Conforming to IS 2266) or equivalent or better type with independent wire rope and regular lay construction, unless otherwise approved. Rope ends shall be anchored by clamps securely attached to the drum so that the connection provides a safety factor of not less than

6 with only 2 wraps on the drum or by an approved socket arrangement. Socketing shall be done in the manner specified by the manufacturer of the socket assembly. Eye splices shall be made in an approved manner and rope thimbles shall be used in the eye. Rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope. Spacing and number of all types of clips shall be in accordance with the clip manufacturer's recommendation. Clips shall be of forged steel. Swaged or compressed fittings shall be applied as recommended by the manufacturer of the fittings.

2.05.19 **Bolts & Nuts**

Bolts and nuts for mechanical equipment shall be semi-finished and shall have hexagonal heads. Nuts shall be secured by effective lock-nuts or other approved locking devices.

2.06.00 **Controls**

2.06.01 **General**

a) The ~~Power House Cranes, the~~ Butterfly Valve House crane shall be designed for operation by remote radio control from respective machine hall / service bay as well as from operator's cabin (standby control) of respective cranes. Control equipment in the stand-by control station(s) of the crane(s) shall be located and arranged so that all operating handles, switches, and buttons are within convenient reach of the operator when facing the area to be served by the load hook in. The arrangement shall allow the operator a full view of the load hook in all positions. Control equipment on remote-controlled cranes shall be located and arranged so that the operating handles, switches, and buttons are convenient for the operator's use.

b) All electrical equipment shall be suitably enclosed so that live parts will not be exposed to accidental contact under normal operating conditions. All master control switches, manually operated switches, circuit breakers, starters, contactors, limit switches and relays shall be clearly and permanently identified by attached nameplates.

c) All hoist controls and brakes shall provide for limiting the vertical movement of the hooks, with rated load and when starting from stand-still, within increments of 1.5 mm.

d) The controls and brakes shall limit the movement of the bridge and trolley, under the above operating conditions, within increments of 3 mm. and 6 mm. respectively.

2.06.02 **Speed Regulation**

a) General: Speed regulation shall be accomplished utilizing a variable voltage & variable frequency static stepless control system for all crane motions.

b) The hoist and travel motions shall be provided with stepless speed-regulations from 5 to 100% of rated speed. Hoist control shall be achieved by adjusting the frequency of the motor electrical supply.

c) The maximum acceleration produced by the control system shall be independent of the rate of change of the control lever position.

d) The speed in the first lowering position shall not exceed 5% of the synchronous hoist speed when lowering any load up to rated load.

e) The speed in the first hoisting position when lifting any load up to 125% of rated hoist capacity shall not exceed 5% of the synchronous hoist speed.

2.06.03 **Control System Details**

a) Bridge and Trolley Travel:

Each travel motion shall have a separate control lever or set of pushbuttons.

b) Hoists

i. General: Separate controllers shall be provided for each hoist. Smooth acceleration shall be provided for all loads in both directions.

ii. Lowering: The lowering speeds for all loads within the rated capacity shall be gradually increased by advancing the controller from the 'off' position toward the 'full-on' lowering position. The lowering speed shall not exceed 125% of the rated speed on any control position.

iii) Hoisting: The hoisting speeds for all loads within the rated, capacity shall be smoothly increased by advancing the controller from the 'off' position toward the full-speed hoisting position. In no case shall any load up to 130% of rated capacity cause a hoist to lower when the controller is in any raising position

c) Control Levers and Pushbuttons

i. All lever-operated controls shall have self-resetting controllers provided with a notch or latch which in the "off" position prevents the handle from being inadvertently moved to the "on" position. Switch levers shall have automatic spring return to the "off" position.

ii. All pushbutton controls shall be of the momentary contact type, which make contact only while the button is depressed.

iii. Wherever possible, controls shall be arranged so that the movement of each controller handle shall be in the same relative direction as the resultant movements of the load. Pushbuttons shall be oriented in the

same relative direction with respect to each other as the resultant movements of the load.

d) Limit Switches

i. Limit switches shall be provided for all cranes as follows:

- Hoist-driven limit switches for the upper and lower hook position.
- A back-up overtravel limit switch for the extreme upper position of each hoist; and
- Lever-operated limit switches for both end positions of all travel motions.

ii. Hoist-driven limit switches shall be totally enclosed and shall be of the traveling nut or rotating cam type, adjustable for circuit opening or circuit closing and adjustable for operation at any hoist position.

iii. Back-up over travel limit switches shall be of the block-operated type, where the trip action is caused by the lower sheave block. These limit switches shall be arranged and adjusted so that they trip only after the normal hoist-driven switch position is overtraveled. Back-up limit switches shall be of the power type which directly interrupts the power supply to the hoist motor.

iv. All limit switches shall be of the type which resets automatically. Limit switches shall be of quick-break type, capable of stopping the equipment quickly under all conditions of speed and loading. All limit switches shall be unidirectional and shall not interfere with the motion in the opposite direction. Contacts shall be enclosed and protected from dust, moisture, and mechanical injury and shall be easily removable for replacement.

3.00.00 GENERAL DESCRIPTION AND TECHNICAL REQUIREMENTS OF CRANE EQUIPMENTS

3.01.00 **Function**

3.01.01 ~~**Power House Crane**~~

~~The powerhouse cranes shall be provided both for erection and maintenance works in the machine hall and for handling all material and equipment. During construction phase, this handling equipment shall also be used to handle and install the construction material and equipment of other contractors~~.

~~The powerhouse cranes will be used principally for the installation and removal of all heavy pieces of equipment located in the powerhouse such as generator rotor assemblies, stator sections and assemblies, and turbine runner assemblies, power transformer sub-assemblies. The assembled generator rotor shall be the heaviest assembly to be handled by the crane. Precise handling of valuable machinery at slow speed is required. The auxiliary hoist will be used for higher speed service, lesser weight assemblies and sub-assemblies. Two numbers of 10 T under slung hoist, one on each girder to handle equipments/assemblies which are beyond the reach of main/auxiliary hoist~~

3.01.02 **Pressure Shaft BF Valve House Crane**

The butterfly valve house crane shall be provided both for erection and maintenance works and for handling all material and equipment. During construction phase, this handling equipment shall also be used to handle and install the construction material and equipment of other contractors.

The Pressure Shaft Butterfly Valve House Crane will be used for the installation and removal of all pieces of equipments located in the valve house such as valve sub-assembly / assemblies, valve disc, valve body, dismantling joint, oil-pressure equipments, electric panels, and in rare exigencies for opening the closed valve through crane actuated lifting of counter-weights (of valve).

3.02.00 **General Description and Operating Duties / Conditions**

3.02.01 **Operating Conditions**

The cranes shall be designed for indoor service. After installation of the generating units and auxiliaries and Butterfly Valve are completed, respective cranes will be used for maintenance purposes.

3.02.02 **General Arrangement & Specification Drawings**

Each crane shall be an electrically-operated single-trolley, overhead traveling bridge crane. The general arrangement of these cranes is shown in the enclosed layout drawings. Each crane shall operate on a runway provided with suitable and standard crane rails supported on crane beams.

3.02.03 **Service Classification**

The cranes shall be rated according to IS- 13834. The broad classification is as tabulated below:

Group classification of the cranes shall be as follows:

- Utilisation Class U4
- Spectrum Class Q2

- Equipment Class A4
- Overall Group Classification
  ~~Power House Crane~~ ~~M5~~
  BF Valve House M4

Mechanism Classification shall be adopted as below:

~~a) Power House crane :~~

~~Mechanism~~	~~Crane travel~~	~~Trolley travel~~	~~Lifting 125T~~	~~Lifting 25T~~	~~Lifting 5T~~
~~Utilisation Class~~	~~T5~~	~~T5~~	~~T4~~	~~T5~~	~~T5~~
~~State of Loading~~	~~L2~~	~~L2~~	~~L2~~	~~L3~~	~~L3~~
~~Mechanism Class~~	~~M5~~	~~M5~~	~~M4~~	~~M6~~	~~M6~~

b) B. F. Valve House Crane :

Mechanism	Crane travel	Trolley travel	Lifting 50 T	Lifting 10T	Lifting 5T
Utilisation Class	T4	T4	T4	T4	T4
State of Loading	L2	L2	L2	L2	L2
Mechanism Class	M4	M5	M4	M4	M4

3.02.04 **Operating Parameters and Speed**

I ~~**Power House Cranes**~~

~~It will be a double hooks crane (one Main Hook and one Aux. Hook) with one under slung monorail hoist.~~

~~EOT crane for Power House shall be suitable for the following parameters / duties:~~

~~A)~~ ~~Rated Capacity (in Tonnes)~~

~~a)~~ ~~Main Hoist~~ ~~125 T~~

~~b)~~ ~~Auxiliary Hoist~~ ~~25 T~~

~~c)~~ ~~Under Slung Monorail~~ ~~5T~~

~~B)~~ ~~Crane Span~~ ~~20800 mm (approx.)~~

~~C)~~ ~~Normal speeds & micro speeds (Inching) with full loads.~~

II B.F. Valve House Crane

It will be double hooks (one Main Hook and one Aux. Hook) crane with one under slung monorail hoist.

EOT crane for Butterfly Valve House shall be suitable for the following parameters / duties.

A) Capacity (in Tonnes)

a)	Main Hook	50 T
b)	Auxiliary Hook	10 T
c)	Under Slung Monorail	5T

B) Crane Span 8300mm

C) Normal speeds and micro speeds (inching) with full loads.

a) For loads upto 50 T (Main Hook)

i)	Normal speed	1.0 m/min
ii)	Micro speed	0.1 m/min

b) For loads upto 10 T (Aux. Hook)

i)	Normal speed	8.0 m/min
ii)	Micro speed	0.8 m/min

b) For loads upto 5 T

i)	Hoisting speed	4.5 m/min
ii)	Micro speed	0.45 m/min
iii)	Travelling Speed	12 m/min

c)	Trolley Travel	10 m/min
d)	Bridge Travel (long)	20 m/min

D) Max. acceleration / deceleration bridge travel and trolley travel — 0.2 m/sec^2

E) Crane Main Hook, Aux.Hook and Under-slung monorail hoist Vertical Travel Reaches
(Refer Relevant Tender Drawing)

	a)	Between B.F. Valve floor level to upper most position	> 22000mm	
F)	Position of Hook from Rail C/L		U/stream	D/stream
	a)	Main Hook (50 T)	< 2000mm	< 2200mm
	b)	Auxiliary Hook (10 T)	< 3200mm	< 1000mm
G)	Clearance from end wall on both sides		< 3000mm	
H)	Runway, travel lengths			
	a)	Gantry rail level	EL871.50m	
	b)	Length of runway	12000mm	
	c)	Trolley travel length	Max. feasible for specified crane span, shall ensure specified hook reaches.	
I)	Distance from rail C/L to nearest side obstruction on			
	Up-stream		< 750mm	
	Down-stream		< 750mm	
J)	Distance from the crane bridge end to nearest side obstruction on			
	Up-stream		> 350mm	
	Down-stream		> 350mm	
K)	Means for Micro speed		Stepless speed control by VVVF drive with min. six (6) pulse designfor inching motion for main and auxiliary lifting hooks.	

The hook travel and crane approaches are subject to review during detailed engineering based on actual requirement for handling of equipments

3.02.06 **Simultaneous Operation of Hoists**

In case ~~of power house crane and~~ butterfly valve house crane, normally one hoist of the crane would be operated at a time. It shall however be possible to change the position of the components from (including runner handling and its removal from the turbine pit using main hook through the floor openings), lying down to vertical position or vice-versa using any two of the hoists of the same crane, by suitable manipulation of the hoisting and other movements as the case may be.

3.02.07 **Performance / Quality of Operations**

Crane shall be capable of raising, lowering, holding and transporting the rated load without any damage to or excessive deflection of any crane component.

Following tolerances shall be maintained in the operation of the crane

a) Smooth control of vertical movement to within 1 mm for loads to be handled by the main hook of the cranes and 3 mm for loads to be handled by the auxiliary hook of the crane with hook carrying rated load at a time and hoist, brakes properly adjusted for normal operation.

b) Control of bridge and trolley motion to be within 10 mm.

c) The motor speed not to exceed 105% of the synchronous speed while lowering the rated load.

d) The vertical deflection of the main girders caused by the rated load plus all dead loads not to exceed 1/900 of the crane span.

3.02.08 **Hook Reaches and Crane Clearances**

a) Limits of travel of the hoist of each crane are specified under clause “Operating Parameters and Speed” the same shall be reviewed during detailed engineering as per requirements.

b) A distance of 950 mm for ~~P.H~~. cranes 750 mm for B.F. Valve house crane from the CL of the rails to the wall faces has been envisaged on either side in the arrangements. It is expected that with this distance it shall be possible to provide clearances as specified between crane extreme points and the walls on either side. The crane Contractor shall ensure this clearance.

c) Necessary minimum clearance required between crane top most point and the lowest overhead civil construction obstruction shall be indicated by the Contractor.

3.02.09 **Micro Speed (Inching Motion) & Acceleration**

a) Normal speeds for hoisting, cross travel and long travel shall be as specified.

b) Cranes shall also have provision for raising and lowering of the loads at reduced speed (inching) of $1/10^{th}$ (one tenth) of the normal speeds in both main and auxiliary hoist capacities.

3.02.10 **Arrangement of Operators Cabins**

In respect of the operator cages / cabins of the crane ~~for the Power House~~, it shall be fitted on the upstream side on the non adjacent girders.

3.03.00 **DESIGN**

The cranes shall be designed in accordance with the requirements of this Specification.

3.03.01 **Structural Features and Parts of Cranes**

3.03.01.01 **General**

The cranes shall conform to all the requirements of clause "Structural Design Features" of this specification. The complete FEM analysis of Girders, End Carriage etc., shall be carried out and submitted to Employer for approval.

3.03.01.02 **Crane Bridge**

a) The crane bridge, made of two (2) girders as box type construction, reinforced with stiffening ribs, supported on end trucks, shall be designed to safely carry the full rated load without undue vertical or lateral deflection or vibration. The design shall ensure that girder vibrations are quickly dampened to within 1 mm in 4 seconds.

b) The bridge shall be designed taking into consideration the specified transport and handling limits in regard to size and weight of packages. Accordingly the bridge shall be sectionalised into suitable but minimum number of sections within the transport constraints and also of need of field erection & handling.

c) The joints between the sections shall be spliced and shall be made by most appropriate method. Most appropriate design shall be adopted for the spliced joints between the sections.

d) The bridge shall have the following provisions :

i. Welded end-stop of steel to act as stoppers for trolley / crane.

ii. Heavy standard rails for trolley.

iii. Large gusset and skew plates with interference fit bolts at girder ends to connect to the end trucks to maintain a square rigid structure secure against shock & skewing of crane on the track.

iv. Suitable number of guide rollers for guiding trolley wheels on rail track.

v. Supporting structure for mono-rail hoist underneath the bridge girder ~~of power house cranes~~.

3.03.01.03 **Trucks (End carriages)**

a) The trucks of box type construction with openings at each end for receiving the truck wheels shall be either cast or weld fabricated or bolted or riveted structure of steel and shall have adequate strength and stiffness.

b) The ends of the trucks shall be shaped to form a hood over the truck wheels extending beyond them to receive the track (rail) sweeps and bumpers. The trucks shall be arranged so that wear may be compensated in order to maintain the drive gear in proper mesh. The size of the journals shall be ample to carry the rated capacity load at specified speed without excessive heating during continuous operation.

c) Wheel assembly shall be mounted on L-type bracket and shall be so arranged that replacement of any wheel can be achieved from the side without undue difficulties. The wheel base shall not be less that $1/6^{th}$ (one sixth) of span, as reckoned between the centres of outer wheels. The end trucks shall be designed to contact end stops.

d) Each truck shall have :

i. Suitable numbers of double flanged rail wheels with bearings running on suitable axles, wheels, fracture props, buffer etc. for easy maintenance.

ii. Suitable track sweeps at each end of trucks, effective in both directions of travel.

iii. Guide rollers extending below the top of rail on both sides to prevent the trucks from leaving the rails.

iv. Lugs to prevent a drop of not more than 2.5mm in case of axle getting broken.

v. Resilient bumpers or spring buffers on contact faces of end stops.

vi. End stops at each end of runway rails, designed in such a way that they make contact with the face of the end truck and not the wheel.

vii. Suitable pads on each truck for all wheels for jacking of the crane for changing truck wheels and bearings, to be so designed as not to interfere with the replacement of the truck wheels.

viii. Lifting jib arrangement alongwith a lifting jack. Jack need not be of built-in type.

ix. Hand holes with removable covers, in each closed compartment of end trucks to facilitate painting of the interior with a spray gun without major disassembly.

e) Arrangement for jacking the cross traverse wheels shall be similar to the one described above for L.T. wheels. The Contractor shall furnish the technical details of jacks to be supplied.

3.03.01.04 **Wheels, Axles and Wheel Bearings**

A) **Wheels**

a) The bridge shall be carried on at least ~~16 (sixteen) wheels, 8 (eight) on each side, for power house cranes and~~ 8 (eight) wheels, 4 (four) on each side for B.F. Valve house crane suitably mounted on trucks and designed so as to distribute the load equally on truck beams & wheels. The wheels shall meet the following requirements :

i) Double flanged type with treads machined and ground to size.

ii) Turned, bored and ground to true and uniform diameters concentrically.

iii) Made of cast steel or forged steel and heat treated. Cast iron wheels are not acceptable.

iv) Equalized in pairs or individually as necessary.

v) Flanges tapered and radiused to prevent derailment.

vi) Tread width to have proper clearance, and to be of sufficient size to withstand maximum static and moving / rolling loads. The BHN of hardness of wheels shall be atleast 50 points more than the BHN of rails.

vii) Bridge wheels shall be identified for interchangeability. Similarily trolley wheels shall be identified for interchangeability.

b) The design of the wheel truck assembly shall be such as would allow the wheels to adjust themselves to irregularities of the runaway within allowable limits

B) Wheel Axles

The wheel axles shall be in accordance with following:

a) Made of forged carbon or alloy steel.

b) Accurately turned, ground and polished at the positions fitting into wheels.

c) Suitable interference fit with the wheels.

d) Driving wheel axles to be keyed, in addition to interference fit.

C) Wheel Axle Bearings

The wheel bearings shall be interchangeable, easily removable type & shall comprise the following:

a) Bearing housings / journals fitted into truck bodies.

b) Anti friction roller bearings with high pressure grease lubrication.

3.03.01.05 **Trolley**

The trolley shall be made as a welded frame of structural steel and shall be designed and fabricated in accordance with the following:

a) Provision of adequate bracing to withstand vertical, lateral and torsional strains.

b) Properly machined to receive the drum, wheels, axles and motors for hoisting and cross travel.

c) Provision of heavy duty roller bearings, for trolley wheels & winding drum, with bearing caps and fittings for pressure lubrication.

d) Double end resilient or spring buffers at bottom of trolley frame on each side to engage stops at each end of the bridge.

e) A provision to fit / receive a device to lift the heaviest parts of the trolley viz. the drum and motors for maintenance without any external place for anchoring the hooks or need for any other device.

3.03.01.06

Operator Cabin, Walkways and Ladders, Safety Guards

a) Operator Cabins

The cabin of structural steel frame shall be designed and constructed in accordance with the following requirements

i. Enclosed type for indoor service having adequate working space for operation and maintenance with sufficient ventilating type windows which also allow the operator to have clear view of all operations. Suitable inspection cages to accomodate two persons to facilitate inspection of down shop lead.

ii. Adequately braced to the crane so as not to sway, swing, or shake.

iii. Floor of steel plates securely connected to the frame and covered with matting.

iv. Located on the upstream side of the bridge ~~Power House and~~ B. F. Valve House crane and suspended from their outside girders.

v. Adequate carbon dioxide gas cylinders of 4.5 Kg..

vi. One non oscillating ventilating fan.

vii. A cut-off switch near the cabin for disconnecting the incoming power supply before entering or leaving the cabin, for operator safety.

viii. One brass gong suspended outside the Cabin and operated from inside.

ix. A foot operated electric warning horn of double bell type suitable for 240 V AC. of noise level 95 dBA at 3.5 m

b) Walkways and Ladders

Ladders, platform, walkways, hand holds, etc., necessary to give safe access to and movement in the cage, bridge drive and trolley drive mechanisms and all other components of the crane needing inspection, maintenance and repair shall be provided. The walkways and ladders shall be in accordance with the following requirements:

i. Walkways to be of steel chequered plating for full bridge length, at same elevation as the bridge, attached to outside of each girders; width, clearance from drive units and head room to be minimum 700 , 500 and 2000 mm respectively.

ii. Steel ladders and stairs to have non-slip treads, not less than 600 mm wide between sides, preferably sloped forward, and provided with back safety guards in case height of ladders exceeds 3000 mm.

iii. Hand rails for access walkways of not less than 800 mm (clear) with hand railing of height of 1100 mm along the both side of bridge girder and cross over walkways, platform, stairs, ladders, etc.with an intermediate rail.

iv. Two plates on each side edge of all walkways of about 100 mm height.

c) Safety Guards

Appropriate and effective safety guards, encasements, and covers shall be provided for various rotating components, and for live electrical conductors of the crane as below:

i. For gears, chain drives: Encasements.

ii. For revolving shafts & couplings: Guards for full lengths.

iii. For sheaves of hook block and rope : Guards to prevent trapping of hand, and to prevent rope from dismounting from sheave grooves even if rope slackening develops.

iv. For openings in foot walk floorings and other inspection platforms: Covers of lockable type.

3.03.01.07 **Safety Lugs**

Suitable safety lugs shall be provided to contain the movement of the crane during an earthquake. Clamps to keep the crane in locked condition while not in operation shall also be provided.

3.03.01.08 **Name Plates**

The crane shall have permanent main name plates affixed to each side of the crane, so as to be clearly legible from the floor, showing the name of the manufacturer and the rated capacity. In addition, each hoist shall have its rated capacity clearly marked on its block. These nameplates shall be in English.

3.03.02 **Mechanical Features and Parts of Cranes**

3.03.02.01 **General**

a) The ~~main Power House~~ Crane shall conform to all requirements of Clause “Mechanical Design Features”.

b) The travel motion shall be equipped with automatic spring set, electrically-released, shoe type brakes. These brakes shall be applied automatically when the control lever of the master contract is in the "off" position and shall be capable of holding the crane stationary.

3.03.02.02 **Bridge Travel Mechanism**

a) ~~For power house crane the mechanism shall comprise of four (4) electric motors and totally enclosed speed reduction helical gear units, two (2) for each end of the bridge, to drive the four (4) bridge wheels and shall ensure equal speed.~~ For other cranes, the mechanism shall comprise of two electric motors. Alternatively for B.F. Valve house, the bridge wheels on both sides can be driven with control drive system and controlling shaft.

b) The gear motors shall be keyed directly to the extended wheel shafts.

c) The bridge motion shall be free from vibrations and rocking under all conditions of operations and the crane structure shall not have any tendency to get out of line.

d) The coupling for the shafts of the motors, gear units and wheels shall be of safety flange type accurately faced and turned and shrunk into place with taper flush keys.

3.03.02.03 **Trolley Travel Mechanism**

This mechanism shall comprise of ~~two (2) electric motors for Power House cranes and totally enclosed speed reduction gear units, one (1) for each end of the trolley to drive two (2) trolley wheels, designed to ensure equal speed and steady motion, free from vibrations and rocking.~~ For B.F. Valve House, motors can be two (2) or less and control drive system as mentioned in bridge travel mechanism can also be adopted.

3.03.02.04 **Hoisting Mechanism for Raising and Lowering of Load**

The hoisting mechanism provided and mounted on the crane trolley shall comprise of motors, speed reduction gear units for normal speed, drums, brakes, lifting tackles and hooks, hoisting rope and slings as below:

a) Hoist Drive for Normal Speed

The hoist shall be driven by a motor through speed reduction gear units for normal speed of the hoist and shall be complete with brakes and retarding devices.

b) Winding Drum

The winding drum shall have machined grooves to receive the full hoisting rope without overlapping. The drum shall be of such size that there will be not more than one layer of rope on the drum when the rope is in fully wound position and its length shall be such that each lead of rope has a minimum of two full turns on the drum when the hook is in its lowest position and one spare groove for each rope lead off the drum when the hook is at its highest position. The drums shall be designed to withstand the maximum compressive stresses and local bending stresses in the drum at the grooves when the rope is wound on.

c) Lifting Tackles & Hooks

i. The lifting tackles shall consist of a safety type lower pulley block, hook, necessary sheaves and flexible steel wire rope. The lower block shall be a heavy steel housing to support the sheaves and hook.

ii. Sheaves shall be made of cast steel and shall be machine grooved to a depth of not less than one and a half (1.5) times the diameter of the rope. The groove shall be finished smooth and shall be free from surface defects likely to injure the rope. The sheaves shall be provided with guards to retain the rope in grooves and other requirements of sheaves shall be as per approved relevant standards.

iii. The swiveling hook shall be of forged steel and mounted on ball thrust bearings and protective skirt shall be provided to enclose the bearings.

iv. The main hook shall be of the Ramshorn type conforming to approved relevant standards (IS:5749) and the auxiliary hook shall be of shank type conforming to IS : 3815.

d) Hoisting Ropes & Slings

i. The hoisting rope shall be of the type as specified above in these specifications. The factor of safety for the hoisting ropes shall be not less than six (6). The rope system shall be equalised and arrangements entailing reverse bends shall be avoided as far as possible.

ii. The offer shall include requisite wire rope slings of suitable lengths having a safety factor of not less than six (6) lifting specified load with the angle formed at the hook not less than 90 degrees. A minimum of five pairs shall be provided for different loads up to the rated

capacity of main hoist for each of the four numbers of cranes under scope of supply. The slings shall be suitable for use with hoist.

iii. Each sling shall have a ring at one end and a ring or a hard eye at the other, with matching shackle for the hard eye. Sling rings are to be suitably proportioned to fit on the crane hook.

iv. A wall chart shall be provided showing the maximum safe lift of the slings individually and in pairs at various angles. Each sling and shackle shall have a permanent fixed label on which is stamped the maximum safe lift at 90 degree spread. A storage rack for safe keeping of the slings shall also be supplied.

3.03.02.05 **Brakes for Various Drives / Motors**

A) The brakes for various motion drives shall be as per the IS : 3177. The following type of brakes shall be provided for the various crane drives:

a) Bridge Travel
- i) Main Braking by means of frequency speed control of motors down to zero (0) (Regenerative braking).
- ii) Automatic DC electro-magnetic brake for each motor drive.
- iii) Automatic Electro-Hydraulic thruster brakes for each motor drive.

b) Trolley Travel
- i) Main braking by means of frequency speed control of motors down to zero (0) (Regenerative braking).
- ii) Automatic DC electro-magnetic brake for each motor drive.
- iii) Automatic Electro-Hydraulic thruster brakes.

c) Hoisting Motion **For Main Hoist:**
- i) Main braking by means of frequency speed control of motors down to zero (0) (regenerative braking).
- ii) Automatic DC electro-magnetic brake for each motor drive

iii) Automatic electro hydraulic thruster brake

For Auxiliary Hoist for ~~Power House and~~ B.F. Valve house crane:

i) Main braking by means of frequency speed control of motors down to zero (0) (regenerative braking).

ii) Automatic DC electro-magnetic brake for each motor drive.

iii) Automatic electro hydraulic thruster brake or double brake discs .

B) The electromagnetic brakes shall be of DC type complete with rectifier equipment to convert the available AC 230 V, 50 Hz supply. The electro-hydraulic thruster brakes shall be of AC type.

C) The operating solenoids of the DC Electro-magnetic brakes shall release the brakes on energisation and shall automatically apply all the brakes immediately in the event of stoppage, interruption or failure of electrical power supply. The brakes shall also apply immediately on operating the emergency stop push button or switch irrespective of controller position.

D) The DC Electro-magnetic brakes shall be of spring set shoe type equally effective in both directions of rotation. The springs for the Electro-magnetic brakes shall be of compression type and shall have adequate factor of safety.

E) The brake system shall have the following provisions:

a) Locking device in the brake lever.

b) Means for adjustment to compensate for wear of the shoes / discs.

c) Emergency stop push buttons.

F) The wearing surfaces of all brake drums shall be machined and shall be cylindrically smooth and free from defects. The brake lining shall be effectively and permanently secured to the brake shoes during the effective life of the lining and shall be protected from water, grease, oil and other adverse effects. The brake pedals in case of foot operated brakes shall have non-slip surfaces and it shall be possible to apply the foot brakes with a force not exceeding 25 kgs**.**

G) All the brakes shall have adequate capacity. The brakes for hoisting when applied shall arrest the motion and sustain the load up to the test load at any position of the lift. Provision shall be made to control with safety the lowering of any load up to the test load.

H) Brakes in other motions shall be capable of bringing the relevant motions of the fully loaded crane safely to rest in the shortest possible time with least possible shock and shall arrest the motion under all other service conditions.

I) The various brakes shall be designed to exert, the torque equal to 1.5 times the full load torque of motors.

J) The brake torques may be increased if considered necessary by the Contractor in order to ensure proper and safe application of the brakes. All Electro-magnetic brake coils shall have continuous rating.

K) Each brake of the travel motions shall be equipped with a manual disconnect lever which will allow the brakes to be released without electrical power.

3.03.02.06 **Gears**

The gears and the gear trains for reduction of speeds of the motors for various motions of the cranes shall be designed, manufactured / fabricated and shall have following provisions:

a) Only spur and helical gears shall be used for speed reduction gearing. The tooth profiles are to be carefully designed and machined.

b) The gears having speeds higher than 500 rpm shall be of helical teeth type with active contact area hardened to a depth of 0.2 to 0.3 mm.

c) Shall be made of cast steel or forged steel and designed as per IS : 4460 for the specified crane duty.

d) Shall be totally enclosed in oil tight gear cases of welded fabricated steel.

e) Shall have Inspection covers on the top of the gear case for quick and easy inspection of gears and for adding oil in the gear case.

f) Adequate breathing and drainage facilities on all gear cases.

g) An oil level indicator.

h) Proper guards for uncased gears.

i) Markings of pitch line on all gears for facilitating erection.

3.03.02.07 **Shaft**

All shafts shall be designed and made in accordance with the following:

a) Material - High tensile rolled steel or forged steel.

b) Shaft diameter to take into account the provision of key slot & splines. Slot bottom shall have proper radius.

c) Where needed designed with suitable shoulders / step-up diameter for carrying and fitting of gears, pinions and similar parts.

d) Provision of fillets of ample radius at all diameteral changes in sections.

e) Designed to limit shaft deflection to within 1/3000th of the span between bearings.

3.03.02.08 **Bearings**

All bearings shall be designed and provided in accordance with the following:

a) Provide antifriction / roller, ball or bush (sleeve) journal type as applicable for components as per sound practice.

b) Bearings shall be located close to the points of loading and shall be easily replaceable type.

c) The bearing preferably shall be of self lubricated type.

d) Bearings at shaft ends shall be sealed appropriately so as to be drip proof in case of oil lubrication.

e) In case of grease lubrication type, open ends of bearings to be appropriately sealed with grease retainers.

3.03.02.09 **Lubrication Arrangement of Bearings**

Lubrication arrangement of bearings, journals, ball & roller bearings in case bearings are not self lubricated type shall comprise the following:

a) Pressure lubrication system comprising gun for lubrication of all easily accessible grease type bearings with grease nipples.

b) Centralized hand operated lubrication system comprising pump and grease pipelines of copper or brass for bearings not easily accessible e.g. end carriage wheels. For reliability, distribution lines shall be double lines, ensuring continuous lubrication, in case one line gets choked.

c) Provision to prevent development of excess lubrication pressure at the bearings.

d) Gear trains shall be lubricated by oil bath. Sleeve bearings shall be oil lubricated type.

e) Initial lubrication of crane before handing over shall be Contractor's responsibility which shall be done in the presence of Employer.

f) Portable hand operated lubrication equipment viz. grease gun etc. shall be included in the supply.

g) Specification and details of lubricants shall be furnished by Contractor. The brands of oil / grease used above shall be stated**.**

3.03.02.10 **Drip Pans and Covers**

a) All bearings and gear cases shall be made oil tight. Suitable drip pans shall be provided to collect oil and grease which may drip from bearings, gear cases and other components of the crane. In case drip proof arrangement is not possible, means for cleaning the drip pans shall be available.

b) Dust covers shall be provided where necessary to protect sliding and rotating parts and to prevent dust from mixing with the lubrication.

3.03.02.11 **Bumpers**

Resilient / spring bumpers shall be attached to the bridge trucks and the trolley. The bridge shall have four bumpers one at each corner, arranged to meet the crane stops squarely. The trolley shall have two bumpers on each side placed to meet the track stops squarely at the end of the stops. The bumpers shall be capable to absorb safely the kinetic energy and shall be capable of bringing the crane and the trolley to a gradual stop when travelling at rated speed in either direction, when the power supply is suddenly cut-off and thus, eliminate excessive stresses and damage to any part of the crane.

3.03.03 **Electrical Features and Parts of Cranes**

3.03.03.01 **General**

a) The electrical drives, switchgear and controls for various motions for the cranes shall comprise of electric motors of requisite capacities for specified duties and speeds, switches, breakers, resistors, electromagnet brakes, isolating switches, controllers, earthing, cabling / wiring, in accordance with the latest version of IS : 3177.

b) The power supply for the electrical equipment shall be 415 V, 3 phase, 4 wire, 50 Hz AC. The supply for crane control shall be 110V AC and for lighting shall be 240 V, 1 phase, 50 Hz AC and shall be obtained through individual 415/110V AC & 415 / 240 V transformers, wherever necessary. These transformers shall be part of crane supply. All electrical equipment shall be suitably designed and constructed for operation under tropical conditions.

c) Permissible temperature rise of the electric motors and individual components of associated switchgear equipment shall be as prescribed in the Indian standards and shall be based on ambient temperature of 40^0C.

d) The electrical control, operating mechanisms and devices shall be located and arranged in neat and convenient manner which shall be subjected to the approval of the Employer. Crane control levers, motors, switches and other operating mechanism shall be marked plainly and permanently.

e) The technical particulars of various electrical equipment and devices shall be as specified here in. The Contractor shall furnish the make, type and other relevant details of the electrical equipment devices, being offered by them.

Description

Equipment for controlling this drive shall be a multi drive system, with inverters in one cabinet. Each cabinet consists of one common rectifier with a common DC-bus, with inverters connected. This system will, in case braking energy is being supplied from one motor, supply the energy to the next motor connected to the DC-bus. If the braking energy exceeds the energy used by the other inverters, a braking chopper will open, and supply the energy to a braking resistor.

It is a vector controlled frequency converter, which means it can drive a motor through 0 rev. at full torque. To achieve this a Pulse encoder (Tacho) is used at the motor to control the flux and phase shift, in order to obtain the exact position of the rotor.

All frequency converters shall be connected to application process controller (APC), where all controls on the frequency converters shall be done. The APC shall programme the application to fit the required specifications.

The APC shall be also provided with communication controllers to other systems, or frequency converters.

The control shall be closed loop vector control system.

Functional Description

Each movement of the crane motors is controlled by joysticks in the crane control cabin. Motors are controlled by the APC in the frequency converter cubicle. The APC gets the direction / speed signals from the joystick. The APC calculates the speed and torque, in order to secure correct speed.

When stopping the operation of hoisting or lowering, the APC performs commands to the frequency converter, for lowering the speed to zero, and keeping it at zero speed before giving order to turn on the brake. When starting the operation of lowering or hoisting, the APC controls the frequency converter with a certain torque before releasing the brake, in order to avoid any drop.

If the braking energy exceeds the energy of all the frequency converters, the braking chopper will open and use the braking resistor.

When being in “position Mode", the joystick signal is being disabled and only joystick movement signal is being used.

When the crane operator moves the joystick forward, the crane will move only over a predefined distance, and stop. To move an additional step he will have to move the joystick once more etc.

3.03.03.02 **Detailed Specifications of Individual Equipment**

a) Motor for Various Motions

i)	Motor Standards	As per IS: 325 and IS: 3177
ii)	Capacity	Of ample capacity to suit respective duties. Full load torque of motors shall be higher than the maximum load torque.
iii)	Type and Enclosures	All motors will be of squirrel cage type to suit 415 V, AC, 3 phase, 50 Hz, four wire power supply, totally enclosed. The motors shall be suitable for direct on line starting any hoisting / lowering rated load, even in event of frequency control system being out of order. Protection. IP- 54 with fan cooling arrangement for Power House crane, for B.F. valve house crane.
iv)	Variation of Voltage & Frequency	Voltage: ± 10%, Frequency: +3%, -5% Any combination values of voltage and frequency variations within the above limits.

v)	Pull out torque	Not less than Two point seven five (2.75) times the full load torque of motors at rated voltage and frequency.
vi)	Insulation	Class - F
vii)	Time rating	One (1) hour for all motors
viii)	Temperature rating	Temperature rise not to exceed the limits in Table-1 of IS : 325. Max. Temperatures rise at full load measured by resistance method shall not exceed 70^0C over the maximum ambient temp. of 40^0C.
ix)	Rated synchronous speed	To suit duty for various motions
x)	Over speed	Two point five (2.5) times rated capacity withstand speed or 2000 rpm whichever is less
xi)	Space heaters	To be provided in case motor capacity is $\geq$ 20 KW (To suit 240 V, AC supply)
xii)	Motor bearings	Roller type. Sealed to prevent grease leakage and entry of dust. Shall be of ample strength to withstand heavy shocks and vibration to which subjected under all conditions of operation.
xiii)	Tests	Type & routine tests as per IS : 325. Copies of test reports to be furnished by the Contractor
xiv)	Temperature rise	By resistance method measurement
xv)	Climate	Shall be located indoor in tropical climate. Protection against fungus, vermin, and corrosion shall be provided
xvi)	Terminal	Shall be arranged such that terminals are easily accessible for inspection and maintenance. Natural ventilation shall not be restricted
xvii)	General requirements	Sturdy and strong to withstand operational shocks and vibrations

b) Limit Switches

c) Limit switches for hoisting motion shall be spindle type, while for bridge and trolley motions, these shall be of lever / roller and proximity type with maintained contacts. The number of limit switches shall be as under:

Motion /Travel	Travel	Raising	Lowering	Emergency 'up' limit
Main Hoist	-	1	1	1
Auxiliary Hoist	-	1	1	1
Bridge (two-way self-resetting type)	2	-	-	-
Trolley (two-way self-resetting type)	2	-	-	-

Type, contact rating and resetting of limit switches shall respectively be totally enclosed type, 5 A at 240 V AC, by reversing the controller.

3.03.03.03 **Load Cell System**

a) The main and auxiliary hoist on the ~~Powerhouse crane as also the~~ B.F. Valve House Crane shall be equipped with a load cell system capable of measuring the load on their hooks. The load cell system shall measure loads from 0 to 130% of the hoists rated capacity with a precision of ± 5% or better, between the effective and the indicated loads, for all loads between 0 and 130% of the rated load of the hoists.

b) The load cell shall be of corrosion-resistant steel construction and shall be designed with a factor of safety of not less than four (4) at 130% of the rated hoists capacity, relative to the ultimate strength of the material.

c) The load cell system shall operate from the crane's AC power supply and shall display the load on the hooks in tons through a 3-digit display or meter readout located at the stand-by station.

d) The load cell system shall incorporate a capacity limiting feature which will prevent the crane from handling a load which exceeds a set point by stopping all crane motions. This point shall be adjustable for any load between 90% and 120% of the hoists rated capacity. Whenever this feature stops the crane, a flashing red light, visible from the floor beneath the crane, shall be energized, to indicate that the crane is overloaded. An override

switch shall be provided in the radio control transmitter to allow for overload tests. The response of this capacity limiting feature shall be suitably delayed to compensate for the momentary, dynamic loading when the hoist's motors are started.

3.04.00 **Electrical Controls and Protection for Operation of Cranes**

3.04.01 **General**

a) ~~Each~~ crane ~~of Power House~~, Butterfly Valve House shall normally be controlled from the floor by radio control. The cranes shall also be controllable from a stand-by control station located in the operator's cage. This stand-by station shall be equipped with a complete set of lever type controls for temporary crane operation and shall provide reasonable visibility for the operator to permit safe temporary operation. The crane shall be provided with a control scheme selector switch located at the stand-by control station. This switch shall select between the radio control and the standby control scheme. Modes of operation shall be controllable by the radio control scheme.

b) The radio control system shall provide all crane motions with separate control levers.

c) All crane motions (hoist, trolley, and bridge) shall be regulated by adjusting either the voltage and / or frequency of the motor electrical supply with a variable frequency drive device.

d) Each crane shall be provided with control panel / desk located in the operator's cabin. The controls shall provide for Individual independent control of cranes for all motions and various speeds up to normal speeds.

3.04.02 **Control Switches, Levers and Speed Controls**

a) For individual independent control (start, stop and motor speed selection) of each crane, lever type switches shall be provided.

b) The controls shall provide for torque and speed control of the various motors in following number of steps in both direction of motions :

~~c)~~ ~~**For Power House cranes:**~~

~~Description~~	~~Hoisting~~	~~Long Travel~~	~~Cross Travel~~
~~Hoist Motor (Main and Auxiliary Hoist)~~	~~6 Steps~~	~~-~~	~~-~~

~~Bridge Travel~~	~~-~~	~~4 Steps~~	~~-~~
~~Cross Travel~~	~~-~~	~~-~~	~~4 Steps~~

~~The trolley travel controllers shall be provided with drift points in both directions of travel.~~

ii) For B.F. Valve House crane

Description	Hoisting	Long Travel	Cross Travel
Hoist Motor (Main) and Auxiliary Hoist)	6 steps	-	-
Bridge Travel	-	4 steps	-
Cross Travel	-	-	4 steps

3.04.03 **Remote Radio Control**

a) General

i. ~~T~~he operation of ~~Power House cranes~~ from machine hall and service bay floor shall be made by remote radio control system. However, provision for control of these cranes, operated individually from the floors immediately below the cranes available during the progressive construction of the power house (including the lowermost floor) when subsequent floors have not been casted, shall also be possible by the above remote radio control system.

ii. Provision for control / operation of the B.F. Valve House crane from the B.F. Valve house floor shall be made by remote radio control system.

iii. The equipment furnished shall provide for the complete radio control of all crane functions specified in following paragraphs.

iv. Each radio controlled crane shall be equipped with a 100-W amber indicator lamp located beneath the center of one of the bridge girders. This light shall be energized whenever the crane is in the radio control mode and the crane's master contactor has been energized.

v. Reliability, dependability, and ease of maintenance shall be prime considerations in the design and construction of all components and parts of the equipment, to ensure positive operation of the system under all conditions of dust, moisture, temperature, vibration, and electrical interference. Reduced maintenance requirements and long service shall be achieved through simplicity and use of conservatively

rated, heavy-duty industrial type parts. The design of the equipment circuitry and application of components shall represent the state of the art.

vi. Wherever practicable, replaceable modules with reliable plug-in connections shall be used.

vii. The system shall be designed so that no field tuning adjustments will be required when replacing a faulty module and shall permit a field change of the operating frequency by replacement of plug-in type components with minimum adjustment.

viii. The radio control equipment shall be the type accepted by and shall conform to all applicable Government rules and regulations. The frequency of operation shall be in the requisite frequency band. ~~However, the remote radio control of the two cranes of the power house shall operate at different operating frequencies within the requisite frequency band~~. The Contractor shall perform a frequency search and shall obtain license on behalf of the Employer.

xi. Radio crane control equipment shall be of reputed make.

b) Operation

i. The following function shall be radio controlled:

- Forward and reverse speed control of the bridge travel motion;
- Right and left speed control of each trolley (crane and monorail hoist) travel motion;
- Up and down speed control of each hoist motions;
- On and off control of the lights on the underside of the crane bridge;
- On and off control for the crane's alarm gong.
- On and off control of the crane's master contactor :

ii. The speed control of each motion shall provide for the direct radio stepless control specified for that motion.

iii. Stepless radio control shall be accomplished with a speed set point telemetering system utilizing pulse rate, pulse width, or other similar systems. The speed of a motion shall be a direct function of the control lever's position and shall preferably utilize a logarithmic scale

for greater control of the slower speeds. A "jogging" system of controlling a motorized potentiometer or any other system, in which the control lever's position corresponds to acceleration rather than a speed is unacceptable.

iv. Control information shall be transmitted using digitally coded information. The radio control system shall allow simultaneous transmission of all crane functions. A means of checking and detecting error in the digital data stream shall be provided to prevent a misoperation of the crane. Radio interference signal shall not cause operation of any of the crane functions.

v. The power supply to the radio receiver shall be obtained from a branch circuit in the power distribution panel.

vi. When a "control hand-over" feature is specified for a crane, there shall be 2 radio control units, each equipped to control all crane functions and tuned to operate on different radio frequencies. Interlocking circuitry in the receiver shall permit only 1 of the 2 control units to be effective at a time. There shall be no crane motion when one of the units takes control, and all crane drives must be stopped when a unit releases control.

c) Safety

i. The complete control systems shall be designed to provide maximum safety for personnel, crane equipment, adjacent structures, plant equipment, and material being conveyed. The equipment shall comply with all laid down safety requirements applicable to this class of equipment.

ii. Control signal combinations shall be designed for safe operation so that uncommanded operation of any crane cannot result from stray or transient control signals or from extraneous natural or man-made sources of radio frequency interference.

iii. The system shall be designed "fail safe". Failure of electronic components or normal aging beyond specific limits shall result in stopping all crane motions. Crane motions shall also stop when any crane receiver is out of the range of its transmitter.

iv. A "dead man" feature, consisting of self-centering control levers and safety cut-off switches, shall be built into the control transmitters to cause all crane motions to stop if the operator releases pressure on the corresponding control lever or if he accidentally trips, or fall or drop the transmitter.

v. Shock conditions or vibration encountered on the cranes shall not defeat the safe operation of the receiver units.

vi. All control devices shall be designed to facilitate safe manipulation by an operator whose attention is normally directed toward the crane under his control. All control levers shall operate in the manner specified in Clause “Control Levers and Push buttons".

vii. The crane control system shall be designed to provide nearly instantaneous operation of all crane motion and functions in response to master control settings.

viii. Operating frequencies shall be selected to be free from interference from other radio frequencies used in the vicinity. ~~It shall also be ensured that remote radio control of Power House crane No. 1 can not operate Power crane No. 2 or vice versa~~.

d) Transmitters

i. The transmitter shall be of light weight construction not exceeding 3 kg in weight (including battery) and shall be equipped with a belt or shoulder harness.

ii. Transmitter control levers shall be furnished for all multi-speed crane motions and shall be spring return and guarded against false operations.

iii. The transmitters shall be operated by compact, nickel-cadmium batteries capable of 8 hr of continuous operation without recharging.

iv. Battery chargers suitable for charging 2 sets of transmitter batteries simultaneously shall be furnished for either wall or shelf mounting. The battery chargers shall operate on 230 V, 50 Hz AC supply. Batteries and battery chargers shall be supplied in an amount as required to permit 24 hours per day, 7 days per week operation of the radio controllers.

v. Radio control units designed and adjusted for use with one crane shall not be capable of controlling any other cranes at the site unless specifically readjusted for the purpose of controlling a different crane.

vi. Transmitters shall be completely solid state.

vii. All control functions shall use crystal controlled radio frequency signals.

e) Receivers

i. Receivers shall be designed to respond only to signals from the transmitter control unit designed and adjusted for operating that specific receiver.

ii. Receivers shall be shock-proof to resist vibration.

iii. Receiving antennas shall be of rugged construction and shall be mounted under the crane bridge.

iv. The receivers shall be completely solid state. All semi-conductors shall be silicon to the extent practicable.

v. Failure of any electronic component shall result in "fail safe" operation bringing all crane motions to a halt. Uncommanded motions shall not be possible. Digital coding shall be designed to prevent inadvertent control actions.

f) Intermediate Relays

i. Intermediate relays shall be heavy-duty type with 10-A continuously rated contacts and shall be capable of withstanding inductive transient voltages resulting from crane control contactor operation. Surge suppression shall also be provided to protect receiver components from inductive transient voltages.

ii. Intermediate relay panels shall be separately fused and provided with disconnect devices.

g) Alarm Gong Operation

The crane shall have a radio control function to sound the alarm gong whenever the operator elects.

h) Operating Distances

The crane shall be operable by radio control system from a minimum horizontal distance equal to the length of the crane's runway. It shall be operable at this distance from the available floor immediately below the crane.

3.04.04 **Operation of Brakes**

Whenever power supply to the various drive motors for various motions are cut-off, the brakes shall be automatically and instantly applied. The brakes shall also be applied immediately in case of any over speed of the hoist motor in the lowering direction.

3.04.05 **Electrical Interlocks**

a) The main circuit breaker (CB) for power supply to the crane shall have interlock providing CB to be able to be closed only when all the control lever switches for the various motors are in "Off" positions. The interlock shall be so arranged that if the contactors for various motors / drives have failed to open even through the control lever switches have been brought to the "Off" positions, the CB will not close.

b) The master controller shall be provided with a thumb operated auxiliary switch so as to ensure the safety of personnel and equipment in case of loss of attention or chance death of the operator during operation of any crane. The control circuit of the master controller shall be so arranged that all the controls during starting and subsequent operations shall be de-energised unless the thumb operated switch is kept in pressed position. During the operation also if the operator fails to keep it pressed, the power supply to the controls shall be disconnected.

c) An isolator fitted on the crane bridge which cannot be operated from the floor, shall be provided to prevent inadvertent operation of the crane from the floor from Radio Remote Control system while maintenance work is being carried out on the crane.

d) Power supply to the cranes shall be provided at two ends at for power house cranes, for B.F. valve house crane. T.P. isolators with indicating lamps shall be provided at these locations so that it can be operated from ground and power supply can be cut off immediately in case of any emergency condition.

3.04.06 **Miscellaneous Features**

The controls shall have following provisions:

a) 3 pole 415 V AC, ACB with rupture current not less than 20 KA.

b) A master push button for complete emergency stop in the cabin at a convenient location.

c) A key operated electrical switch for the control circuit to prevent unauthorised operation and for the safety of maintenance and operating personnel.

d) Indicating lamp to show that the control circuit is healthy.

e) Indicating lamp for the main circuit breaker position (OFF or ON).

f) Radio Remote Control system with proper indication.

g) All control panels shall be of minimum 14 SWG, CRCA sheet steel.

3.04.07 **Automatic Electrical Protection**

The electrical equipment and circuitry shall be provided with automatic protection, as detailed below against various faults and mal-operation of the equipment.

a) Protective relays for protection against instantaneous over-current, over-load, single phasing and under voltage for all motors. The OC relay shall be adjustable between two (2) to three (3) times the full load motor current.

b) Protective relays of motors to trip the main power supply circuit breaker in case of their operation due to fault.

c) MCCB's for control and protection of all motor circuits.

d) Air circuit breaker located in operator cabin, of 3 pole, 415 V, A.C, totally enclosed type for power supply tapping from the main collectors, with interrupting capacity not less than 20 KA, equipped with short circuit, overload and under-voltage trip devices and one shunt trip coil and prevention against single phasing, three (3), timer relays and other necessary devices / items.

e) Protection against over speed of the hoist motors which shall cut-off the power supply and apply the brakes in case any hoist motor speed increases to 105% of the rated synchronous speed.

f) Operation of any protective relays of motors shall trip the motor supply circuits by opening the primary contactors of the motors.

3.04.08 **Control gear Accessories**

a) Motors

i. Controls for various motors shall be full magnetic reversing type with definite time limit or frequency controlled acceleration devices.

ii. The motor - speed changes shall be provided by variable voltage & variable frequency for ~~Power House,~~ B.F. valve house cranes.

iii. Master switches for operation shall be vertical type lever handle design pointing in the actual direction of the performed motion when operated. These shall be suitably labeled indicating directions of motion for which they are meant.

b) Circuit Breaker / Controllers.

Each main supply circuit breaker or contactor shall have an interrupting capacity of not less than 45kA symmetrical at 415 volts. All switches, contactors, primary relays and primary circuits on the controller shall have a thermal capacity corresponding to 45kA for one second without injury and shall have a rating of atleast 660 volts and capacity ratings in accordance

with the British Standards or those of the National Electrical Manufacturer's Association (NEMA) standards. Allowable temperature rises shall be as prescribed in the Indian Standards or other equivalent standard and based on an ambient temperature of 40 deg. C.

c) All switchgear control and protective equipment viz breakers, contactors, controller control switch, HRC fuses, relays, meters etc. shall be housed suitably in a cabinet placed in a manner convenient for operation and maintenance in the cabins / travelling girders of the cranes for wiring suitable terminal blocks complete and ready for making external connection shall be provided. The cabinet shall be tropicalized.

3.04.09 **Alarm Gong**

An electrically operated alarm gong or buzzer which will sound while the crane is in motion shall be furnished with each crane. The alarm gong shall also be operable from a conveniently located switch when the crane is not in motion.

3.05.00 **Power Supply Tapping & Other Electrical Arrangement**

3.05.01 **Collectors**

The collectors shall be designed to reduce sparking between collectors and conductors to the minimum. The minimum clearance between live parts and ground parts shall be 80 mm. The collector shall be suitably covered to avoid accidental contacts.

3.05.02 **Trolley Conductors**

The trolley conductors shall be of PVC/TRS flexible trailing cable type of copper core and of suitable size. It shall be mounted on retracing support.

3.05.03 **Down Shop Leads (Main Runway Conductors)**

a) A safe, robust and compact approved shrouded type down shop leads (DSL) power supply system with suitable collector using latest technology shall be provided for the along the entire length of ~~Power House and~~ B.F. Valve House. The locations of these conductors are shown on respective specification drawings. It shall consists of substantial rolled copper conductors or angle iron of adequate capacity with end brackets and insulators, straining bolts, intermediate brackets and insulators etc. to suit various caverns / underground buildings. One end of each conductor shall be fitted with a terminal log to enable power and earth wires to be connected. Safety guards shall be provided to avoid the possibility of any accidental touch with these conductors. The supply to D.S.L. shall be controlled by two (2) nos. L.T. breakers installed at each end at a convenient place so as to receive the supply from L.T. Switchgear.

b) Down shop lead conductor system shall have ratings and characteristics as follows:

- Normal operating voltage, V 415
- Maximum design voltage, V 600
- Number of poles 3 + 1 N

Theses conductors shall have a continuous current rating as necessary to supply the maximum demand during crane operation, as determined by the greater of the following two (2) operating conditions:

- Load current for the simultaneous operation of main hoist motors and all bridge travel motors and
- Load current for the simultaneous operation of main hoist motors and all trolley travel motors.

c) The Down shop lead system, when assembled in place, shall permit independent longitudinal movement of the housings and conductors to allow for unequal thermal expansion and contraction. All conductors wherever required shall be housed in a common enclosure made of sheet steel not less than 16 gauge thick. Conductors shall be capable of carrying the rated current per pole continuously without overheating. Pickup trolleys shall have wheels equipped with sealed ball bearings and contacts of sufficient size to maintain full current carrying capacity without overheating. Contacts shall maintain constant contact pressure and alignment with the conductors.

d) The Contractor shall furnish all necessary supports, wall brackets, mounting bolts and accessories, anchor bolts, concrete inserts, and conduit and cable connections for the power supply to the feed box. The Contractor shall verify and satisfy himself about the adequacy of levelling, grouting etc.

3.05.04 **Power Conductors for the Crane Trolley**

Trolley power conductors shall be of the festooned (looped) insulated wire type. Each motor on the trolley shall have separate conductors for the power and control circuits, and in no case shall a power conductor be used as a common conductor for more than one circuit. The power conductors shall be insulated, jacketed, 90^0C conductor temperature, extra flexible cables. All conductors, insulators, and brackets shall be supplied with each crane.

3.05.05 **Circuit Arrangement**

a) The leads from the down shop collector shall be connected to a master manual magnetic contactor which shall be controlled by "on" and "off" pushbuttons and / or radio-controlled relays as specified for each crane. A

control transformer shall be provided to activate the contactor and the radio receiver. The master contactor shall be connected to two (2) circuit breakers, each of appropriate carrying and interrupting capacity. One circuit breaker shall be connected to a 415 V/ 220 V, 3-phase, dry-type transformer of the rating required to supply power for all lights, controls, heaters, and convenience outlets on the crane. The second circuit breaker shall supply the main feed for the bridge, trolley, and hoist motors.

b) A 220 V, distribution panel equipped with branch circuit breakers as required, shall be provided to distribute power to the lights, heaters, and receptacles.

c) Interlocking circuits shall permit closure of the contactor only when all motion controllers are in the "off" position. Other interlocking features, as specified for the individual cranes, shall also be furnished.

3.05.06 **Wiring**

All electrical wiring shall conform to latest version of IS : 1554 (part I) "PVC insulated (heavy duty) electric cables, for working voltage upto and including 1100 volts". All conductors for primary power, lighting and control circuits shall be insulated for not less than 1100 volts and shall have standard moisture resisting double braid coverings. All conductors between the secondaries of the motor contactors and resistors shall have sufficient current carrying capacity in accordance with the standard specifications and shall be insulated with 1100 volts class asbestos, high temperature type tropical insulation with moisture resisting impregnation. The primary conductors to the motor shall have standard, continuous current carrying capacity of not less than 100% of the rated full load primary current of the motors. All control and lighting conductors shall be of copper of suitable sizes. All the wiring shall be subject to approval of the Employer. All wiring shall be laid in hot dip galvanised metal conduits. Alternately armoured cables can be used. Conductor having nominal equivalent copper area of cross section less than 2.5 mm shall not be used for wiring.

3.05.07 **Illumination and Convenience Outlets**

The permanent AC illumination system on the crane shall consist of four 1000 watts high bay beamed flood lighting units for the Power House and two 1000 watts high bay beamed flood lighting units each for BF Valve House to illuminate uniformly the area under each crane. Two 100 watts lighting units and two convenience outlets shall be provided in operator’s cabin. A convenient outlet at each end of the bridge shall also be provided. The system shall be supplied from 415 V. AC crane power system through 415 V circuit breaker. For lighting and convenience outlets, 4 branch circuits shall be taken; one connected to two 100 watts lights in the operator's cage, another two branch circuits each connected to two 1000 watts high bay lights and fourth branch circuit connected to four convenience outlets. The wiring shall be done in accordance with latest Indian Electricity Rules. The 415V circuit breaker shall be provided with an overload tripping element for each pole.

The flood lighting units shall be suitable for control by both on-off push-buttons and radio control.

A portable hand lamp with plug and 25 m long wiring shall also be supplied for each of the crane by the Contractor for use during maintenance.

3.05.08 **Earthing**

a) The crane structure, motor frames and metal cases of all electrical equipment including metal conduits or cable armoring or guards shall be efficiently bonded to facilitate earthing as per Indian Electricity Rules 1956 and latest edition of IS : 3043.

b) The Contractor shall provide an earthing system to which all equipment under his scope of supply shall be interconnected. This system will in turn be connected to the power house earth mat.

3.06.00 **Runway Rails, and other Miscellaneous Items**

3.06.01 **Runway Rails for ~~Power House,~~ BF Valve House**

a) One (1) set each of runway rails suitable for each sets of cranes complete with sole plates, anchor bolts, clamps etc. for the bridge travel shall be designed and supplied by the Contractor. The rails shall extend for the :

i. ~~Power House length covering the generating units and service bay~~.

ii. Butterfly Valve House length.

b) The runway rails for ~~Power House and~~ B.F. Valve House cranes shall preferably be ~~CR 100,~~ CR 80 type respectively, as per IS : 3443. . The faces of the rail lengths shall be inclined at an angle of forty five (45^0) degrees to the length to provide oblique gaps between rail lengths.

c) The rails for bridge travel shall be laid on and fixed to the crane beam by means of anchor bolts etc. The Contractor shall supply all the materials including embedded parts for fixing the bridge rails on the crane beam. The supervision of erection of embedded parts for crane rails shall be responsibility of the contractor.

3.06.02 **End Stops**

Suitable end stops shall be provided at the end of the runway-rails for each set of the cranes.

3.07.00 **Miscellaneous Requirements**

3.07.01 **Hook Reach Limits**

The required hook reach limits are indicated in this specification and also in specification drawings (Part-E) etc. However, this is subject to review during detailed engineering.

3.07.02 **Specification Drawings**

The supplier shall note that the specification drawings as appended with the tender documents are merely illustrative and are not to be construed as defining or limiting the design of cranes.

4.00.00 SHOP ASSEMBLY AND TESTS

4.01.00 **General**

a) The Quality Assurance Plan and requirement of tests in general have been discussed in Part-B Section VI of the specification. All applicable tests as laid down in IS : 807 and IS : 3177 shall be carried out.

b) All motors, accessories and auxiliary equipment forming part of the crane shall be tested in accordance with the requirement of the latest relevant IS / IEEE standards. Each mechanical and electrical sub-assembly shall be tested for proper functioning and continuity of the electrical circuit.

c) On all auxiliary equipments, routine and type tests shall be carried out in the shop as per standard and test certificates shall be submitted to the Employer for approval before despatch.

4.02.00 **Material Tests**

The material tests shall include chemical analysis, mechanical test and non-destructive tests.

a) Chemical analysis:

For all main components and components exposed to high stresses and / or conditions where the composition is of importance, chemical analysis of the material will be carried out in accordance with normal practice to verify that the components conform to the required specifications.

b) Mechanical Tests :

Mechanical tests will be carried out on all main components according to the normal practice and relevant standards to ascertain that material properties conform to the requirements and specification. Such tests include the determination of the yield strength, UTS, elongation / contraction and impact

strength in aged / non-aged condition as required. Bend test of plates and sheets will also be performed as required.

c) Non-Destructive Test

i) Non-destructive test include ultrasonic test, x-ray tests, magnetic particle tests and dye-penetrant tests.

ii) The test of visual examination will be carried out on all principal castings and forgings which are subject to, or affected by, high service stresses. Defects, if any, will be removed by suitable means and soundness of metal will be checked by means of magnetic particle or dye penetrant inspection.

iii) Plates which are subjected to high service stress impact, fatigue, or vibration stress will undergo visual inspection and ultrasonic testing prior to use for manufacture and welding.

iv) All welds shall be 100 % radiographically tested. Alternatively, these shall be subjected to ultrasonic examination. Defects in welds disclosed by ultrasonic or radiographic testing or dye penetrant or magnetic particle testing will be completely removed by chiseling and after re-welding, the new weld will again be subjected to radiographic examination for soundness.

v) The tests shall be carried out as per applicable National / International codes and standards.

4.03.00 **Radiographic Test on Welded Joints**

Welded joints of the bridge girders shall be one hundred (100%) percent tested during the course of fabrication (radiographic / ultrasonic sound test / magnetic particle test) and test certificates shall be submitted to Employer for their approval.

4.04.00 **Test on Steel Plates**

Steel plates used for manufacture shall be certified by the steel plate producers, highlighting the following information

a) Charge No.

b) Chemical analysis of the melt

c) Plate thickness and size

d) Following tests along rolling direction

i. Yield strength, tensile strength and elongation rupture

ii. Three ISO, V-notch toughness test at 0^0C in the thickness direction

The findings should conform to minimum requirements of the specification for the material approved for the relevant structure.

Ultrasonic tests will be made on all plates subject to lateral stress.

4.05.00 **Shop Assembly Test**

a) The cranes shall be subjected to tests as elaborated in , Part-QA, Section VI of the specification.

b) The cranes shall be load tested as per IS 3177 including overload test.

c) All control elements, including brakes and limit switches, shall be connected and operable for the shop test. The controls shall be tested, and all relay operations shall be checked.

~~**5.00.00 FIELD ASSEMBLY, ERECTION, TESTING AND COMMISSIONING**~~

~~**5.01.00 General**~~

~~a) All equipment will be assembled and installed in accordance with the applicable Drawings; written instructions of the Contractor and applicable codes, standards, and specification. Test will include, but not be limited to, those specified herein.~~

~~b) Details of complete procedure and sequence of operation shall be indicated. The mobile crane, if needed, shall be arranged by the Contractor. All the tools, tackles, instruments, devices and any consumables needed for the erection, testing and commissioning of the EOT cranes shall be arranged by the Contractor.~~

~~c) All welding done at site shall be subject to 100 % radiographic examination.~~

~~5.02.00 **Preliminary Checks**~~

~~The crane equipment shall be examined for proper field assembly and damage during shipment. In particular, it will be checked for rain or moisture damage to motors and panels, inadequate painting, accumulations of dirt and rubbish, and oil leaks.~~

~~5.03.00 **Site Tests**~~

~~The Contractor shall furnish a complete list in sequential order of all essential site tests to be performed on cranes during the course of assembly, erection, pre-commissioning and commissioning. The Contractor shall furnish a comprehensive and exhaustive list of all such tests, covering test values & permissible tolerances~~

ANNEXURE-IV

SURFACE TREATMENT AND COATINGS

Object: The present specifications apply to equipment and spare part surface coating. They define surface coating, the types of recommended coating, and the associated guarantees. In any case, the Contractor shall submit to the Employer his coating schemes.

1.00.00 CORROSION PROTECTION

The Contractor shall take all necessary favorable measures to protect equipment from all abnormal corrosion and, taking into account project specific risks.

In particular, the Contractor shall choose the materials most suited to this project and shall submit a modification request to the Employer when the materials indicated in the specifications are considered unable to guarantee its behaviour against corrosion.

1.01.00 Equipment in Contact with Reservoir Water.

For all equipment on the water conveyance circuit (trashracks, valves, pipes, pump turbines instruments), the use of uncoated carbon steel is prohibited, even where corrosion allowance is planned. If he considers it necessary, the Contractor may apply stainless steel cladding to some carbon steel parts, or manufacture these parts in solid stainless steel.

If maintenance is unsure because of peculiar equipment arrangement, or if the equipment cannot easily be shutdown, the Contractor may submit to the Employer, alternative corrosion protection methods, so that vulnerable surfaces can be protected effectively.

1.01.01 Outdoor Exposed Equipment.

Among these equipment can be distinguished: those figuring as the subject of a particular specification, and for which the nature of materials and corrosion protection is clearly defined, those which, unlike the above, are not functional in nature and so are not subject to the same attention regarding problems of corrosion: parapets, gratings, lighting poles, etc. Even this second category of equipment shall be subject to particular attention with regard to choice of materials and corrosion protection.

In general, attention shall be paid to taking constructive measures or acquiring standard equipment, whatever the function, to avoid any water build-up. Such constructive measures are, for example: for constructive using structural sections (dam gates, stop logs), that all horizontal sheet metal sections have drainage holes at regular intervals, for auxiliary structures, embedding holes shall be completely filled with concrete, taking care to avoid any break in corrosion protection where concrete is exposed to the air.

2.00.0 **GENERAL**

The Contractor shall provide a complete and reliable surface treatment of the equipment furnished for corrosion protection.

Surface protection shall comprise:

A surface preparation phase with mechanical cleaning, grit blasting or chemical cleaning, a surface treatment phase with either metallizing and application of one or two priming coats suited to the type of metal surface, or application of priming coat, an application phase with several coatings of products, including final colored coat.

Surface protection shall be performed either in the Contractor's shops or on site with the necessary precautions taken.

Finishing touch-ups shall be performed on site upon completion of erection.

3.00.00 **SURFACE PREPARATION.**

All surfaces to be coated shall first be mechanically or chemically cleaned.

3.01.00 MECHANICAL CLEANING.

Surfaces shall be mechanically cleaned using one of the following methods:

shot-blasting or grit blasting, scraping, stripping, mechanical brushing.

3.01.01 SHOT-BLASTING OR GRIT BLASTING.

If mineral abrasives are used, they shall be selected in compliance with the prevailing regulations concerning workers' safety.

The required care levels of surface states after cleaning are defined by the illustrations in standard ISO 8501, or equivalent. The required care shall be as follows:

- preparation of steel surfaces to be imbedded set in concrete = Level 1,
- preparation of steel surfaces to receive definitive protection = Level 2.5,
- preparation of steel surfaces to receive metallized protection = Level 3.

The roughness of the cleaned surfaces shall be Ra = 12.5 µm, except for surfaces that shall be metallized later, for which the roughness shall be Ra = 6.3 µm.

3.01.02 SCRAPING, STRIPPING, MECHANICAL BRUSHING.

This type of cleaning shall concern:

- Parts to be set in concrete, which shall not be coated.

These parts shall be brushed immediately prior to concreting.

- Repair of defective surface coating. In this case, cleaning by scraping, stripping or brushing shall only be performed if shot-blasting or grit blasting is impossible.

The required care shall be as follows:

- St 2 for surfaces which shall subsequently receive a definitive coating.
- St 1 for surfaces to be set in concrete with no surface protection.

After cleaning, all surfaces shall be thoroughly dusted.

3.01.03 SURFACE PROTECTION REPAIR

Before surface protection is repaired, the old protection shall be partially or entirely removed. A new defects liability period shall start as soon as the zone in question has been repaired.

The old coating shall be completely removed by shot-blasting or grit blasting, in compliance with the specifications in 3.01.01.

If this process is impossible, the old coating shall be removed by scraping, stripping or mechanical brushing, in compliance with the specifications in 3.01.02.

4.00.00 CHEMICAL CLEANING

All traces of pollution shall be removed with solvents (degreasing, neutralisation).

The surfaces shall then be rinsed and dried (with special cleaning paper).

The Contractor shall submit, for the Employer's approval, a list with the characteristics of the solvents that he intends to use.

5.00.00 SURFACE TREATMENT

Immediately after surface preparation, the Contractor shall employ one of the following three surface treatment processes:

6.00.00 METALIZING

Metalizing shall be performed within 2 hours after preparation.

The chemical composition of the metal used shall be: 85 % Zinc - 15 % Aluminum. The thickness shall be 120 µm.

Application shall be by spray gun in compliance with ISO standard R 2053.

After metalizing, pores shall be plugged by applying a wash primer, or, if the equipment is intended for immersion, by applying a thin coat of zinc epoxy (max. 20 µm).

7.00.00 HOT GALVANIZING

This coating performed by quenching shall have the following characteristics:

- minimum unit mass : 5g/dm²,
- average thickness : 70 µm

This process shall be used when metalizing cannot be performed under satisfactory conditions.

8.00.00 PRIMING COAT APPLICATION

This coating shall have the following characteristics:

- product : zinc epoxy coat,
- thickness : minimum 40 µm.

9.00.00 APPLICATION OF THE PROTECTION

The Contractor shall carefully control relative humidity and temperature before and during applying any coating. In any case, the relative humidity shall not exceed 80%.

All traces of condensation shall be eliminated before protection is applied. If the relative humidity remains between 50 and 80%, the first coat shall be applied four (4) hours after the surface preparation.

The undercoats or finish coats shall be applied in compliance with the drying time required between each application.

Each coat shall be of a different color.

10.00.00 TOUCH-UPS

If more than 20 % of the total surface area of a given zone shall be touched-up, the Contractor shall replace the surface treatment over the entire surface.

11.00.00 PROTECTION OF THE SURROUNDING SURFACES

The Contractor shall take every measure to protect the surrounding equipment and surfaces from product spattering, and from any damage caused by the surface preparation that he performs.

Equipment or surfaces that are soiled or deteriorated in spite of these measures shall be repaired or cleaned, or if this is impossible, replaced at the Contractor's expense.

12.00.00 CARBON STEEL - STAINLESS STEEL CONNECTION

When carbon steel and stainless steel parts are connected, the surface coating shall be prolonged by 50 cm on the stainless steel part.

13.00.00 TYPES OF COATING

The coatings to be applied, except when expressly stipulated otherwise in the equipment specifications, shall be defined as follows:

14.00.00 CARBON STEEL SURFACES IN CONTACT WITH WATER

System chosen	Thickness
• 1 zinc epoxy priming coat	40 µm
• 2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 µm

The system's minimum thickness shall be 450 µm.

The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.

15.00.00 CARBON STEEL SURFACES IN CONTACT WITH AIR AND INSTALLED OUTSIDE

System chosen	Thickness
• 1 epoxy priming coat	40 µm
• 2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 µm

The system's minimum thickness shall be 450 µm.

The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.

16.00.00 CARBON STEEL SURFACES UNDER COVER THAT STILL RISK CONDENSATION

System chosen	Thickness
• Zinc epoxy priming coat	40 µm
• 2 coats colored solvented epoxy pitch	2 x 150 µm minimum

The system's minimum thickness shall be 300 µm.

The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.

17.00.00 CARBON STEEL SURFACES UNDER COVER WITH NO RISK OF CONDENSATION

System chosen	Thickness
• Zinc epoxy priming coat	50 µm
• 2 coats colored solvented epoxy pitch	2 x 100 µm minimum

The system's minimum thickness shall be 200 µm.

The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.

18.00.00 CARBON STEEL SURFACES IN CONTACT WITH OIL

System chosen	Minimum thickness
• 2 coats of epoxy-polyamide paint containing aluminum	2 x 75 µm minimum

The Contractor shall ensure that the paint chosen is compatible with the oil in contact.

The complete protection shall be applied in the shop.

19.00.00 TEMPORARY PROTECTION OF GROOVES

The grooves, along with an area from 100 to 150 mm on either side of them, shall receive a temporary protective coating, according to the following system:

System chosen	Minimum thickness
• 1 coat of weldable epoxy-zinc paint	40 µm

The complete protection shall be applied in the workshop.

20.00.00 TEMPORARY PROTECTION FOR MACHINED SURFACES

The surfaces shall be degreased, rinsed and dried before application of the temporary protective coatings.

System chosen	Minimum thickness
Solvented corrosion resistant paint	
• 2 coats for oxidizing surfaces	2 x 35 µm
• 1 coat for non-oxidizing surfaces	1 x 35 µm

The protection shall be applied in the shop and eliminated on site before erection, using a rag impregnated with a solvent compatible with the materials temporary protected.

21.00.00 CONDENSATION PROTECTION

The Employer and the Contractor shall mutually agree on the products to be used.

22.00.00 **SPARE PARTS**

The spare parts' surface coating shall be applied in compliance with the present specifications.

All temporary surface protections (until the spare parts are used) shall be designed to last for 15 years storage of the parts.

23.00.00 **COLOR OF THE FINISH COAT**

The Employer shall define the color of the finish coat.

24.00.00 **PROTECTION THICKNESS**

Protection thickness shall be checked in compliance with the following specifications:

24.01.00 Number of measurement points

The number of measurement points is defined in the following table:

Size of the surface to be tested (reference zone, in m² or in linear meter))	**Number of measuring points recommended**
< 10	10 to 20
10 to 100	20 to 50
100 to 1000	50 to 100
1000 to 10000	100 to 200

24.02.00 Tolerance on system minimum thickness

Spot measurements less than the minimum thickness shall be accepted if both following conditions are fulfilled:

- the average of all the measurements performed on the reference zone is equal to or greater than the required minimum value, and
- no measurement point is less than 80% of the required minimum value.

In case of non-compliance with the criteria listed here above, the Contractor shall be obliged to touch up surface protection, either locally or completely.

The touch-up procedure shall be submitted to the Employer.

25.00.00 PRODUCT CHARACTERISTICS DATA SHEET

For each product, the Contractor shall provide a characteristics data sheet specifying:

- the manufacturer's references,
- product characteristics,
- application conditions.

The Contractor shall submit a model data sheet to the Employer. This sheet shall then be used for all surface protection works.

26.00.00 PAINT/COATING QUALITY CONTROL SHEET

During coating operations, the Contractor shall follow quality control procedure as agreed between the Employer and the Contractor:

PERFORMANCE GUARANTEES TO BE DEMOSTRATED AT SITE

	S.N.	DESCRIPTION OF TESTS TO BE PERFORMED (AS PER IS-3177)
	1.0	"FIELD ASSEMBLY, ERECTION, TESTING AND COMMISSIONING"
	2.0	General
	a	All equipment will be assembled and installed in accordance with the applicable Drawings; written instructions of the Contractor and applicable codes, standards, and specification. Test will include, but not be limited to, those specified herein.
	b	Details of complete procedure and sequence of operation shall be indicated. The mobile crane, if needed, shall be arranged by the Contractor. All the tools, tackles, instruments, devices and any consumables needed for the erection, testing and commissioning of the EOT cranes shall be arranged by the Contractor.
	c	All welding done at site shall be subject to 100 % radiographic examination.
	3.0	Preliminary Checks:The crane equipment shall be examined for proper field assembly and damage during shipment. In particular, it will be checked for rain or moisture damage to motors and panels, inadequate painting, accumulations of dirt and rubbish, and oil leaks.
	4.0	Site Tests : The Contractor shall furnish a complete list in sequential order of all essential site tests to be performed on cranes during the course of assembly, erection, pre-commissioning and commissioning. The Contractor shall furnish a comprehensive and exhaustive list of all such tests, covering test values & permissible tolerances for approval during design stage which shall cover but not be limited to tests stated in the following clauses:

	5.0	No-Load Static Tests
		1. All gearing, bearings, couplings, and rotating parts will be checked for proper oil level or lubrication, and hydraulic brakes will be checked for brake fluid. 2. The controller for each motion will be checked to ensure that hook and travel motions agree with marked controller directions. 3. All lights will be checked for satisfactory operation and to determine if lamp fixtures on each bridge walkway are operable and convenient for re-lamping. 4. All hooks will be numbered and all throat openings will be measured and recorded. These values will be compared to the dimensions recorded by the Contractor 5. Overall inspection & verification of crane dimensions, clearances, hook reaches and other important items. 6. Verification of insulation resistance for electrical equipment and wiring ircuits. 7. Operational tests on each controller, switch, contactor, relay and other control devices including limit switches. 8. Operational tests on all protective devices. 9. Tests for checking correctness of all circuits, interlocks and sequences of operation. 10. Any other tests as laid down is IS : 807 & IS : 3177.
	6.0	No-Load Operation Tests
	i	Each hoist will be run in both the hoisting and lowering direction for the full length of the hook lift until the limit switches stops travel. Both upper and lower limit switches will be checked for proper setting (for resulting hook elevation and amount of rope remaining on drum after switch stops travel) and operation. The additional overtravel limit switches will also be checked by temporarily by-passing the action of the normal upper limit switch. Each hoist will be checked to determine whether the hooks operate within the specified maximum speed ranges. At least two (2) complete raising and lowering operations will be made for each hoist at maximum speed. Proper alignment, quiet operation, and any major tendency toward overheating of motors, bearings, and gear drives will be checked. Hoist brakes will be checked to determine whether they are functioning properly.
	ii	All hook approaches, both the side approaches to the rails and the end approaches to the end walls, will be checked for conformance to approved shop drawings and the requirements of these Specifications. The limit switches shall allow the specified hook approaches or better approaches.
	iii	The trolley will be run in each direction of travel for at least four (4) complete cycles of trolley travel to disclose any tendency towards noisy operation and misalignment at bearings, gearing, or motor. The trolley will be checked to determine whether the trolley travels at the required speed. The motion of the trolley upon setting the controller to the "off" position will be checked to determine whether the travel brake correctly stops the trolley.

	iv	The bridge drive will be run in both directions of travel for the full available length of runway. The test will consist of a check for quite operation as well as a check of both the electric and hydraulic brakes. The bridge will be run at full speed in both directions to determine whether the drive operates within the specified maximum speed range. The electric brake and drift points will be checked for smooth and effective operation.
	7.0	Rated Load Tests
	a	Hoist
	i	With each hoist loaded with its rated load, the tests outlined under this specification shall be repeated except that the additional block-operated over travel limit switch operation need not be rechecked. The operation of the electric load brake will be carefully checked. All components will be checked for overheating. Operating speed on the maximum speed point will be checked and recorded. The maximum lowering speed will be checked to ensure that it is not more than 125% of the no-load hoisting speed. The control system will be checked for proper operation. The first speed point will be checked to ensure that it does not exceed 5% of the no-load hook speed in the lowering direction and 25% in either direction. The entire hoist will be checked for overheating after completing the hoisting and lowering cycle with the test load.
	ii	The loaded hoist will be checked to determine whether the hoist control and the solenoid brake satisfactorily control the handling of the load. The hoist must demonstrate its ability to raise, lower, and hold the rated load in any position.
	b	Trolley Travel : The tests outlined above will be repeated for the trolley with the hoists loaded with their rated load.
	c	Bridge Travel : The tests outlined above will be repeated with the main hoists loaded with their rated load.
	8.0	Overload Tests
	a	Hoist : With each hoist loaded with 125% of rated load, the hoist will be checked to determine whether it can raise, lower, or hold the overload in all speed positions without a drift. Each hoist will be checked to determine that the load will not lower on any hoisting position. The throat openings of all hooks will be re-measured and recorded after the overload test and compared to the initial measurements to check for deformation.
	b	Bridge The bridge structure will be checked for excessive deflection while loaded with 125% of their rated capacity with the trolley at the center of the crane span.
	c	Travel No trolley or bridge travel will be required during the overload tests.
	d	Deflection of the bridge girders with 100% and 125% of full load keeping the trolley at the centre of the crane span shall be measured and should be within the limits prescribed in the standards and as guaranteed in this specification.

	Note	Bidders' scope of work shall also include, arranging the statutory clearance from the concerned Government body/Authority. It shall be bidder's responsibility to ensure the presence of competent authority at the time of testing and obtaining the clearance and acceptance certificate from the concerned authority. Necessary fees/expenditure as required shall be borne by the supplier. The test Loads for the load testing at Site shall be provided by Employer within the vicinity of project site (including barrage area almost 50 km from project site). Transportation, handling etc. of test loads from their location to the power house and back to their original location shall be done by the bidder. Cradle and slings required for load testing shall be provided to Bidder on returnable basis and same shall be required to be transported to and fro from the Power house by bidder. (Approximate distance between power house and BFV house is 15 km). It is bidder's responsibility to ensure proper arrangement of available loads on the cradle.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-414-501-A002	DATE: 06-02-2024
	CUSTOMER : NTPC HYDRO LTD		QP NO.:---	DATE:--
	PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)		PO NO.:	DATE:
	ITEM: DG EOT UPTO 100T	SYSTEM: EOT CRANE	SECTION:	SHEET OF

ANNEXURE VIII

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	**			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9					
1.	**RAW MATERIAL**													
a.	Steel Plates (Box Girder, End Carriage, Trolley & Gear Casing ,Fabricated Rope Drum)	1.Chemical & Physical	Major	Chemical & Physical	100%	-	CUSTOMER APPD GA DRG./ CRANE DS/TECH SPEC/ IS:2062-2011, GR-BR (E 250/350)	CUSTOMER APPD GA DRG./ CRANE DS/TECH SPEC/ IS:2062-2011, GR-BR (E 250/350)	T.C.	√	P	#V/W	V	# In absence of co-related TC, check testing shall be witnessed on samples selected by Main contractor
		2. NDT	Major	UT (25mm & above thickness)	100%	-	ASTM A435 / A 578 LEVEL B	ASTM A435 / A 578 LEVEL B	I.R.	√	P	#V/W	V	# Co-related Mill TC inclusive of UT will be reviewed by BHEL/CUSTOMER, In absence of UT conformance in Mill TC , then UT will be witness by BHEL.
b.	Round Bars (For Pinion ,Gear ,Axles & Shafts)	1. Chemical & Physical	Major	Chemical & Physical	100%	-	CUSTOMER appd GA DRG. /CRANE DS /EN-8(080M40), EN-9(070M55), EN-19(709M40),EN-24,BS-970		T.C.	√	P	V	V	NOTE: (1) Mech. Properties against H.T condition if applicable against respective Material standard/Grade (2) Hardness test report review after applicable Q & T condition

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-414-501-A002	DATE: 06-02-2024
	CUSTOMER : NTPC HYDRO LTD		QP NO.:---	DATE:--
	PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)		PO NO.:	DATE:
	ITEM: DG EOT UPTO 100T	SYSTEM: EOT CRANE	SECTION:	SHEET OF

ANNEXURE VIII

		2. NDT	Major	U.T	100%	-	ASTM A 388-2007	UT PROCEDURE (Attached)	I.R.	√	P	V	V	
c.	Forgings (For Gears, Wheels)	1. Chemical & Physical .	Major	Chemical & Physical	100%	-	CUSTOMER APPD GA DRG./CRANE DS / EN- 9/19(070M55)- BS:970/ C55Mn75, IS:1570-1979		T.C.	√	P	#V/W	V	# In absence of co-related TC, check testing shall be witnessed on samples selected by Main contractor NOTE: (1) Mech. Properties against H.T condition if applicable against respective Material standard/Grade (2) Hardness test report review after applicable Q & T condition
		2. NDT	Major	U.T	100%	-	ASTM A 388-2007	UT PROCEDURE (Attached)	I.R.	√	P	W	W	
d.	Casting for Gear	1. Chemical & Physical	Major	Chemical & Physical	100%	-	CUSTOMER apprd. Drg./ DS / Cast steel as per IS 2708.G-II	CUSTOMER apprd. Drg./ DS / Cast steel as per IS 2708.G-II	T.C.	√	P	V	V	
		2.NDT	Major	U.T	100%	-	ASME Sec.V,article-23,SA-609	SA - 609 , Level - II	I.R.	√	P	V	V	
e.	Pulley & Brake Drums	1. Chemical & Physical	Major	Chemical & Physical	100%	-	IS 1030-1982/IS-2707-1989/ CUSTOMER apprd. Drg./ DS	IS 1030-1982/IS-2707-1989/ CUSTOMER apprd. Drg./ DS	T.C.	√	P	V	V	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-414-501-A002	DATE: 06-02-2024
	CUSTOMER : NTPC HYDRO LTD		QP NO.:---	DATE:--
	PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)		PO NO.:	DATE:
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		2.NDT	Major	U.T (only boss area)	100%	-	ASME Sec.V,article-23,SA-609	SA - 609 , Level - II	I.R.	√	P	V	V	
f.	Seamless Pipe for Rope Drum	1. Chemical & Physical	Major	Chemical & Physical	100%		ASTM - A 106 GR . B	ASTM - A 106 GR . B	T.C	√	P	V	V	
		2.NDT	Major	U.T	100%		ASTM A 435 / A 578 LEVEL B	ASTM A 435 / A 578 LEVEL B	I.R	√	P	V	V	
			Major	Mac ro Etching/Flattening for Seamless Pipe	100%		ASTM A 106-2007,GR-B	ASTM A 106-2007,GR-B	I.R.	√	P	V	V	
2.	**BOUGHT OUT ITEMS**													
a.	Hook	Forging Raw material	Major	Visual Check	100%		Drg. / Tech. Spec./ IS :1875-1992	No Visual defect	I.R	—	P	W	V	
			Major	UT after forging	100%		ASTM A 388-2007	UT PROCEDURE (Attached)	I.R	√	P	#W	V	# For MH Hook , UT in proof machined condition and AH Hook in grinding condition.
		Heat treatment	Major	Heat treatment after forging	100%		Mfg. Std. / Drg./Tech. Spec./ IS:1875	Mfg. Std. / Drg./Tech. Spec./ IS:1875	HT Chart	√	P	#V/W	V	# HT chart review for Main Hook at mfg. place
		Chemical test	Major	Chemical integral test piece.	Per Heat/ Batch		Appd. Drg. / IS :1875 -1992 , CLASS – II	Appd. Drg. / IS :1875 -1992 , CLASS – II	T.C.	√	P	V	V	
		Physical test	Major	Tensil test on integral test piece after heat treatment	Per Heat/ Batch		Appd. Drg. / IS :1875 -1992 , CLASS – II	Appd. Drg. / IS :1875 -1992 , CLASS – II	T.C.	√	P	W	W	Test Piece will be drawn from top of shank portion to be identified by BHEL and CUSTOMER.

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		Macro etching	Major	Grain Size	100%		ASTM E 112	Grain size 6 or final	Lab T.C	√	P	V	V	
		NDT before Proof Load	Major	UT	100%		ASTM A 388-2007	UT PROCEDURE (Attached)	I.R	√	P	V	V	
			Major	DPT	100%		ASME Sec V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R	√	P	V	V	
		Proof Load Test	Major	Proof Load Test	100%		Drawing / IS: 5749/ IS: 15560 / DS	Drawing / IS: 5749/ IS: 15560 / DS	I.R	√	P	W	# V/ W	
		NDT after Proof Load (UT only shank portion)	Major	U.T & MPI/DPT after Proof Load Test	100%		ASTM A 388-2007 / ASTM E 709-2007	ASTM A 388-2007 / ASTM E 709-2007	I.R	√	P	W	# V/ W	
		Identification Punch	Major	Visual	100%		—	—	—	—	P	H	H	H - Hold point (identification by CUSTOMER & BHEL)
b.	Wire Rope & slings	Visual & Breaking Strength	Major	Type, grade, breaking strength & visual , Diameter	100%		IS: 2266 – 2002 / G.A DRG / DATA SHEET	IS: 2266 – 2002 / G.A DRG / DATA SHEET	Mill T.C.	√	P	V	V	
c.	Rails	Chemical & Tensile , Cross section , Hardness , Dimension	Major	Chemical & Tensile , Hardness , Dimension	100%		G.A Drawing / IS: 3443-1980/APPD DATA SHEET	G.A Drawing / IS: 3443-1980/APPD DATA SHEET	T.C / I.R	√	P	V	V	

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3.	ELECTRICAL ITEMS													
a.	Transformer (like Control transformer ,Light transformer)	Make , Rating	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		IR		P	V	V	
		Routine Test	Major	Doc. Review	100%		Mfg. Catalog / DS	IS :2026 & IS: 12021 for control transformer	Mfg. TC		P	V	V	
b.	SFU , MCCB , MCB , CONTRACTORS , DSL, RELAYS , FUSES , RESISTENCE BANK,HOOTER, PUSH BUTTONS, indicating instruments , junction box, Limit Switches	Make / Rating / Type / Size	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		IR		P	V	V	
		Functional / Continuity Check	Major	Doc. Review	100%		Drg./ Data Sheet / Relavant Std.	Drg./ Data Sheet / Relavant Std.	IR / COC		P	V	V	10% Verification by CUSTOMER
c.	Motor	Type, Rating, Make, Size	Major	Visual	100%		CUSTOMER approved BOI list & ADS / DRG		Mfg. TC	√	P	V	V	
		Routine Test	Major	Measurement	100%		IS: 325 / App. Data sheet/CUSTOMER ADS	IS: 325 / App. Data sheet/CUSTOMER ADS	IR	√	P	V	V	
d.	Brakes	Make,Type, Rating	Major	Measurement	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg. TC		P	V	V	
		IR,HV,Functional Test	Major	Measurement	100%		MFG. STD.	MFG. STD.	Mfg. TC		P	V	V	

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e.	VVVF Drive	Type, Rating, Make,	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg. TC/ COC		P	V	V	
		Routine Test	Major	Measurement	100%		CUSTOMER APPD DA/GA DRG.	CUSTOMER APPD DA/GA DRG.	Mfg. TC	√	P	V	V	
f.	Cables (Power / Control / Trailing / Flexible)	Make, Type, Size	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC		P	V	V	
		Routine Test	Major	Measurement	100%		CUSTOMER Spec. / IS : 9963 / IS:694 /IS: 1554 / IS:7098	CUSTOMER Spec. / IS : 9963 / IS:694 /IS: 1554 / IS:7098	Mfg TC	√	P	V	V	
g.	Radio Remote, Master Controller, Pendent Station, Switches	Make / Rating / Type / Functional	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC / IR / COC		P	V	V	
h.	Anti - Collision Device , Cable Gland & lugs , Rectifier ,Lamps, load Cell	Make / Type	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC / IR / COC		P	V	V	
4.	**OTHER BOUGHT OUT ITEMS**													
	Bearings	Type & Size	Major	Verification	100%		Appd.drg./ Mfr's catalogue		Mfg TC / IR / COC	√	P	V	V	
	Tools and tackles	Verification of type size / rating	Major	Verification	100%		As per PO / BBU		IR / COC	√	P	V	V	

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	Spares (Mandatory / recommended spare / commissioning spares)	Verification of type size / rating	Major	Review Of Internal Inspection Reports / Mfr's TC / COC	100%	100 %	Approved Spare List		IR / COC	√	P	V/W	V/ W	
5.	**IN PROCESS : FABRICATED COMPONENTS : GIRDER, END CARRIAGE, TROLLEY, GEAR BOX CASING , FABRICATED ROPE DRUM**													
a.	Welding	WPS & PQR	Major	Review of Document	100%		ASME SEC IX 2007	ASME SEC IX 2007	ASME PRO	√	P	V	V	Earlier CUSTOMER Approved WPS and CUSTOMER / BVQ/Lloyds/EIL qualified Welder acceptable.
b.	Weld Fit Up & Edge Preparation	Dimension	Major	Dimension	100%		Mfg. Drg.	Mfg. Drg.	I.R		P	V	V	
c.	Fillet Weld	NDT	Major	DPT on Fillet Weld	100%	10 %	ASME - Sec. V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R.	√	P	V/W	V	DP test of fillet weld for rope drum to be conducted after final machining. Random witness by BHEL
d.	Butt Weld (Girder ,End-carriage, Trolley & Fabricated Rope drum,if applicable)	NDT	Major	Radiography Test / Gamma Ray	$		ASME - Sec. V	ASME - Sec. VIII,Div-1, Clause- UW-51 & 52	I.R.	√	P	V	V	$ 100% in Tension Zone, 25% in Compression Zone & 100% for rope drum Seam weld, RT Film shall be reviewed by CUSTOMER & BHEL
				DPT on Butt Weld	100%	10%	ASME - Sec. V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R.	√	P	W	V	10% random witness by BHEL
e.	Heat Treatment (SR) of Rope drum and Gear Box Casing	–	Major	Review of SR chart/Test Report	100%		Drg./ Relavant Std. / CUSTOMER	Drg./ Relevant Std. / CUSTOMER Spec.	SR Chart	√	P	V	V	

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							Spec.							
f.	Cabin, Platform, Hand railing	Dimension	Major	Dimension	100%		Mfg. Drg	Mfg. Drg	—	—	P	V	V	
g.	Final Inspection of Fabricated Components (Girders, End Carriages & Trolley, end stopper)	Visual & dimensional	Major	Dimensional & Visual Check	100%		Appd. G.A Drg / CRAB	Appd. G.A Drg / CRAB	I.R.		P	V	V	At the Time of Final Insp. Of Crane
6.	**IN PROCESS INSPECTION OF MACHINED COMPONENTS**													
a.	Pinions,Gear & Wheels	1. Dimensional Check	Major	Measurement	100%		Mfg Drg / Crane Data sheet	Mfg Drg / Crane Data sheet	I.R	√	P	V	V	Hardness test report review after applicable Q & T condition
		2. Heat Treatment	Major	Heat Treatment chart	100%		Material specification/ Mfg std/ Mfg drg	Material specification/ Mfg std/ Mfg drg	I.R	√	P	V	V	Heat treatment Chart to be reviewed by BHEL & CUSTOMER
		3. Hardness	Major	Measurement	100%	100 %	Mfg Drg / Crane Data sheet/ IS: 3177	Material specification/ Mfg std/ Mfg drg	I.R	√	P	#W	V	#W - (1) 100% witness for MH/ AH Gear,pinion of entire lot (2) 100% witness for CT & LT Gear, pinion of entire lot
		4. NDT	Major	DPT on teeth	100%		IS:3658-1981 / ASME - Sec. V	NO CRACKS & LINEAR INDICATION	I.R	√	P	V	V	
b.	Difference of Hardness of Pinion & Gear	–	Major	Documents review	100%		IS 3177 / CUSTOMER apprd. Drg. / DS	IS 3177 / CUSTOMER apprd. Drg. / DS	I.R	√	P	V	V	

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c.	Rope Drum	1.NDT & Dimensional Check	Major	DP test on fillet weld & Dimension	100%		ASME SEC VIII Div -1 / Mfg. Drg.	NO RELEVANT INDICATION	I.R.	√	P	V	V	
		2.NDT	Major	DP test on Groove after machining	100%		IS: 3658-1981 / ASME - Sec. V	NO RELEVANT INDICATION	I.R.	√	P	V	V	
d.	Pulley & Brake Drums	1.Visual & dimension	Major	verification	100%		Mfg. Drg	Mfg. Drg	I.R.	√	P	V	V	
		2. NDT	Major	DPT after machining	100%		IS: 3658-1981/ ASME - Sec. V	NO RELEVANT INDICATION	I.R.	√	P	V	V	
e.	Assembled Gear Box	1. Visual & Dimensional	Major	Visual & dimensional	100%		As per Mfg Standard / DS / TS	As per Mfg Standard / DS / TS	I.R.	√	P	V	V	
		2. NDT	Major	DPT on Fillet Weld	100%		IS: 3658-1981 / ASME - Sec. V	NO RELEVANT INDICATION	I.R	√	P	V	V	
		3.Mechanical	Major	Backlash ,Contact Pattern	100%		Approved Drawing /Data Sheet/Mfg. Std.	Approved Drawing /Data Sheet/Mfg. Std.		√	P	V	V	
			Major	Reduction Ratio , No Load Run Test For Check of Oil Leakage / Temp. Rise, Vibration & Noise	100%	100 %	Approved Drawing /Data Sheet/Mfg. Std	Approved Drawing /Data Sheet/Mfg. Std	I.R.	√	P	#V/W	V	NOISE Max.85 db at 1 mtr. & 30^0 C temp. rise at ambient # W - for Main hoist and Aux. Hoist Gear box
f.	DSL Guard	Dimensional	Major	Dimension	100%		Mfg. Drg.	Mfg. Drg.	I.R.		P	V	V	
7.	**FINAL INSPECTION**													

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a.	CONTROL PANEL With VVVF Drive	Identification of all Elect. Components , Cable laying / Dressing/Ferulling /Terminations Dimensional Functional , HV, IR, interlocks, Protection DOP	Major	Visual, dimensional, Operational & Functional Check , HV,IR, Painting	100%	100 %	IS:3177 -1999 / Appd. Drg / Data sheet	IS:3177 -1999 / Appd. Drg / Data sheet	T.C	√	P	W	W	(HV at 2.5 KV Ac for power ckt at 2 KV for control ckt ,DOP by paper insertion method) BOI as per CUSTOMER Approved Makes. Will be Checked at the time of Final Inspection.
		Paint Shade/ Thk/ Adhesion	Major	Visual / DFT Check	100%		APPD Painting Procedure / GA	APPD Painting Procedure / GA	T.C		P	V	V	7 Tank Pretreatment before Painting

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b.	EOT crane assembly with control panel, Master Controller / Remote Controller Pendent Station (At Works)	Visual & dimensional	Major	Dimensional ,Span, Diagonal & Wheel Base Dimension, LT Stopper Dimension	100%	100 %	Approved G.A. Drg. / IS 3177 / DS	Approved G.A. Drg. / IS 3177 / DS	I.R.	√	P	W	W	Crane Should be Operable by RRC meant for that Crane only.

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		Operational	Major	(1) Speed & Current Measurement at No Load for Hoist & CT/LT motion (2) Speed & Current measurement at SWL of Hoist & CT motion (3) Over load test (125%) of SWL for Hoist motion (4) Deflection test at SWL (5) Operation Check of Brake at SWL (6) Interlock & Functional test	100%	100 %	Approved G.A. Drg. / IS 3177 / Load test procedure / DS	Approved G.A. Drg. / IS 3177 / Load test procedure / DS	I.R.	√	P	W	W	Functional & Interlock test as per approved Electrical Schematic drawing
8.	Electric Hoists with pendent and panel	Operation	Major	-do--	100%	100 %	Approved G.A. Drg. / IS 3938 / Load test procedure / DS	Approved G.A. Drg. / IS 3938 / Load test procedure / DS	IR	√	P	W	W	
9.	Cleaning & painting	Paint Shade / DFT	Major	Visual , DFT Check	100%		Painting Scheme / DS / TS	Painting Scheme / DS / TS	IR	√	P	V	V	
10.	Review of QA documentation						As per approved QAP				V	V	V	
11.	Packing of components	Visual inspection	Major	Visual	100%		BOM / Elec. DODL Packing specification		IR	√	P	V	V	

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ANNEXURE VIII

NOTE :

1) Original TCs / Photocopies certified in original by mill shall be furnished for review. Test In absence of correlated TCs Check test shall be carried out from each plate/ bar for above 10 mm thk., certificates shall be offered for review at the time of stage inspection of components / assembly. Supplier shall ensure that pitted material is not used.
2) X-Ray to be taken for thickness upto 19 mm and Gamma Ray for thickness above 19 mm. If Gamma Ray is used for lower thickness slow speed film like D2 or equvalent which gives enough readable and interpretable film quality to be used for clarity. All NDT shall be carried out by Qualified Level II personnel.
3) Performance of electrical & control devices along with the interlocks, protection & sequence to be checked during crane assembly and parked at works.
4) Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable:/ Vendor's UT Procedure approved by BHEL may also be used.

(i) Cracks, flakes, seams and laps
(ii) Defects giving indications larger than 6 mm diameter equivalent flaw.
(iii) Groups of defects with maximum indication less than that from a 6 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 40%.
(iv) Defects giving indications of 3 to 6 mm diameter equivalent flaw separated by a distance less than four time the length of the larger of the adjacent flaws

5) Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable:/ Vendor's UT Procedure approved by BHEL may also be used.
(i) Cracks, flakes, seams and laps
(ii) Defects giving indications larger than 4 mm diameter equivalent flaw.
(iii) Groups of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%.
(iv) Defects giving indications of 2 to 4 mm diameter equivalent flaw separated by a distance less than four time the size of the larger of the adjacent flaws
For hooks, for carrying out UT on the areas where there is loss of back wall echo due to geometry, the calibration shall be done on blocks of same material of similar thickness having Flat Bottom holes of required size as given above.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	TECHNICAL SPECIFICATION **RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)** **DOUBLE GIRDER EOT CRANE FOR BUTTERFLY VALVE HOUSE (50/10/5 T)**	**PE-TS-414-501-A002** **Rev. No. 00** **Date: 08.02.2024**

SUB VENDOR LIST

SR. NO.	ITEM	SUPPLIERS	REMARKS
1.	STEEL	SAIL	
		TISCO	
		JINDAL	
		ESSAR	
2.	HOOKS	STEEL FORGING & ENGG. CO.,	
		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	
7.	BRAKES	ELECTROMAG	
		SPEED-O- CONTROL	
		BCH	FOR DCEM BRAKES ONLY
		KAKKU	
		PATHE	
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	
		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.	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS	
		BAJAJ	
		CROMPTON	
16.	CABLE LUGS (HEAVY DUTY)	DOWELLS	
		UML ENGINEERS	
		JAINSON	

17.	HOOTERS	BEACON	
		OSC	
		TARGET	
		KHERAJ	
18.	LIGHTING SWITCHES	ANCHOR	
		ELLORA	
		BAJAJ	
		PHILIPS	
19.	PVC POWER CABLES	APAR INDUSTRIES LTD.	
		CORDS CABLE INDUSTRIES LTD.	
		DIAMOND POWER INFRASTRUCTURE LTD	
		GOYOLENE FIBRES (INDIA) PVT.LTD	
		GOVIND CABLE INDUSTRIES	
		GUPTA POWER INFRASTRUCTURE LIMITED	
		HAVELLS INDIA LIMITED	
		KEI INDUSTRIES LTD.	
		KRISHNA ELECTRICAL INDUSTRIES LTD	
		KEC INTERNATIONAL LIMITED	
		MANSFIELD CABLES COMPANY LTD.	
		NICCO CORPORATION LTD.	
		PARAMOUNT COMMUNICATIONS LTD.	
		POLYCAB WIRES PVT. LTD.	
		RADIANT CORPORATION PRIVATE LIMITED	
		RAVIN CABLES LIMITED	
		SUYOG ELECTRICALS LTD.	
		SRIRAM CABLES PVT. LTD.	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	
		SAM CABLES & CONDUCTORS (P) LTD	
		THERMO CABLES LTD	

20.	**PVC CONTROL CABLES**	ADVANCE CABLE TECHNOLOGIES (P) LTD	
		APAR INDUSTRIES LTD., CMI LTD	
		CMI LIMITED	
		CORDS CABLE INDUSTRIES LTD	
		CRYSTAL CABLE INDUSTRIES LTD	
		DELTON CABLES LTD	
		DIAMOND POWER INFRASTRUCTURE LTD	
		ELKAY TELELINKS LTD	
		GEMSCAB INDUSTRIES LTD	
		GOVIND CABLE INDUSTRIES	
		GUPTA POWER INFRASTRUCTURE LIMITED	
		HAVELLS INDIA LIMITED	
		INCOM CABLES (P) LTD	
		KEI INDUSTRIES LTD	
		KRISHNA ELECTRICAL INDUSTRIES LTD	
		KEC INTERNATIONAL LIMITED	
		MANSFIELD CABLES COMPANY LTD	
		NICCO CORPORATION LTD	
		PARAMOUNT COMMUNICATIONS LTD	
		POLYCAB WIRES PVT. LTD	
		RAVIN CABLES LIMITED	
		SUYOG ELECTRICALS LTD	
		SPECIAL CABLES PVT. LTD	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	
		SAM CABLES & CONDUCTORS (P) LTD	
		SPM POWER & TELECOM PVT. LTD	
		TORRENT CABLES LTD	
		THERMO CABLES LTD	
		TIRUPATI PLASTOMATICS PVT. LTD	
		UNIVERSAL CABLES LTD	
21.	**TRAILING CABLES**	NICCO	
		UNIVERSAL	
		INCAB	
		ICL	
		APAR INDUSTRIES LTD	
		CMI LTD	
		KEI INDUSTRIES LTD	
		SUYOG ELECTRICALS LTD	

22.	**XLPE POWER CABLES**	APAR INDUSTRIES LTD	
		CORDS CABLE INDUSTRIES LTD	
		CRYSTAL CABLE INDUSTRIES LTD	
		DIAMOND POWER INFRASTRUCTURE LTD	
		GEMSCAB INDUSTRIES LTD	
		GOVIND CABLE INDUSTRIES	
		GUPTA POWER INFRASTRUCTURE LIMITED	
		HAVELLS INDIA LIMITED	
		KEI INDUSTRIES LTD	
		KRISHNA ELECTRICAL INDUSTRIES LTD	
		KEC INTERNATIONAL LIMITED	
		MANSFIELD CABLES COMPANY LTD	
		PARAMOUNT COMMUNICATIONS LTD	
		POLYCAB WIRES PVT. LTD	
		RAVIN CABLES LIMITED	
		SUYOG ELECTRICALS LTD	
		SPECIAL CABLES PVT. LTD	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	
		SRIRAM CABLES PVT. LTD	
		TORRENT CABLES LTD	
		THERMO CABLES LTD	
		TIRUPATI PLASTOMATICS PVT. LTD	
23.	**XLPE CONTROL CABLES**	APAR INDUSTRIES LTD	
		CABLE CORPORATION OF INDIA LTD	
		CRYSTAL CABLE INDUSTRIES LTD	
		DIAMOND POWER INFRASTRUCTURE LTD	
		GEMSCAB INDUSTRIES LTD	
		HAVELLS INDIA LIMITED	
		KEI INDUSTRIES LTD	
		KRISHNA ELECTRICAL INDUSTRIES LTD	
		KEC INTERNATIONAL LIMITED	
		PARAMOUNT COMMUNICATIONS LTD	
		POLYCAB WIRES PVT. LTD	
		RADIANT CORPORATION PRIVATE LIMITED	
		RAVIN CABLES LIMITED	
		SUYOG ELECTRICALS LTD	
		SRIRAM CABLES PVT. LTD	
		TORRENT CABLES LTD	
		UNIVERSAL CABLES LTD	

24.	CABLE GLAND	COMMET	
		SUNIL&CO	
		ARUP ENGINEERING	
		JAINSON	
		DOWELL	
25.	PUSH BUTTONS	SIEMENS	
		L&T	
		BCH	
		SCHNEIDER	
26.	LIMIT SWITCHES	SPEED-O-CONTROL	
		ELECTROMAG	
27.	MASTER CONTROLLER	SPEED-O-CONTROL	
		ELECTROMAG	
28.	SAFETY SWITCHES	ALSTOM	
		L&T	
		SIEMENS	
29.	PENDENT PUSH BUTTON STATION	OEM	
30.	INDICATING LAMPS	TECKNIC	
		BCH	
		SIEMENS	
		STANDARD	
31.	MCB	MDS	
		INDO COPP	
		STANDARD	
		SIEMENS	
		L&T	
		ABB	
		SCHNEIDER	

32.	**PANELS**	OEM	
		RITTAL	
		PYROTECH	
33.	**RESISTANCE BOXES**	ENAPROS	
		OEM	
34.	**FIRE EXTINGUISHERS**	ASKA EQUIPMENTS LTD.	
		ASHOKA ENGINEERING COMPANY	
		KANADIA FYR FYTER PVT. LTD	
		NITIN FIRE PROTECTION INDUSTRIES LTD	
		NEW ENGINEERING CORPORATION	
		SAFEX FIRE SERVICES LTD	
		UNITED FIRE EQUIPMENTS PVT. LTD	
		ZENITH FIRE SERVICES (INDIA) PVT LTD	
35.	**VVVF**	YASKAWA	
		ABB	
		SIEMENS	
		SCHNIEDER	
		FUJI ELECTRIC	
		MITSUBISHI ELECTRIC	
36.	**SHROUDED DSL**	SUSHEEL	
		STROMAG	
37.	**ANTI COLLISION DEVICE**	ELECTRONIC SWITCHES INDIA	
38.	**LOAD CELL**	IPA	
		SARTORIUS	
39.	**RRC**	ACROPOLIS ENGINEERING	
		SNT CONTROLS	
40.	**GEAR BOX**	OEM	* = Applicable for Geared Motors only
		ELECON ENGINEERS	
		SHANTI GEARS	
		PBL*	
		NAW*	
		NORD*	
		SEW*	
		BONGFILIOLI*	
41.	**RAIL**	JSPL	
		SAIL	

42	**CENTRALIZED LUBRICATION / HYDRAULIC POWER PACK**	LUBCON, PUNE	CRANE OEM MAKE POWERPACK IS NOT ALLOWED.
		PRAKASH LUBRICANT, KOLKATA	
		AFMC, KOLKATA	
		SKF ENGG AND LUBRICATION (LINCOLN HELIOS)	
		VIJAY ENGINEERS	
		INDO HYDRAULIC BOMBAY PVT LTD	
		MEHATA HYDRAULIC EQUIPMENT	
		CLAYSYS	
		VEDNAT ENGINEERING SERVICES	
		ELECTROPNEUMATICS AND HYDRAULIC PVT LTD	
		SN HYDRAULIC	

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

	TECHNICAL SPECIFICATION **RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)** **DOUBLE GIRDER EOT CRANE FOR BUTTERFLY VALVE HOUSE (50/10/5 T)**	**PE-TS-414-501-A002**
		Rev. No. 00
		Date : 08.02.2024

STANDARD MANUFACTURING QUALITY PLAN FOR DOUBLE GIRDER EOT CRANE

बी एच ई एल BHEL	**TECHNICAL SPECIFICATION** **RAMMAM STAGE-III HYDRO ELECTRIC** **PROJECT (3 X 40 MW)** **DOUBLE GIRDER EOT CRANE FOR BUTTERFLY VALVE HOUSE (50/10/5 T)**	**PE-TS-414-501-A002** **Issue No: 01** **Rev. No. 00** **Date : FEB, 2024**

PAINTING REQUIREMENT

Package	Condition	Surface Preparation	Primer Coat	No. of Coats	DFT (in Microns)	Intermediate Coat (in Microns)	No. of Coats	DFT (in Microns)	Final Coat	No. of Coats	DFT (in Microns)	Total DFT
	FOR DETAILS, REFER SECTION UNDER "COMPLIANCE DRAWINGS".											

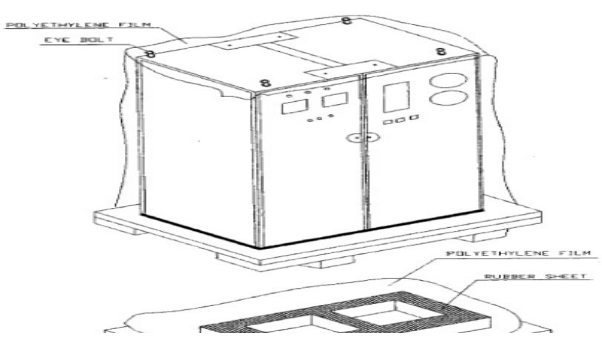
COLOR SHADE			
SL. No	**Item Description**	**Color Shade**	**Remarks**
1	Crane Structure, Electric Hoist	Golden Yellow Shade: RAL 1004	IDENTIFICATION TAG/BAND: White Equivalent RAL 9010
2	Bottom block assembly	Golden Yellow Shade: RAL 1004	TAG/BAND: White Equivalent RAL 9010
3	Hooks	Signal Red Shade: RAL 3001	
4	Motor, Hand rails	RAL 5012	
5	Control panels & other equipments	RAL 9002. Inside of panel-Glossy white.	

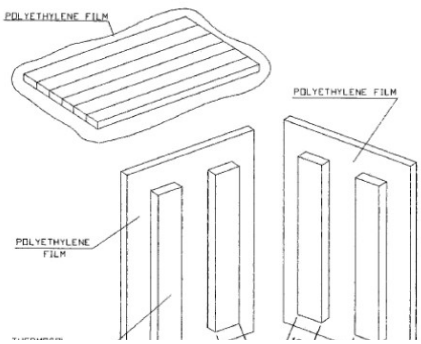
	TECHNICAL SPECIFICATION RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANE FOR BUTTERFLY VALVE HOUSE (50/10/5 T)	PE-TS-414-501-A002 Rev. No. 00 Date: 08.02.2024

PACKING REQUIREMENT

	COMMON GUIDELINES FOR PACKING
1	**GENERAL:**
1.1	The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage of materials.
1.2	All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.
1.3	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.
1.4	Each package shall be accompanied by a packing note 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.
2.	**TYPES OF PACKING:**
	The following 5 types of packing have been standardized for packing of General Components/ Assemblies.
a	**OP'** - Open Type.
b	**PP'** - Partially Packed.
c	**CP'** – Crate/Box Packing - Components/Equipment requiring physical protection.
d	'**CQ**' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
e	**'CR'** - Case Packing – Electrical/Electronic Components/ Assemblies, which require special packing viz. Water Proof, Shock Proof etc…
3.	**DESCRIPTION OF TYPES OF PACKING:**
	The various types of packing, as standardized above, are described below.
3.1	**'OP' - Open Type**
	In case, of components which are not affected by water & dust and do not require special protection, are generally not machined, shall be sent as open packages. However, these components may be sent in crates, wherever necessary.
3.2	**PP' - Partially Packed**
3.2.1	Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene
3.2.2	Film. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film.
3.3	**'CP' - Crate Packing**
	Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.
3.4	**'CQ' - Case Packing -** Machined Components/Assemblies/Equipment
3.4.1	Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of silica gel or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film, wherever required. This may be prescribed for electronic parts/critical machined components/surfaces.
3.4.2	For mechanical product like valves where motors are separately securely wrapped in polyethylene, the requirement of individual component wrapping shall be exempted.
3.5	**CR' - Case Packing** - Electrical & Electronic Components/Assemblies
	Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel.
4	**PREPARATION OF PACKING CASES**
4.1	**DIMENSIONS:**

a)	Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm as per applicable drawings of the respective units/manufacturers.
b)	Width of all planks including the tongue shall be more than 125mm and after plaining it shall be minimum 100mm.
c)	Minimum number of planks shall be used for a shook.
d)	Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel.
e)	Width of binding planks shall be minimum 100mm.
f)	Distance between any 2 binding planks shall be less than 750mm.
g)	diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm
h)	Distance of the outer edges of these planks from the edge of case shall be less than 250mm.
i)	Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.
4.2	**HOOP IRON STRIPS**
	These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust. If sufficient nailing is done for bigger boxes, strapping need not be done.
4.3	**BRACKETS**
	These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of “L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.
4.4	**MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM**
	100GSM (Colourless) Multi Layered Cross Laminated Polythelene Film are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.
4.5	**RUBBERISED COIR:**
	The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.
5	**MULTI LAYER CROSS LAMINATED POLY FILM WHILE PACKING OF CUBICLES/CASING**
5.1	The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.4) using blue nails wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.
5.2	The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film. This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.
5.3	The cubicles shall be covered with Multi-layer cross laminated poly film.
6	**PACKING OF LOOSE ITEMS/SPARES**
6.1	Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 5.4) using blue nails.
6.2	Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
6.3	Internal packing: Items that go into the box shall be packed using 100GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film. Any space left between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect.
6.4	Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.
6.5	Silica gel held in cotton bags shall be kept at proper places in the box.
6.6	Packing slip kept in polyethylene bag shall be placed in the box.
6.7	Two numbers of hoop iron strips shall be strapped tightly on the case using clips.
6.8	Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.
6.9	Loose items to be kept inside the cubicle/casing
	- Other items which are given loose in addition to cubicle shall be packed in separate boxes.
7	**TYPICAL PATTERN OF WOODEN BOX**





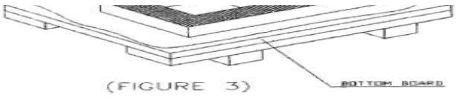


Figure 2

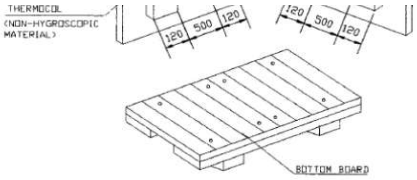


Figure 1

8	**SEALED PACKING:**
	Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture. The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp

9	**MARKINGS/STENCILINGS**
9.1	**"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".**
9.2	Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height.
9.3	In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel.
9.4	Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.
9.5	Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.
9.6	In case the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

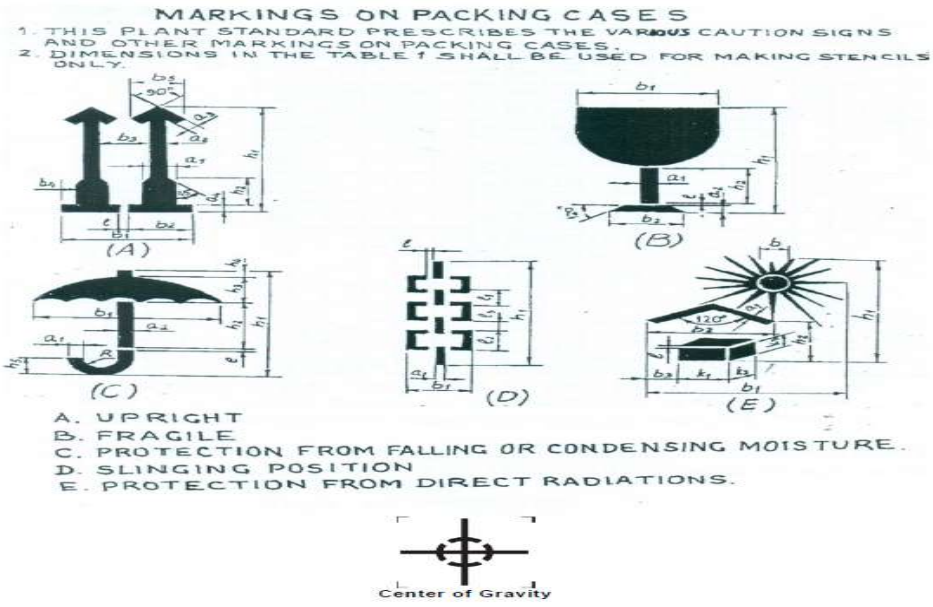


Figure 3

	BHEL – <unit> - <location> - <pin>				
CONSIGNEE					
MATERIAL					
CUSTOMER REF.			MO. NO.		
DESPATCH ADVICE NOTE NO			CASE NO		
DIMENSIONS(MM) L x B x H			NET WT.–KGS	GROSS WT.–KGS	
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT				

Figure 4 – TYPICAL MARKING PLATE (225 X 170)

Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

10	STANDARD METHOD OF PACKING					
Table 1 - Standard Method of Packing						
S. No.	**DESCRIPTION**	**CASE**	**CRATE**	**BUNDLE**	**BARE**	**DRUM**
1	FAB STRUCTURALS, GIRDER				O	
2	FAB STRUCTURALS, GIRDER				O	
3	SUPPORTING STRUCTURALS				O	
4	STRUCTURE SUB ASSEMBLY, CRAB, END CARRIAGE, END STOPPERS, ROPE DRUM				O	
5	RAIL				O	
6	STAIR CASES				O	
7	HANDRAILS/ PLATFORMS/ LADDERS/ CAGE				O	
8	FASTENERS, RAIL CLAMPS AND FIXING ACCESSORIES	O				
9	BEARING BLOCKS	O				
10	FANS	O				
11	GASKETS	O	O			
12	FLANGES	O	O			
13	PAINT TINS		O			
14	PAINT DRUMS					O
15	MOTORS, TRANSMFORMERS, VVVFD, LIMIT SWITCHES, ELECTRIC HOIST ASSEMBLY, RELAYS, FUSES, LIGHTING FIXTURES, PENDANT, ISOLATING SWITCH, RRC, TRANSMITTERS AND OTHER ELECTRICAL ACCESORIES	O				
16	SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES, PANELS,		O			
17	INDICATORS, VIBRATOR SWITCHES	O				
18	CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL,		O			
19	OPERATIONAL SPARES , MAINTENANCE TOOLS AND TACKLES	O				
20	ALL OTHER LOOSE ITEMS	O				
	Note					
	Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.					

	TECHNICAL SPECIFICATION RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANE FOR BUTTERFLY VALVE HOUSE (50/10/5 T)	PE-TS-414-501-A002 Rev. No. 00 Date: 08.02.2024

		BILL OF QUANTITY						
A	**MAIN SUPPLY:**							
	S. No.	**Description**	**For EOT Crane**					
			Qty	**UOM**				
	1	**Bridge girders** along with walkway, platform, handrails, CT stoppers etc.	2	Nos.				
	2	**End carriages**	1	Set				
	a	End carriages structure with wheels, walkway, platform, handrails, LT buffers etc.	1	Set				
	b	Long Travel Mechanism (Motor, gear box, shaft couling, brakes, bearings etc.)	1	Set				
	3	**Crab (trolley)**	1	Set				
	a.	Crab (trolley) structure with wheels , CT rails, platform, handrails, CT buffers etc.	1	Set				
	b	Main Hoist Mechanism (Motor, Gear box, Rope drum, Rope Upper block, Lower block, hook, couplings, shaft, brakes, bearings etc.)	1	Set				
	c.	Aux Hoist Mechanism (Motor, Gear box, Rope drum, Rope Upper block, Lower block, hook, couplings, shaft, bearings, brakes etc.)	1	Set				
	d.	Cross Travel Mechanism (Motor, gear box, shaft couling, brakes, bearings etc.)	1	Set				
	4	**Long Travel End stopper**	4	Nos.				
	5	Safety lugs for earthquake and clamps for crane	1	Set				
	6	Rail for Long travel along with base plates, full length sole plates, rail clamps, lock nuts.	13.7	Mtrs				
	7	PVC insulated shrouded bus bar Copper conductor type DSL, collector arms with all fittings and connections.	13.7	Mtrs				
	8	All electrical equipment including cables, junction box and other panels	1	Set				
	9	Operator's cabin along with operator's seat, gong, fan and other accesories	1	Set				
	10	Main hoist limit switch (Rotory gar + Gravity)	1+1	Nos.				
	11	Aux hoist limit switch (Rotory gar + Gravity)	1+1	Nos.				
	12	CT lever type limit switch (one way/two way)	2/1	Nos./No.				
	13	LT lever type limit switch (one way/two way)	2/1	Nos./No.				
	14	Power cables, control cables etc. along with cable tray/conduits etc.	1	Set				
	15	Temporary cable: 3.5 Core Power copper flexible cable of suitable size as per load calculation for commissioning, testing & operation of EOT Crane till such time the DSL is charged.	25	Mtrs				
	16	Main Isolating switch cum Changeover	1	No.				
	17	Incoming Power supply cables from two nos. supply feeders to Main isolating switch cum changeover.	2 x 25	Mtrs				
	18	Protective Panel along with Control tansformers, lighting transformers, 415/110V (DC) transformer, contactors, switches, fuses relays and other accessories.	1	No.				

	19	Main Hoist Panel along with VVVFD, contactors, switches, fuses relays and other accessories	1	No.				
	20	Aux Hoist Panel along with VVVFD, contactors, switches, fuses relays and other accessories	1	No.				
	21	Cross Travel Panel along with VVVFD, contactors, switches, fuses relays and other accessories	1	No.				
	22	Long Travel Panel along with VVVFD, contactors, switches, fuses relays and other accessories	1	No.				
	23	Master Controllers	1	No.				
	24	Lighting for cranes (including illumination in cabin, over bridge and under bridge) along with fittings, sockets etc.	1	Set				
	25	Portable hand lamp with suitable length of flexible cable for inspection	1	Set				
	26	Fire extinguishers	4	Nos.				
	27	Maintenance cage	1	No.				
	28	Mechanical overload protection (Load cell) for hoist mode (MH,AH & Electric Hoist)	3	No.				
	29	Radio Remote control with transmitter unit, receiver unit, batterg etc.	1	Set				
	30	Electric hoists -5T capacity along with pendent , control panel , ISMB.	1	No.				
	33	Lubrication system	1	Set				
	34	DSL Phase indicating lamps (RYB)	1	Set				
	35	Earthing arrangement	1	Set				
	36	First fill of lubricants i.e. oils, grease, servo fluids, cadmium compounds etc.	1	Set				
	37	Pairs of wire rope slings for different loads of 5T, 10T, 20T, 30T & 50T rated capacity of minimum 10m length each & a storage rack.	1	Set				
	38	**Maintenance tools & tackles**						
	a.	Complete Set of ring spanners	1	Set				
	b.	Complete Set of screwdrivers (Min. 6 Nos., Indicate the sizes)	1	Set				
	c.	Adjustable Spanner	1	No.				
	d.	Insulated plier	1	No.				
	e.	Wrench spanner	1	No.				
	f.	Grease Gun	1	No.				
	g.	Oil Gun.	1	No.				
	h.	Hand Lamp.	1	No.				
	i.	Line tester	1	No.				
	j.	O&M Manual	1	No.				
	k.	Steel box to place above tools & manual	1	No.				
	l.	Hydraulic jacks(suitable for removal of LT wheels & other maintenance purpose of crane	1	Set				
	39	**Erection & Commissioning Spares**	----	----				
	a.	Oil seal for each gear box	2	No.				
	b.	Indicating lamps of each color	2	No.				
	c.	Push button of each type and rating	2	No.				
	d.	Auxiliary Contactor of each rating	2	No.				
	e.	Limit switches	2	No.				
	f.	Touch up paints	10	Ltr.				
	40	**Operation and maintenance Spares**						

	a.	Gear Oil (ISO VG 68)	10	litres				
	b.	Grease (ISO VG 220)	10	kg				
	c.	Brake shoes of each size and rating	2	nos.				
	d.	Brake liners of each size and rating	2	nos.				
	e.	Brake springs of each size and rating	1	No.				
	f.	Oil seal of each size for each gear box	2	nos.				
	g.	Main contactors of each rating	1	No.				
	h.	Overload relays of each rating	1	No.				
B	**SERVICE**							
	1	Unloading, handling, transportation to site.	1	No.				
	2	Assembly, erection & commissioning including Performance guarantee tests at site.	1	No.				
	3	Training of Customer's O&M staff	1	No.				
	4	Final handing over to Customer	1	No.				
C	**MANDATORY SPARES:**							
	S. No.	**ITEM DESCRIPTION**	**Qty**	**UOM**				
	1	Bearing for						
	1.1	Bridge travel wheels	2	No.				
	1.2	Trolley wheels	1	No.				
	1.3	Long travel motor	1	Set				
	1.4	Cross travel motor	1	Set				
	1.5	Main hoist motor	1	Set				
	1.6	Aux. hoist motor	1	Set				
	1.7	Rope drums	1	Set				
	1.8	Pulleys for main hoist	1	Set				
	1.9	Pulleys for aux. Hoist	1	Set				
	1.10	Pulleys for under slung hoist	1	Set				
	2	Pair of brake shoe / disc with lining for each size of brake used viz. D.C. operated Electro-mechanical of Hydraulic Thruster operated.						
	2.1	Long travel motion	2	Set				
	2.2	Cross travel motion	2	Set				
	2.3	Main hoist	2	Set				
	2.4	Auxiliary hoist	2	Set				
	2.5	Under slung hoist	2	Set				
	3	Pair of brake linings with rivets or each size of brake used						
	3.1	Long travel motion	2	Set				
	3.2	Cross travel motion	2	Set				
	3.3	Main hoist	2	Set				
	3.4	Auxiliary hoist	2	Set				
	3.5	Under slung hoist	2	Set				
	4	Main springs for each size of brake used						
	4.1	Long travel motion	2	Set				
	4.2	Cross travel motion	2	Set				
	4.3	Main hoist	2	Set				

	4.4	Auxiliary hoist	2	Set				
	4.5	Under slung hoist	2	Set				
	5	Current collectors for DS.	5	No.				
	6	Insulator for conductors support assembly	6	No.				
	7	Limit switches	1	one of each type				
	8	Thruster of each size used	2	No.				
	9	Pair of oil seals for each gear box used	1	Set				
	10	Contactors of each size used	1	No.				
	11	Fixed & Moving contacts of each size of contactors	1	No.				
	12	3 Nos. coils for each size of contactor used.						
	12.1	Main hoist	2	Set				
	12.2	Auxiliary hoist	2	Set				
	12.3	Cross travel	2	Set				
	12.4	Long travel	2	Set				
	12.5	Under slung hoist	2	Set				
	13	3 Phase overload relay for each motor.	2	No.				
	14	3 nos. fuse links of each size used on cranes	4	Set				
	15	1 printed circuit of each size and type	1	Set				
	16	Complete Set of lamps for lighting and signals	2	Set				
	17	Rope for auxiliary hoist	1	Set				
	Note	Refer Sl no 12.0 of "General Technical Requirement" for Spares.						

	TECHNICAL SPECIFICATION RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANE FOR BUTTERFLY VALVE HOUSE (50/10/5 T)	PE-TS-414-501-A002 Rev. No. 00 Date: 08.02.2024

DOCUMENTATION REQUIREMENT

DRAWINGS & DOCUMENTS TO BE SUBMITTED BY ALL THE BIDDERS ALONG WITH THE BID

Sl. No.		DOCUMENT TITLE	
1		PQR CREDENTIALS	
2		COMPLIANCE SHEET	
3		"NO DEVIATION" CERTIFICATE DULY STAMPED AND SIGNED.	

DRAWINGS & DOCUMENTS TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT ALONG WITH SUBMISSION SCHEDULE

S.N.	NTPC drawing No.	BHEL drawing No.	Title	Approval category	Schedule days of submission from date of LOA.
1	5602-003-H143-PVE-B-064	PE-V0-414-501-A017A	BFV HOUSE EOT: PROTECTIVE CIRCUIT AND PARTS LIST FOR INDIVIDUAL OPERATION	A*	21
2	5602-003-H143-PVE-B-065	PE-V0-414-501-A017B	BFV HOUSE EOT:POWER CIRCUIT, CONTROL CIRCUIT, CONTROLLER & CONTACTORS AND PART LIST FOR MAIN HOIST MOTION	A*	35
3	5602-003-H143-PVE-B-066	PE-V0-414-501-A017C	BFV HOUSE EOT:POWER CIRCUIT, CONTROL CIRCUIT, CONTROLLER & CONTACTORS & PART LIST FOR AUXILIARY HOIST MOTION	A*	35
4	5602-003-H143-PVE-B-067	PE-V0-414-501-A017D	BFV HOUSE EOT:POWER CIRCUIT, CONTROL CIRCUIT, CONTROLLER & CONTACTORS AND PART LIST FOR C.T. MOTION	A*	35
5	5602-003-H143-PVE-B-068	PE-V0-414-501-A017E	BFV HOUSE EOT:POWER CIRCUIT, CONTROL CIRCUIT, CONTROLLER & CONTACTORS AND PART LIST FOR L.T. MOTION	A*	35
6	5602-003-H143-PVE-B-078	PE-V0-414-501-A008	BFV HOUSE EOT:DSL FIXING ARRANGEMENT	A*	21
7	5602-003-H143-PVE-F-071	PE-V0-414-501-A018	BFV HOUSE EOT:PANEL LAYOUT FOR PROTECTIVE CIRCUIT	A*	28
8	5602-003-H143-PVE-H-069	PE-V0-414-501-A019A	BFV HOUSE EOT: CABLE SCHEDULE	I	35
9	5602-003-H143-PVE-H-070	PE-V0-414-501-A017F	Electrical Bill of Material for 50/10T EOT Crane for BFV House	I	35
10	5602-003-H143-PVE-U-072	PE-V0-414-501-A019B	BFV HOUSE EOT:CABLE SIZING CALCULATION/ SELECTION FOR CRANE	A*	28
11	5602-003-H143-PVE-W-063	PE-V0-414-501-A017G	BFV HOUSE EOT:DESIGN PHILOSOPHY FOR ELECTRICAL SYSTEM	I	28
12	5602-003-H143-PVE-Y-073	PE-V0-414-501-A003	BFV HOUSE EOT:TECHNICAL DATA SHEET AND CURVES FOR MOTORS	A*	42
13	5602-003-H143-PVM-B-075	PE-V0-414-501-A005A	BFV HOUSE EOT: GENERAL ARRANGEMENT DRAWING	A*	21
14	5602-003-H143-PVM-B-076	PE-V0-414-501-A032	BFV HOUSE EOT: RAIL FIXING SUB-ASSEMBLY DRAWING	A*	21
15	5602-003-H143-PVM-B-077	PE-V0-414-501-A006A	BFV HOUSE EOT:CRAB SUB-ASSEMBLY DRAWING	A*	21
16	5602-003-H143-PVM-B-079	PE-V0-414-501-A010	BFV HOUSE EOT:LT DRIVE ASSEMBLY DRAWING	A	28
17	5602-003-H143-PVM-B-080	PE-V0-414-501-A009A	BFV HOUSE EOT:50 T SNATCH BLOCK SUB-ASSEMBLY FOR MAIN HOIST	I	28
18	5602-003-H143-PVM-B-081	PE-V0-414-501-A009B	BFV HOUSE EOT:10 T SNATCH BLOCK SUB ASSEMBLY FOR AUX. HOIST	I	28
19	5602-003-H143-PVM-B-084	PE-V0-414-501-A006B	BFV HOUSE EOT:GA OF MAINTENANCE PLATFORM ON TROLLEY	I	35

20	5602-003-H143-PVM-B-085	PE-DC-414-501-A033	BFV HOUSE EOT:ASSEMBLY AND DETAIL OF BOGIE COMPENSATING BEAM AND TIE BEAM	A	35
21	5602-003-H143-PVM-B-086	PE-V0-414-501-A006C	BFV HOUSE EOT: CT DRIVE ASSEMBLY	A	28
22	5602-003-H143-PVM-B-087	PE-V0-414-501-A009C	BFV HOUSE EOT:50T HOOK AND NUT DETAIL	I*	28
23	5602-003-H143-PVM-B-088	PE-V0-414-501-A009D	BFV HOUSE EOT:10T HOOK AND NUT DETAIL	I*	28
24	5602-003-H143-PVM-B-089	PE-V0-414-501-A005B	BFV HOUSE EOT:EOT CRANE NAME PLATE	I	42
25	5602-003-H143-PVM-F-082	PE-DC-414-501-A034	BFV HOUSE EOT:EQUIPMENT LAYOUT	I	42
26	5602-003-H143-PVM-F-083	PE-V0-414-501-A016	BFV HOUSE EOT:CABIN LAYOUT	I	35
27	5602-003-H143-PVM-U-091	PE-V0-414-501-A012	BFV HOUSE EOT:STRUCTURAL SIZING CALCULATION	I*	35
28	5602-003-H143-PVM-U-093	PE-V0-414-501-A004	BFV HOUSE: EOT MECHANISM CALCULATIONS - SELECTION OF MOTOR, CT & LT RAIL, BRIDGE GIRDER, WHEEL SIZE, WIRE ROPE, ROPE DRUM, SHEAVES ETC.	A*	21
29			FIELD QUALITY PLAN	A	70
30			OPERATION AND MAINTENANCE MANUAL	I	70
			ERECTION MANUAL	I	70

LEGENDS

A= Approval category

I= Information category

*Marked drawing/documents are Basing engineering drawing/documents.

Notes:-

1. Bidder to follow the following the drawing submission schedule:
   i.1st submission of drawings from date of LOI as per the submission schedule.
   ii.Every revised submission incorporating comments – within 10 days.
   iii. BHEL shall furnish comments/approval with 21 days.
2. Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

DRAWINGS & DOCUMENTS TO BE SUBMITTED AS FINAL/AS-BUILT DOCUMENT

Sl. No.		DOCUMENT TITLE	No. of prints (Sets)	No. of portable hard disk
1		APPROVED DOCUMENTS	10	3
2		AS BUILT DRAWINGS/ DOCUMENTS	10	3
3		ERECTION MANUAL	10	3
4		O&M MANUAL	10	3
5		PERFORMANCE AND FUNCTIONAL GUARANTEE TEST REPORTS	8	3

COMPLIANCE CERTIFICATE

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

1	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.
2	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.
3	All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
4	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.
5	All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
6	Guarantee for plant/ equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions.
7	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.
8	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
9	As built drawings shall be submitted as and when required during the project execution.
10	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.
11	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.
12	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.

Signature of authorised Representative
Name and Designation :
Name & Address of the Bidder
Date

PRE QUALIFICATION REQUIREMENT (TECHNICAL)

1	The Bidder should have designed, manufactured & supplied at least One (1) no. crane of capacity 30T or more with minimum crane span of 10 meters, which is in successful operation in power plant/other industrial application for a minimum period of one (1) year. Supplier should have testing facility/ capability of testing maximum capacity crane required for the tender.
2	The Bidder has to submit following supporting documents meeting above mentioned pre-qualifying requirement- Copy of minimum one (1) performance certificate (in English/Hindi) from end user specifying that the product/equipment is running successfully for one (1) year from date of commissioning meeting the minimum pre-qualifying requirement along with copy of related Purchase Order (PO) or Letter of intent (LOI) or Letter of Award (LOA) or Work Order (WO). Bidder to furnish necessary documentation of testing facilities details along with relevant photograph for testing facilities as specified at sl.no.1.
3	Bidder shall submit design documents to substantiate technical parameters specified in PQR, if the same is not mentioned in performance certificate/purchase order.
4	Minimum one (1) no. Purchase order shall also be submitted which should not be more than seven (7) years old as on date of bid submission, for establishing continuity in business. This is over and above the requirement of PO/LOI/LOA/WO mentioned of PQR clause at S. No. 2.0 above.
5	Bidder to submit all supporting documents in English/Hindi. If documents submitted by bidder are in language other than English/Hindi, a self-attested English/Hindi translated document should also be submitted.
6	Notwithstanding anything stated above, the BHEL/Customer reserves the right to assess the capabilities and capacity of the Bidder/ its subcontractors to perform the contract, should the circumstances warrant such assessment in the overall interest of the BHEL/Customer.
7	Consideration of offer shall be subject to Customer’s approval of bidders, if applicable.
8	After satisfactory fulfilment of all the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

PRE QUALIFICATION REQUIREMENT (FINANCIAL)